



# Radiological Investigations of Chest and CVS Diseases

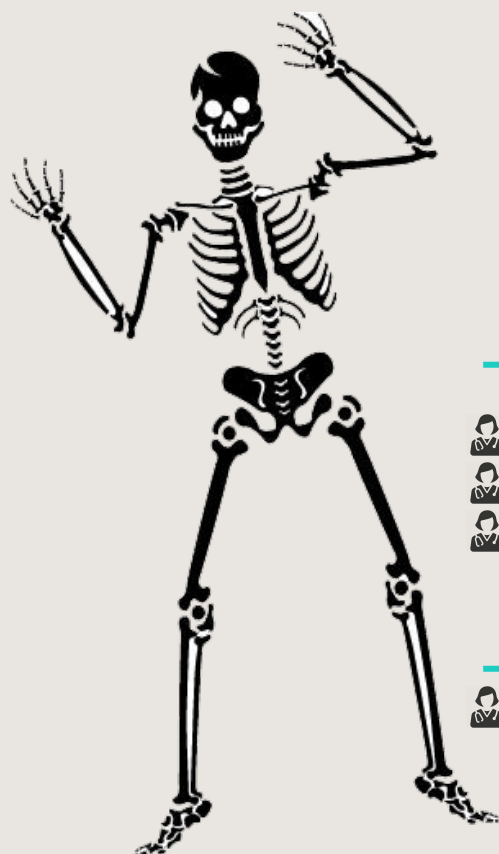
## Color Index:

- ✓ Important
- ✓ Notes
- ✓ Extra

[Editing File](#)

objectives:

→ Not provided.



Done by:



**Alanoud Salman**



**Renad alsweilmy**



**Laila Alsabbagh**



**Dawood Ismail**



**Anas Jabaan**

Revised by:



**Aseel Badukhon**

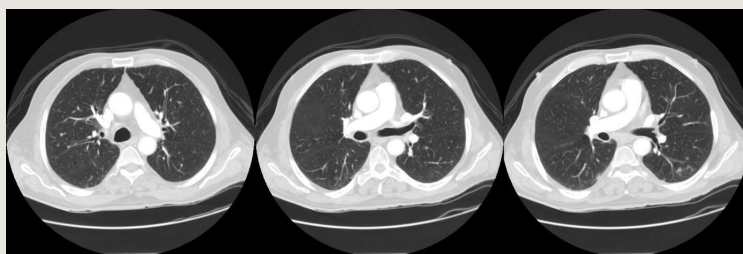
# Radiological anatomy



chest X-Ray

- Plain film gives us basic information, but it is limited, the finding is weak and sometimes not specific, but it should be first step.
- Plain film is the basic examination for intrathoracic diseases "chest or cardiac".
- CXR helps you to exclude other diseases when a patient presents with chest symptoms so this can help you to avoid additional tests

## CT (computed tomography)



Lung Window

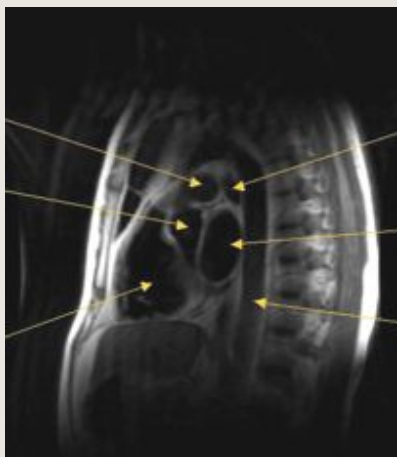


Mediastinal Window

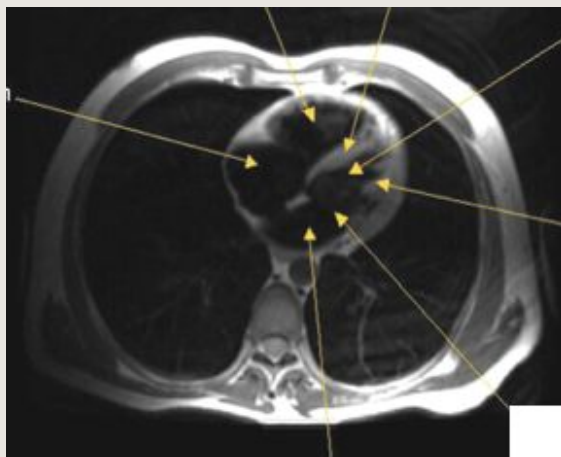
We can get different windows. Before, you have to examine each window separately and it takes much time but now from settings you can reach windows. In lung window you can see the lungs but in the mediastinal window you only see the vessels, bones and heart -you can not see the lungs-

## MRI

Sagittal



Axial

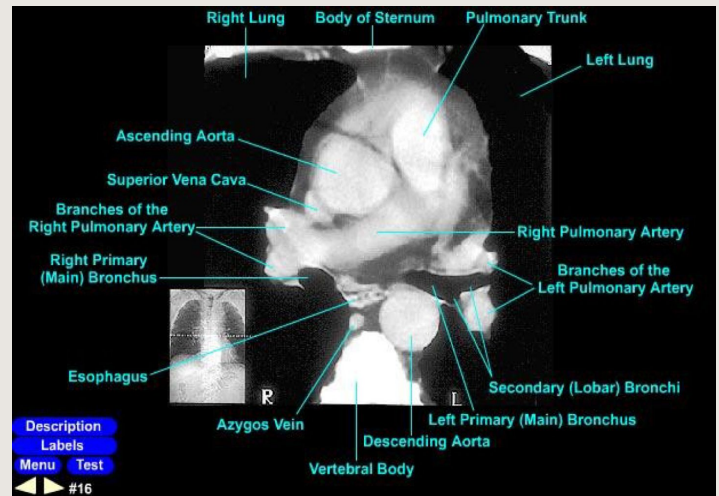
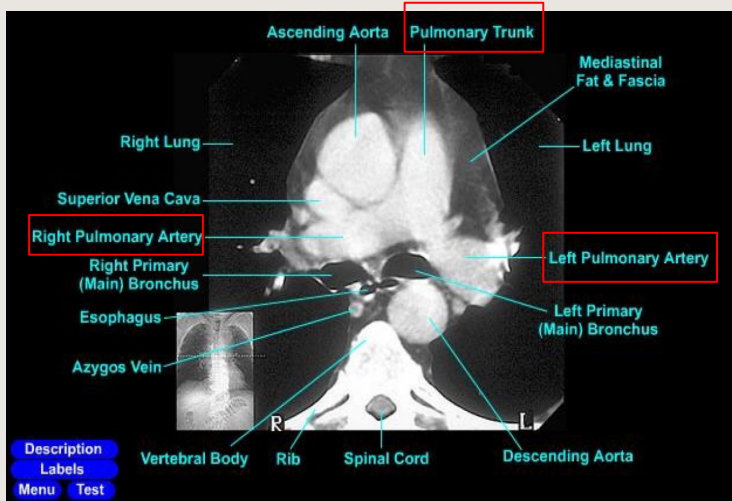


Coronal



- One of the revolutions that you can assess child with congenital defect.
- gold standard in congenital defect
- Big advantage of MRI is that you can examine the patient with magnetic field without ionizing radiation.
- MRI for the lung is not your preferred option since lungs are filled with air and that can not be seen very well in the MRI; MRI still a good option for the heart

# Vascular Anatomy of the chest

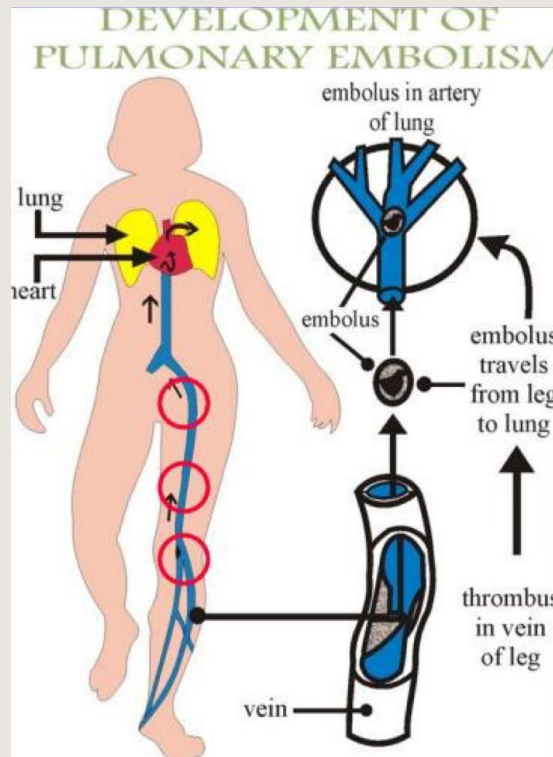


The most important level (at level of hilum) you get what we call (Mercedes), if you see IV contrast is homogenous with blood in this area (no filling defect) that is mean the patient doesn't have major problem, if the patient has embolus here it is may be fatal

"This is another level. It is lower than the previous one - picture on left - and as you go down, the LPA will start to fade; just few parts are shown in this level"

case:  
 Patient came to ER, he was bedridden for some time because of fracture for 4 months. After 4 months, he has chest pain and difficulty in respiration. He came to ER the most suspicious clinical diagnosis is acute pulmonary embolism because he is bedridden probably develop DVT in the lower limb.  
**The gold standard is CT Angiography.**

# Pulmonary artery



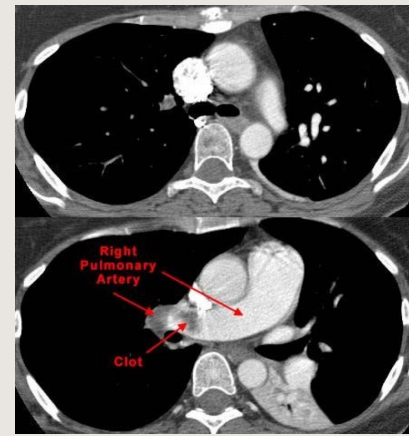
So that is the story, that usually what is happen, patient with C-section and she is bedridden or patient with traffic accident and have lower limb DVT because he is bedridden for long time and he get thrombus in the lower limb vein and go to heart then pulmonary.

**IMPORTANT**

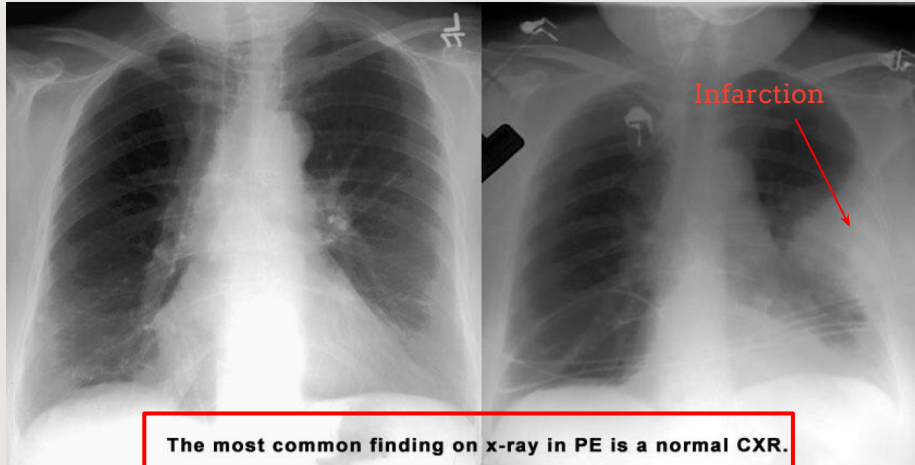
# Pulmonary embolism

- The gold standard for diagnosis of PE is **CTA (CT Angiography)**.

Acute pulmonary embolism is one of the fatal diseases, so you have to investigate the patient very early. When we do x-ray, there are many patients their result will be negative, but this is not mean they don't have PE. So, the gold standard today is CT angiography, we give IV contrast and do CT angiography for pulmonary vessels or for chest to check for PE.



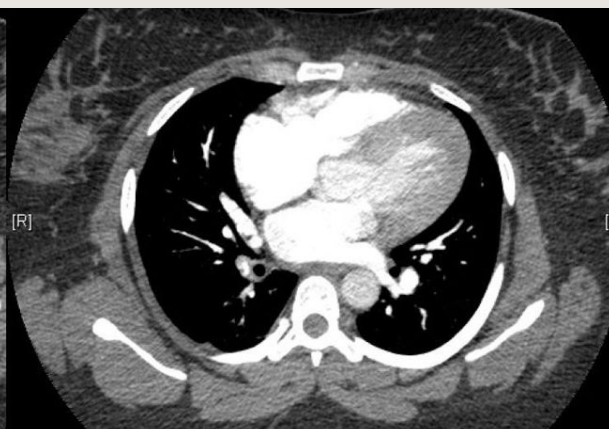
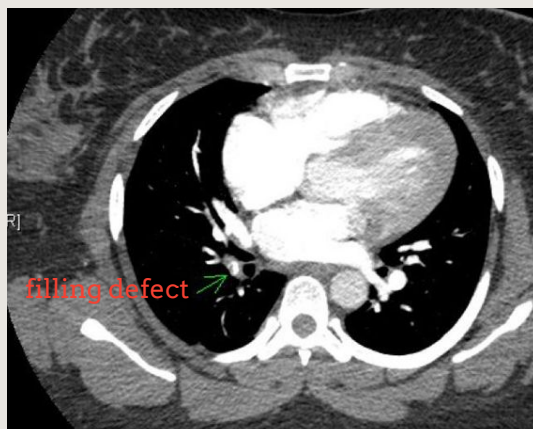
The picture on the left is normal for someone with PE whom his clinical symptoms were neglected because of the normal CXR. He was sent home but one day later and he came back again in ER with worsening sx and the right CXR was taken and showed pulmonary infarction in the left lung"



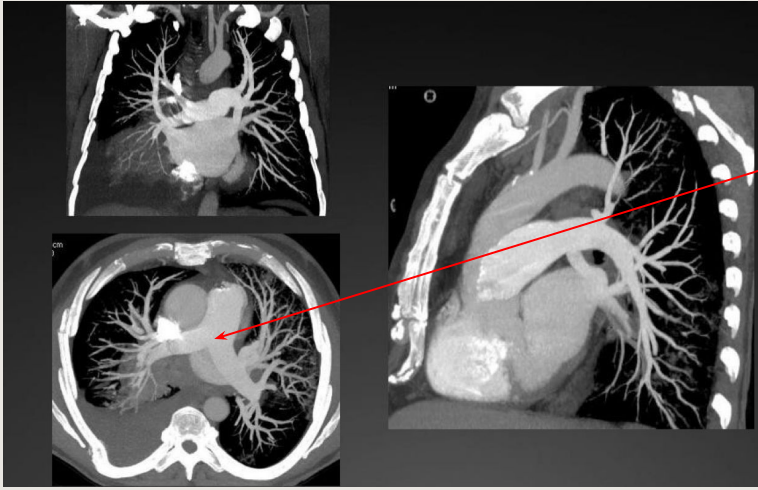
The most common finding on x-ray in PE is a normal CXR.



- The level in which we see all vessels together is the level of hilum.
- When the embolism is more to the peripheral its clinical significance decreases



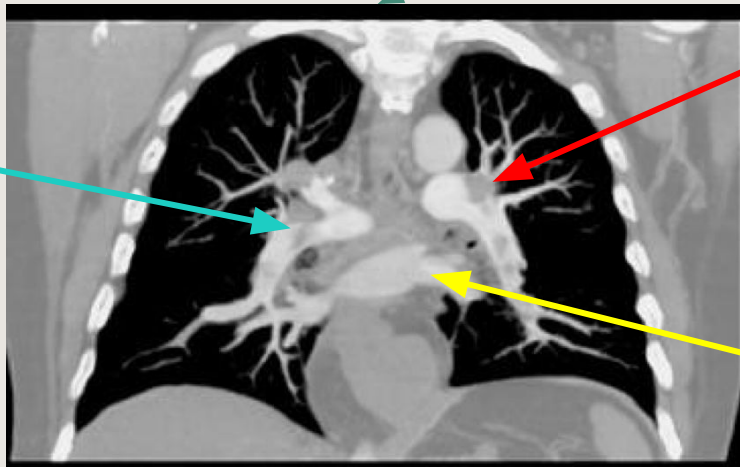
# CTA pulmonary vasculature



mercedes sign

This shows multiple embolisms which indicates Acute Massive PE

## CTA (Coronal reconstruction)



Embolus in descending right pulmonary artery

Embolus in left main pulmonary artery

Normal Homogenous filling of the vessels

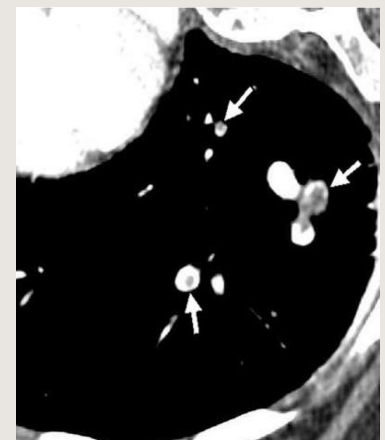
## Aortic arch anatomy

Another advancing revolution, MR angiography you can see the heart and vessels, It can also show you the veins alone or arteries alone as well (just to know it)



## CT angiogram

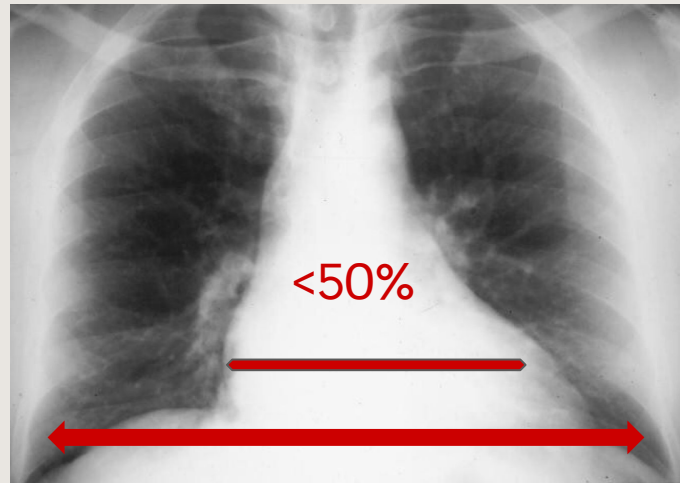
The arrows here show filling defects which indicate the presence of clots within the vessel. They can vary in size



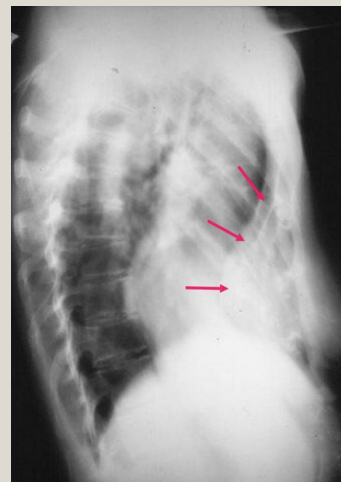
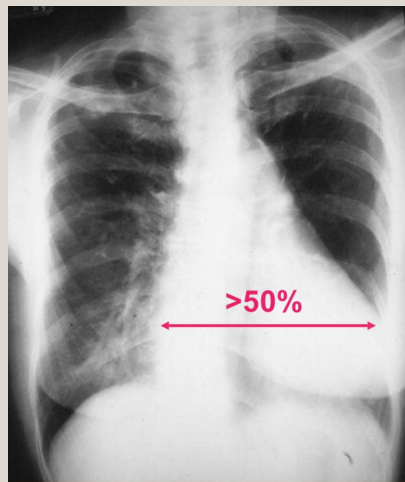
# Cardiothoracic ratio

One of the easiest observations to make is something you already know:

- the cardiothoracic 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)



It is not used anymore because sometimes you can get less than 50% but patient actually has cardiomegaly.

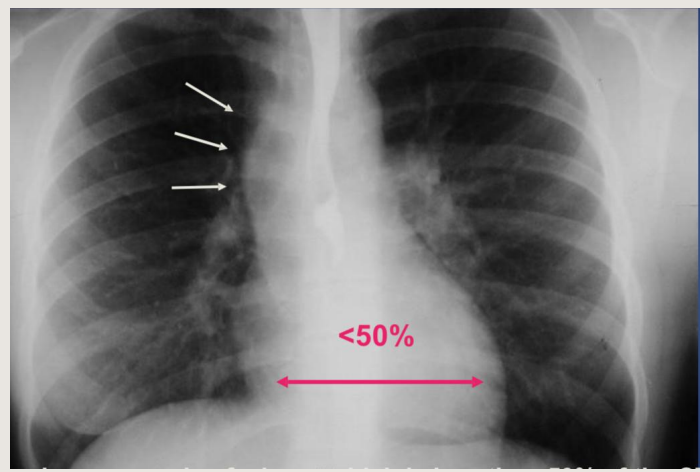


Here is a heart that is larger than 50% of the cardiothoracic ratio, but is still a normal heart. This is because there is an extracardiac cause for apparent cardiomegaly. On the lateral film, the arrows point to the inward displacement of the lower sternum in a pectus excavatum deformity

CTR is <b>more</b> than 50% but heart is <u>normal</u>	CTR is <b>less</b> than 50% But heart is <u>abnormal</u>
<p>Extracardiac causes of cardiac enlargement</p> <ul style="list-style-type: none"> <li>- portable AP films</li> <li>- Obesity</li> <li>- Pregnant</li> <li>- Ascites</li> <li>- Straight back syndrome</li> <li>- Pectus excavatum</li> </ul>	<ul style="list-style-type: none"> <li>- obstructive to outflow of ventricles, ventricle hypertrophy</li> <li>- Must look at cardiac contours</li> </ul>

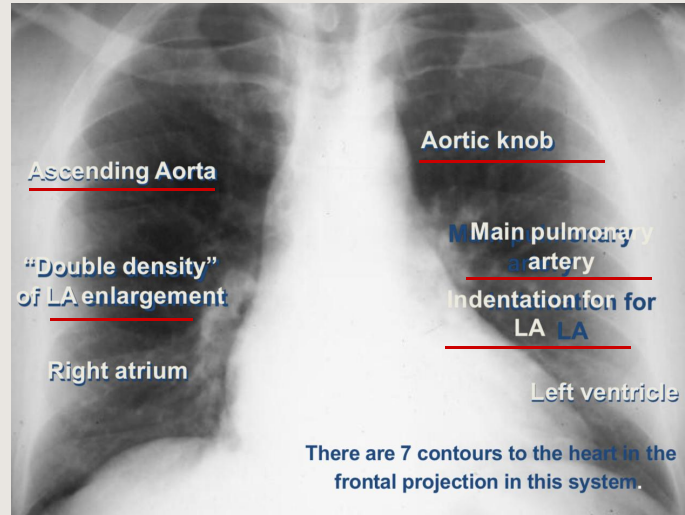
# Cardiothoracic ratio

- Here is an example of a heart which is less than 50% of the CTR in which the heart is still abnormal.
- This is recognizable because there is an abnormal contour to the heart (arrows).



# The Cardiac contours

The only top five are important in making a diagnosis

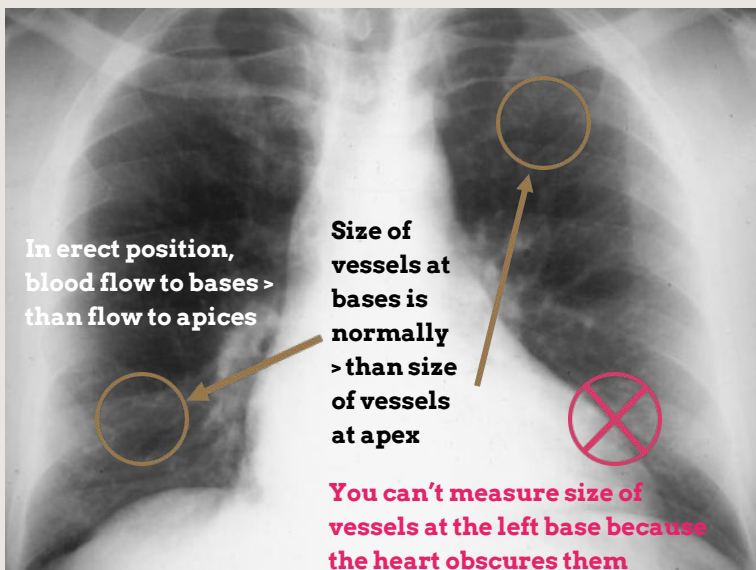


# The Pulmonary Vasculature

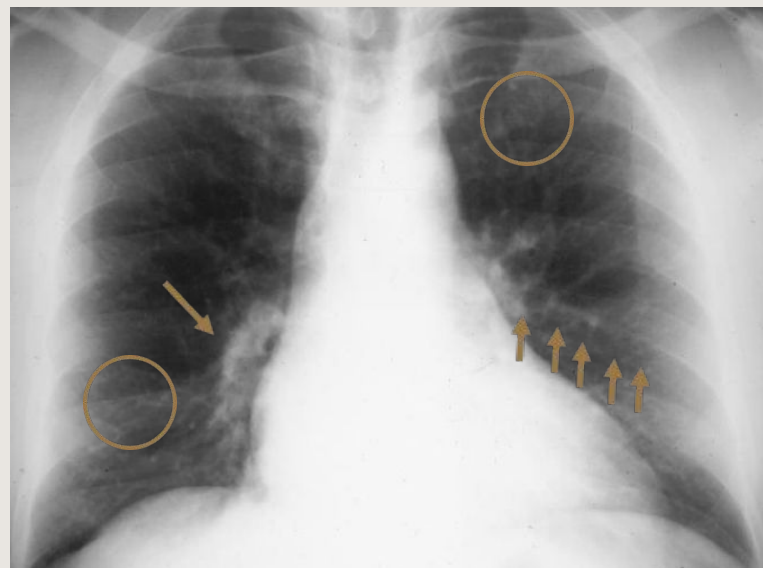
## Five states of the pulmonary vasculature:

- Normal
- pulmonary venous hypertension
- Pulmonary arterial hypertension
- Increased flow
- Decreased flow

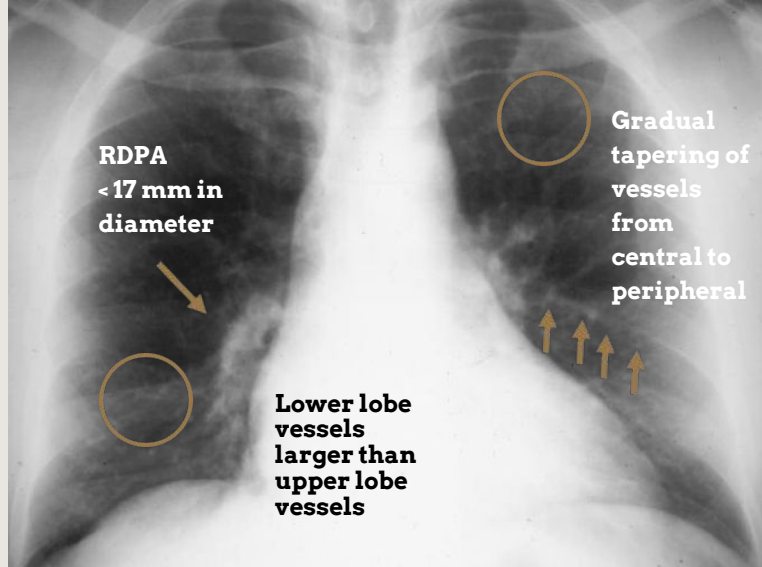
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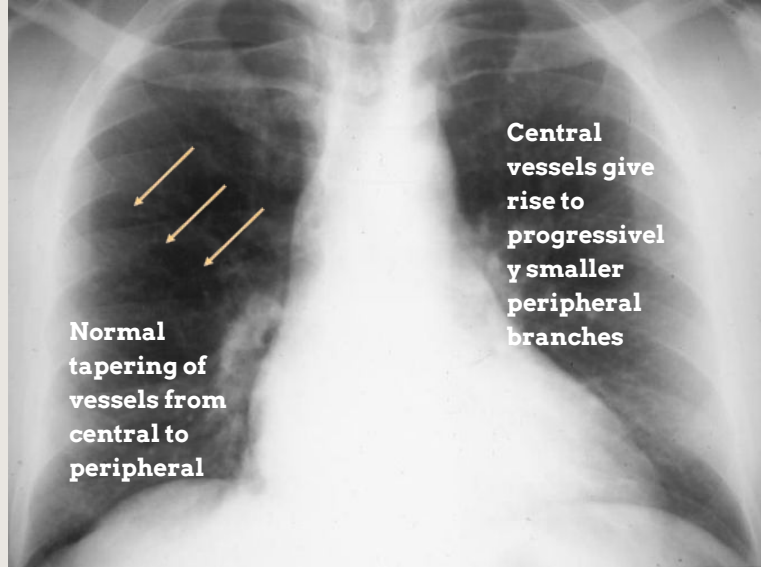
Normal Distribution of Flow  
Upper vs Lower Lobes



What to Evaluate



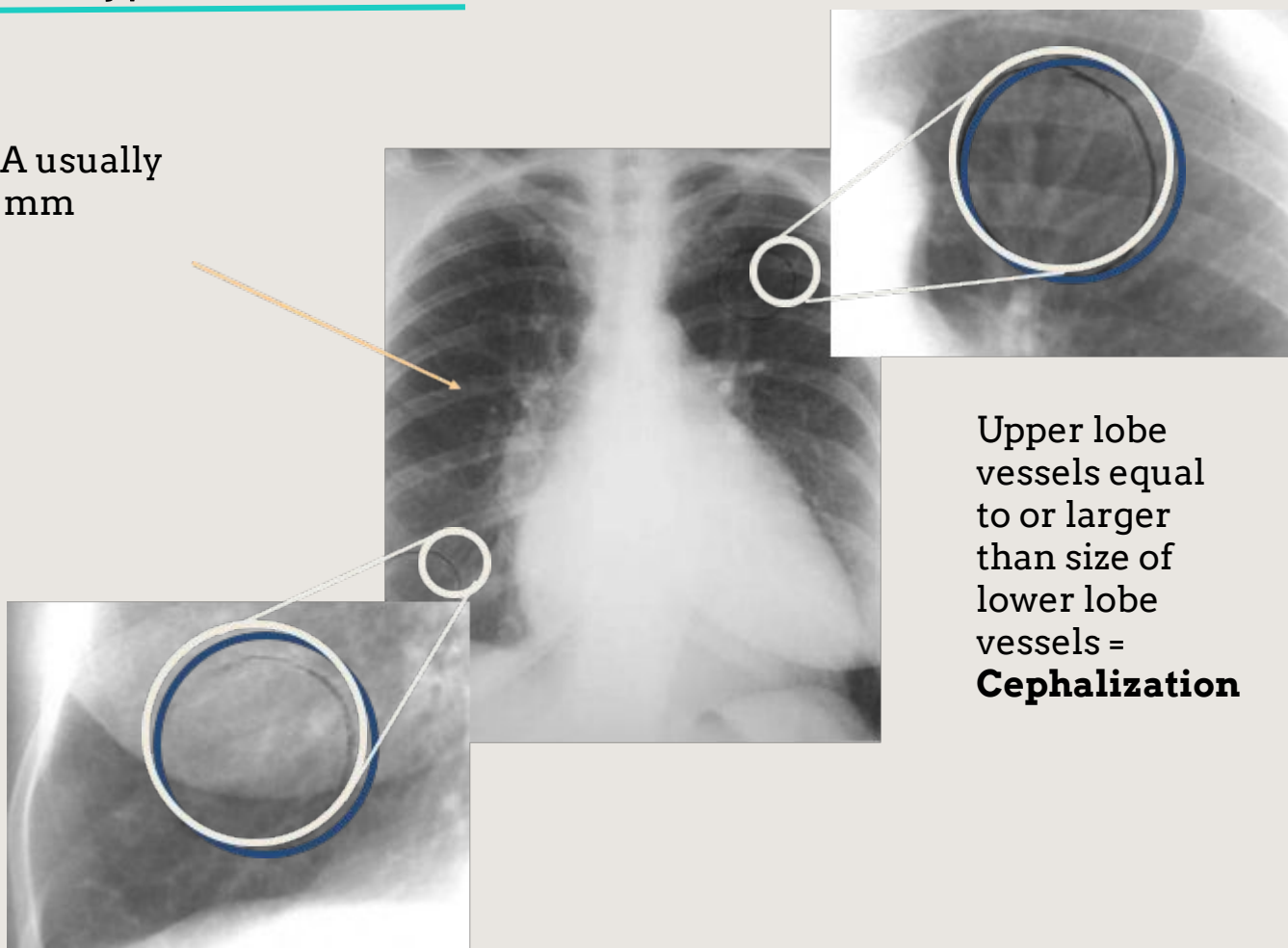
Normal Vasculature - review



Normal Distribution of Flow  
Central vs peripheral

## Venous Hypertension

RDPA usually  
> 17 mm



Upper lobe vessels equal to or larger than size of lower lobe vessels =  
**Cephalization**

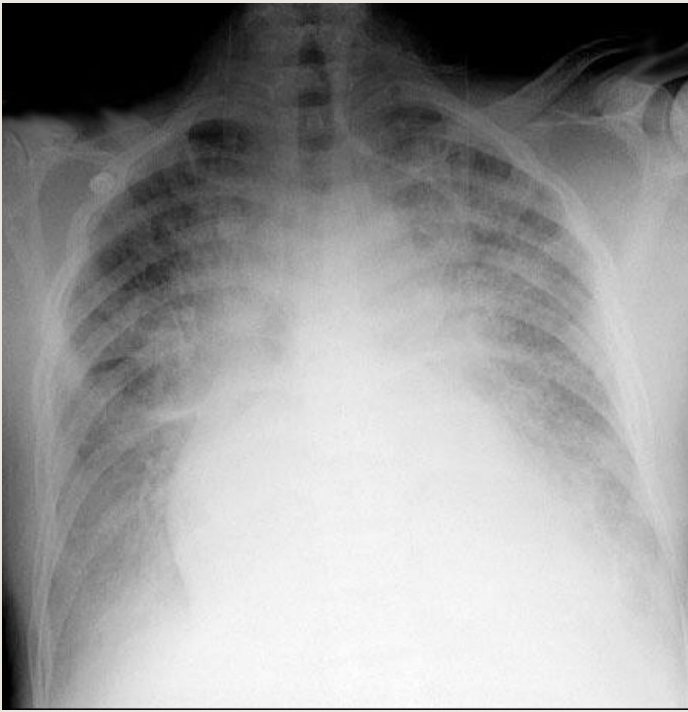
## The Pulmonary Vasculature

- Normal
- Pulmonary venous hypertension
- Pulmonary arterial hypertension
- Increased flow
- Decreased flow - mostly unrecognizable even when it is present

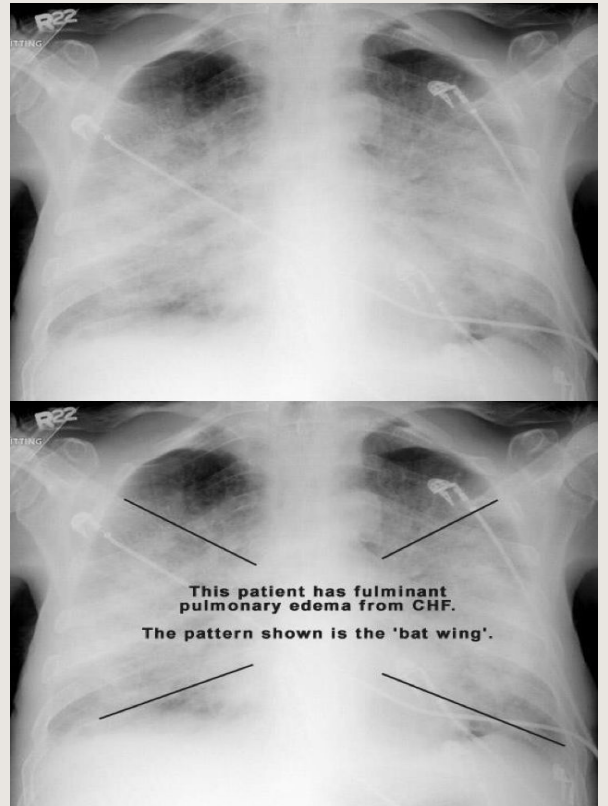
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## CHF

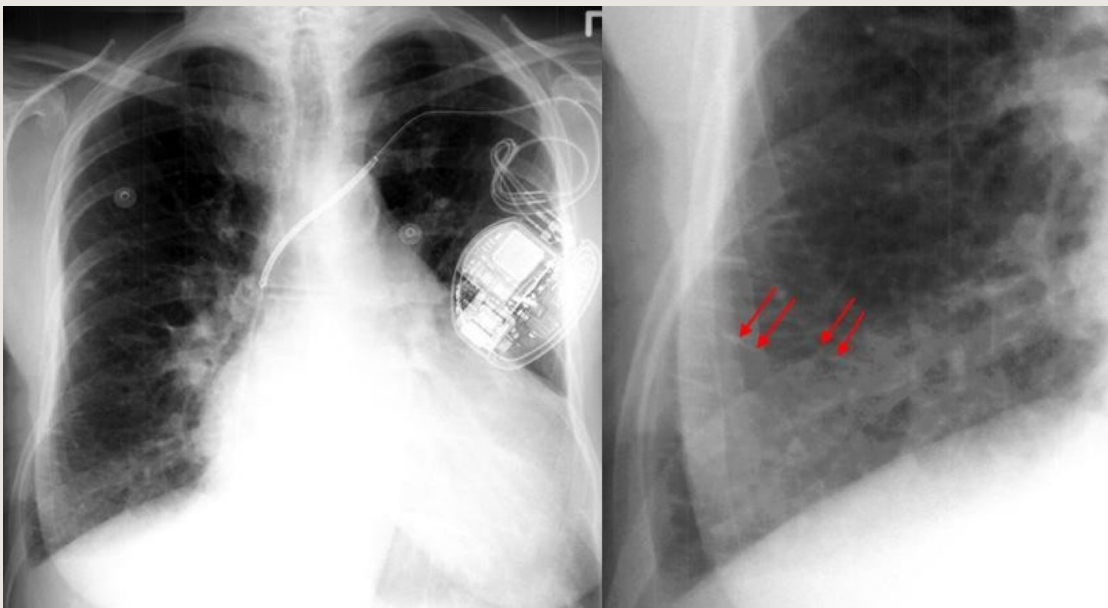


## Acute Pulmonary Edema



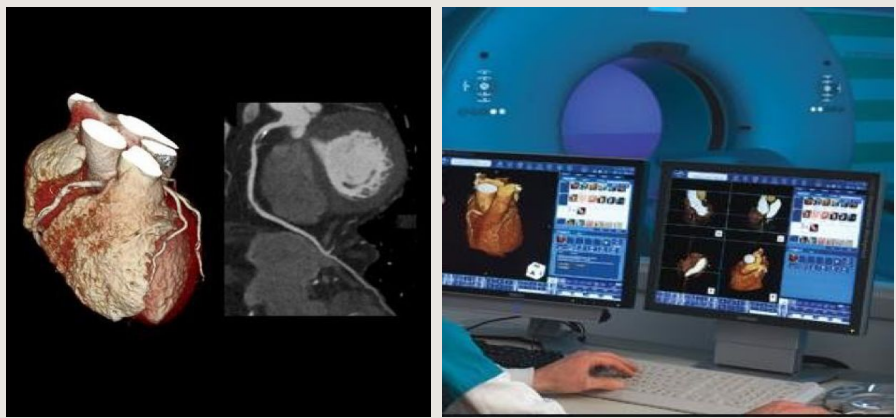
- Opacity in the lungs, cardiothoracic ratio is increased, if you see these findings but without clinical symptoms you may face some problems, but if there are clinical symptoms (dyspnea, orthopnea, he can't lie down on his back, shortness of breath, swelling lower limbs, swelling face) so you have to suspect heart failure.
- One of supporting things that having shadow thing called **(butterfly)**.
- Pneumonia is taking consolidation in the segment like middle lobe, right lower lobe but here is not taking segments **(butterfly or batwing)** so you have to suspect heart failure.
- How to differentiate between pneumonia and heart failure? Pneumonia come with fever, heart failure maybe low-grade fever.
- We give patient diuretics and do x ray you will see improvement in the chest, the symptoms are improving, and this will not happen in pneumonia. So, this is **called diagnostic test**.

## Kerely's B-lines



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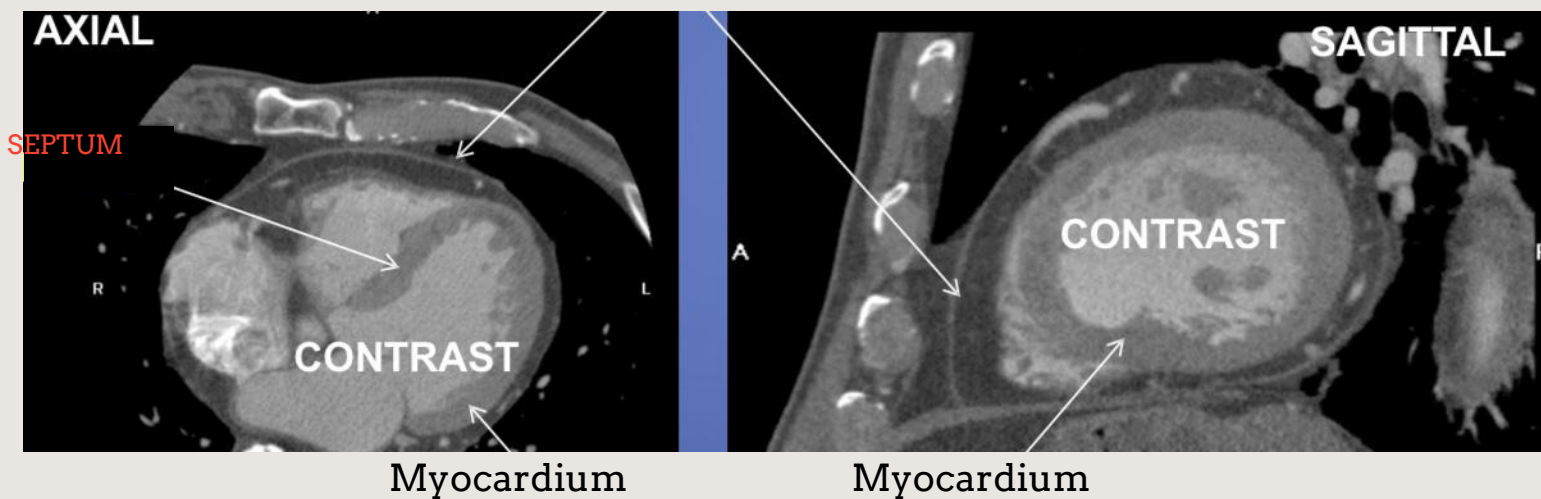
# Cardiac CT



CT For the heart and coronary vessels

## Pericardium

### Pericardium



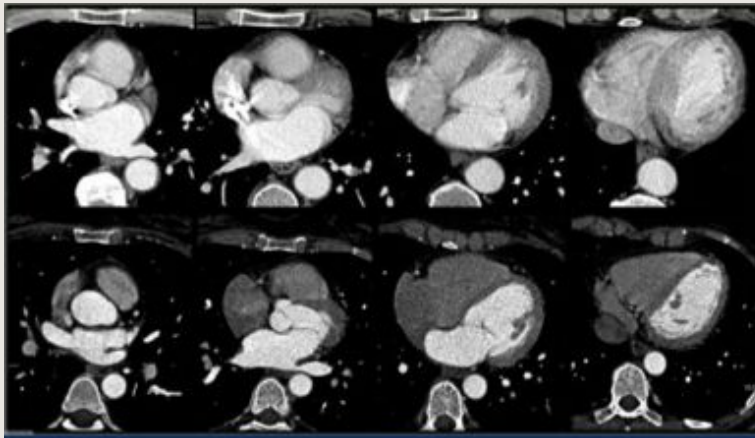
Fat is look like close to black and surrounding the heart. If patient comes to you and he has shortness of breath and he can't lie down also and the problem that his cardiac looks enlarge, if you do CT, you will find lumen of the heart filled with contrast, and instead of the fat surrounding the heart you will find fluid this condition is called pericardial effusion.

### **Pericardial Effusion:**

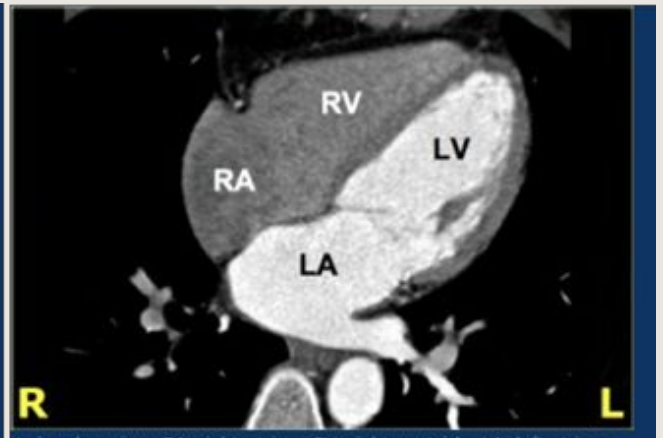
- whenever we encounter a large heart figure, we should always be aware of the possibility of pericardial effusion simulating a large heart.
- On the CXR it looks as if this patient has a dilated heart while on the CT it is clear, that it is the pericardial effusion that is responsible for the enlarged heart figure.



# Cardiac Chambers



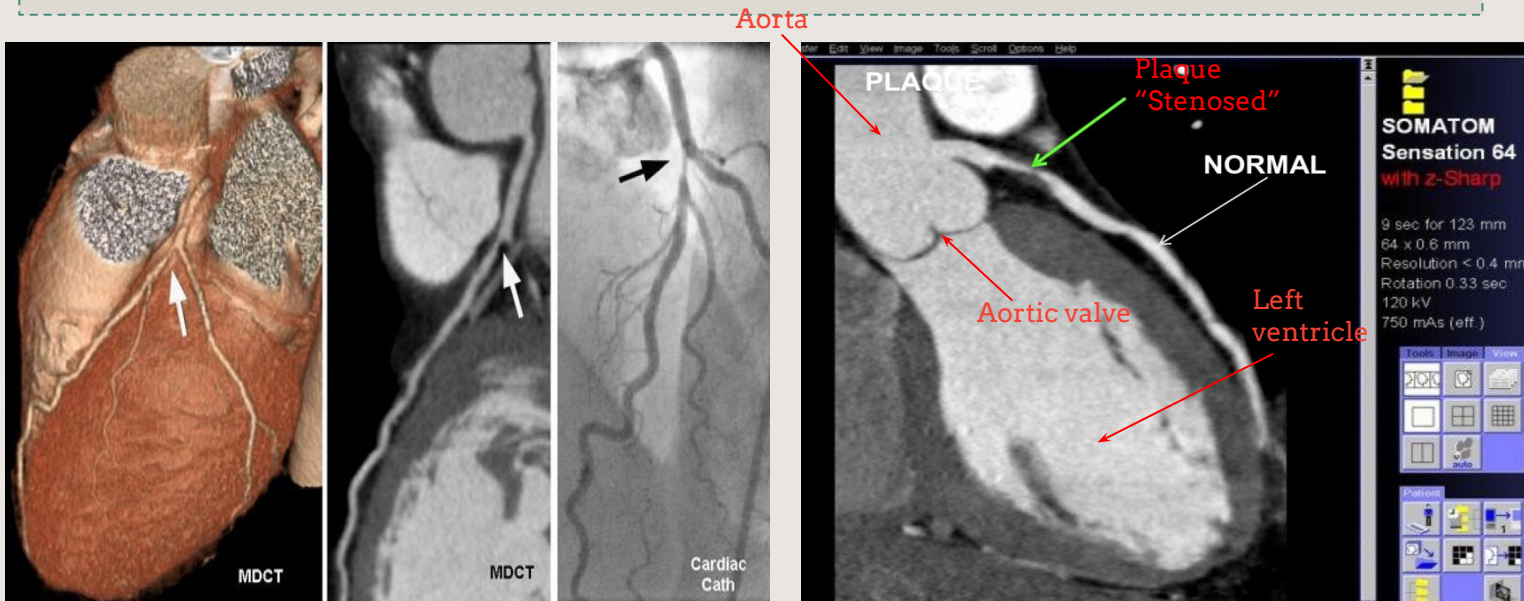
Axial slices through the heart



4-chamber view. RA=right atrium, RV=right ventricle, LA=left atrium, LV=left ventricle

# Coronary Arteries Maximum Intensity Projection

It is important to understand differences between CTA and catheter.



Plaque = vascular narrowing

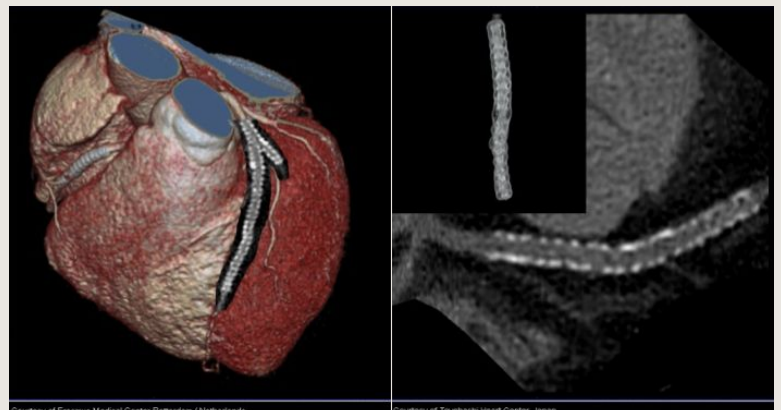
- Soft plaque in proximal LAD
- Narrowed lumen

If you do cardiac cath, you put something like guide catheter inside patient. So, it is invasive technique, besides, CT or MRI of the heart or blood vessels you just put IV line and just give the patient contrast and he is lying in the table you are not harm the patient except giving him radiation, so it is non-invasive

High risk pts to ACS >> Do catheter

Low risk pts such as young >> Do CT or MRI

If the patient is already having stent and you want to check you can do CT angiography with coronary vessels.

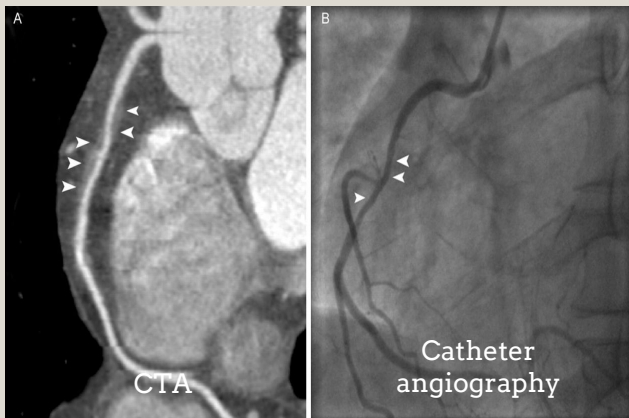


Courtesy of Erasmus Medical Center Rotterdam / Netherlands

Courtesy of Toyohashi Heart Center, Japan

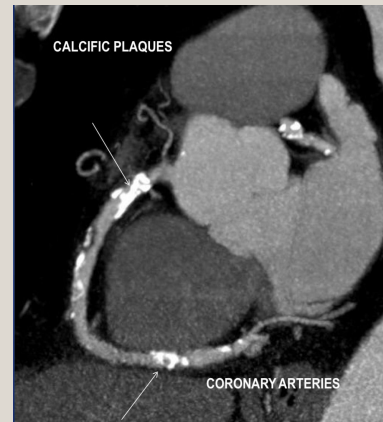
# Types of Plaque

## Soft Plaque



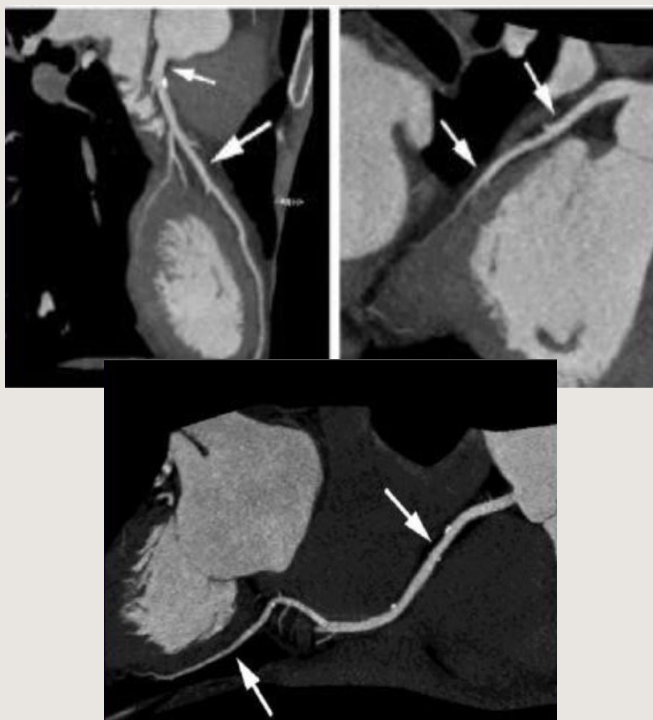
- Plaque is black and not calcified which is area of stenosis is called soft plaque, it can be treated by balloon.
- In cardiac cath, they have advantage, when they see the area of narrowing, they put stent, the exam is long if it is normal, you waste the time of the patient and you have to keep patient the unit until night then patient can go

## Calcific Plaque

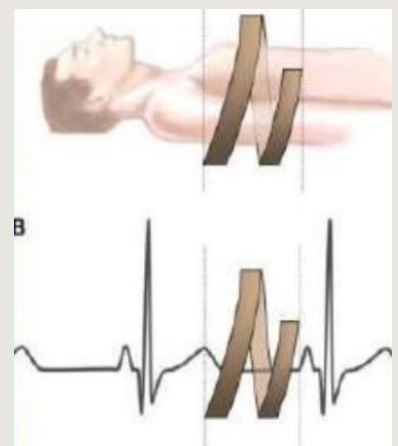
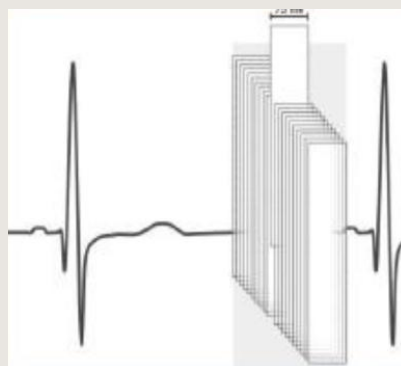


- Plaque is **calcified** is called calcific plaque, it is hard to treat.

## High Pitch Coronary CT Scanning



you can examine each segment of the vessel individually



## Gated with contrast



## Plaque visualization



Catheter Angiography

CT

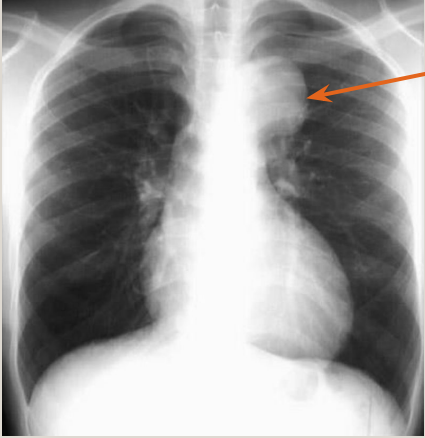
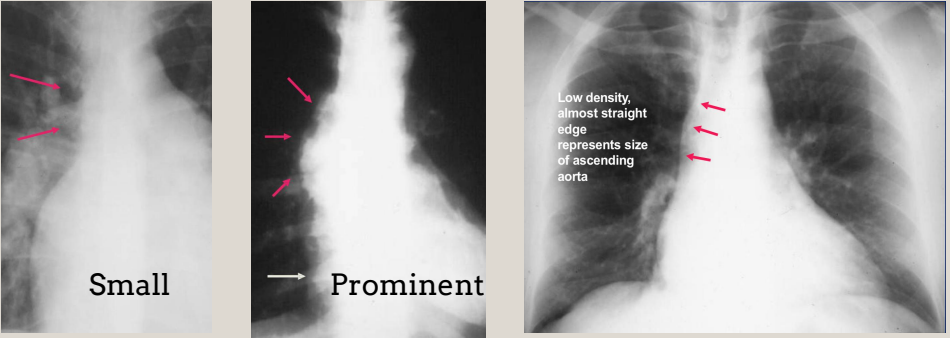

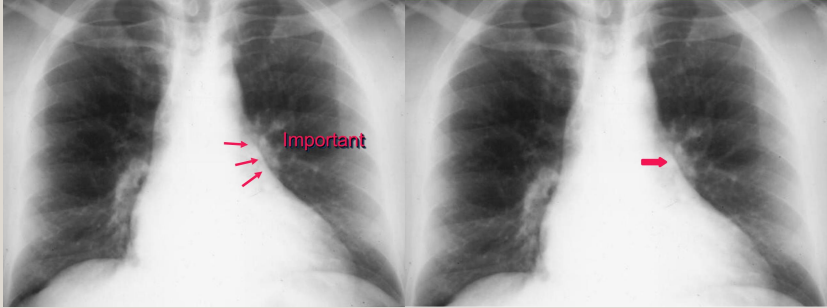
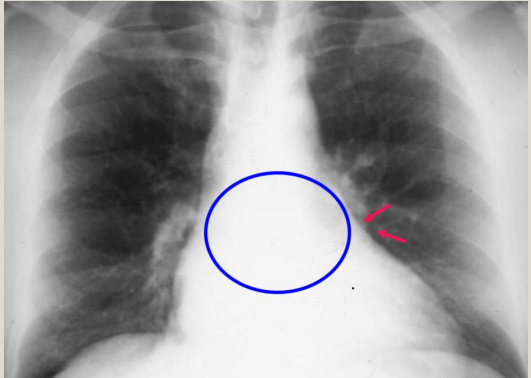
Notice the difference

# Advantage & disadvantages

From 436 team

	Advantages	Disadvantages
X-ray	<ul style="list-style-type: none"><li>• Widely available, portable, cheap.</li><li>• Proper in assessing heart size &amp; position.</li><li>• Lung assessment.</li></ul>	<ul style="list-style-type: none"><li>• Use Ionizing radiation.</li><li>• Limited assessment of heart chambers and myocardium &amp; valves &amp; pericardium &amp; mediastinum.</li></ul>
Angiogram	<ul style="list-style-type: none"><li>• Minimal invasion.</li><li>• Proper in assessing and treating coronary diseases.</li></ul>	<ul style="list-style-type: none"><li>• Use Ionizing radiation.</li><li>• Invasive procedure.</li><li>• Contrast complications.</li></ul>
Echocardiogram	<ul style="list-style-type: none"><li>• Proper in assessing heart morphology &amp; function by using doppler effect.</li><li>• Proper in assessing pericardial effusion.</li></ul>	<ul style="list-style-type: none"><li>• Operator dependent.</li><li>• Not proper to assess coronary arteries.</li></ul>
CT scan	<p>Gold standard for Pulmonary embolism.</p> <ul style="list-style-type: none"><li>• Proper in assessing heart anatomy, pulmonary artery, aorta &amp; coronary arteries.</li><li>• Proper in assessing structure around the heart and mediastinal vessels.</li></ul>	<ul style="list-style-type: none"><li>• Uses Ionizing radiation.</li><li>• Heart rate &lt; 60 beat/min for an adequate cardiac exam.</li><li>• Intravenous contrast complications.</li></ul>
MRI	<ul style="list-style-type: none"><li>• No Ionizing radiation.</li><li>• Better soft tissue Characterization.</li><li>• Proper in assessing myocardium, cardiac valves &amp; aorta.</li></ul>	<ul style="list-style-type: none"><li>• Not widely available.</li><li>• Contraindications (cardiac devices)</li><li>• Intravenous contrast complications.</li></ul>
Nuclear scan	<ul style="list-style-type: none"><li>• Assess physiology/ pathophysiology.</li><li>• Proper in assessing myocardial perfusion &amp; lung perfusion.</li></ul>	<ul style="list-style-type: none"><li>• Use ionizing radiation.</li><li>• Not widely available.</li><li>• Poor in assessing anatomy.</li></ul>
V/Q scan	<ul style="list-style-type: none"><li>• To diagnose PE.</li><li>• Includes ventilation phase and perfusion phase.</li><li>• Normal exam shows similar lungs uptake in ventilation and perfusion phases.</li></ul>	

# Skipped Images by the doctor

<p><b>Aortic Aneurysm:</b></p>	 <p>Aortic knob/knuckle</p>
<p><b>Ascending Aorta:</b></p>	 <p>Small      Prominent</p> <p>Low density, almost straight edge represents size of ascending aorta</p>
<p><b>Aortic knob:</b></p>	<p>Enlarged with :</p> <ul style="list-style-type: none"> <li>-Increased pressure</li> <li>-Increased flow</li> <li>-Changes in aortic wall</li> </ul>  <p>42mm</p>
<p><b>Main Pulmonary Artery:</b></p>	<p>The next bump down is the main pulmonary artery and is the keystone of this system</p>  <p>Important</p>
<p><b>Left Atrial Enlargement:</b></p>	<p>Concavity where L atrium will appear on left side when enlarged</p> 

## Pulmonary Embolism

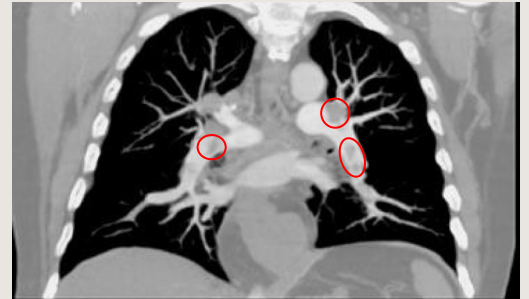
- ✓ The most common findings on chest x-ray in case of PE is normal CXR
- ✓ **The gold standard to diagnose PE is CT-angio**

**Normal**

Homogeneous filling of the vessels

**Indicate an Embolus**

Filling defect



## Cardiomegaly

- ✓ When cardiothoracic ratio is more than 50%.
- ✓ But, it is not that accurate, there are some cases of abnormal heart with Cardio-thoracic Ratio less than 50% and cases of normal heart with cardiothoracic ratio more than 50%.



**CTR >50% with normal heart**

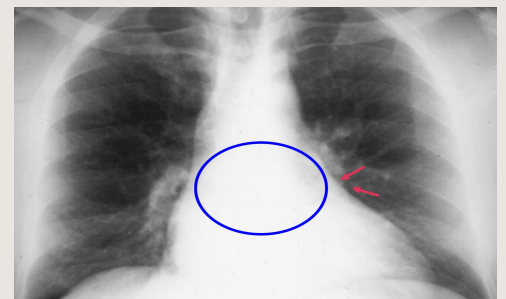
- portable AP films
- Obesity
- Pregnant
- Ascites
- Straight back syndrome
- Pectus excavatum

**CTR <50 with abnormal heart**

- obstructive to outflow of ventricles, ventricle hypertrophy
- Must look at cardiac contours

## Left atrial enlargement

- ✓ Concavity where Left atrium will appear on left side when enlarged



## Enlargement of the Aortic knob

Occur due to:


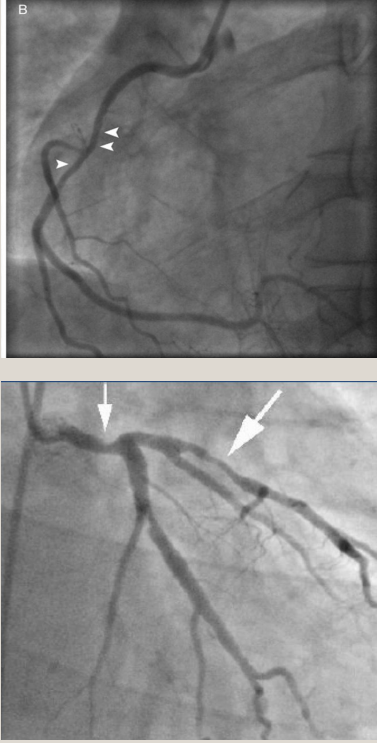
- Increased pressure
- Increased flow
- Changes in aortic wall





# SUMMARY

## CT Angio vs Coronary catheter

CT - angio	Catheter Angiography
Less invasive	Invasive procedure
Immediate intervention is not applicable	Immediate intervention is applicable
Usually we use it with young or low-risk of coronary artery disease patients	We use it with high risk patients or patients with
Images: 	Images: 

# QUESTIONS

1. 36-year-old man who presents to your A&E department with shortness of breath, he has been immobile for 6 weeks because He has been in a plaster cast for a left sided lower limb injury which was removed last week. The oncall physician suspected PE. **What is the golden standard test to diagnose it?**

- a) Simple CXR
- b) CXR with contrast
- c) CT- Angiogram
- d) Spirometry

2. 22 years old man presented to ER with chest pain, he has very low probability of coronary artery disease, which modality is the best to use in this case?

- a) screening CT
- b) catheter angio
- c) CXR
- d) MRI

3. What is the main advantage of coronary catheterization over screening CT in case of coronary artery disease?

- a) less invasive
- b) immediate intervention
- c) it is used for low risk patients
- d) There isn't any differences

4. False positives high cardio thoracic ratio could be due to:

- a) sternal fracture
- b) sternal depression
- c) sternal elevation
- d) not related to sternum at all

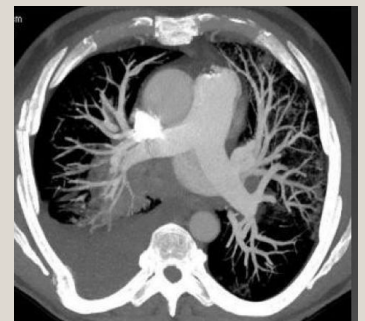
5. 68 years old male, with BMI of 44.7. he started smoking before 40 years ago. CXR as shown, What is the diagnosis

- a) PE
- b) heart failure
- c) COPD
- d) aortic aneurysm



6. This is an CT Angiogram of 26 years old post c-section women, what is the diagnosis?

- a) coronary artery disease
- b) PE
- c) complicated parapneumonic effusion
- D) left heart failure



7. We never accept cardio thoracic ratio that indicates cardiomegaly in case of:

- a) AP orientation
- b) PA orientation
- c) lateral orientation
- d) Simple CXR in any orientation

8. Echocardiogram is excellent in assessing cardiac function

- a) true
- b) false

help us improve with your feedback:



RadiologyRadiology437@gmail.com



@437Radiology



please fill this very very quick form



## References

- ✓ Dr.mohamed al sharkawy Slides
- ✓ 436 Teamwork



# THANK YOU FOR CHECKING OUR WORK

