

Radiology of cardiovascular system

DR VALENTINA OPANCINA, MD, PHD

ASSOCIATE PROFESSOR

**DEPARTMENT OF RADIOLOGY, FACULTY OF MEDICAL
SCIENCES, UNIVERSITY OF KRAGUJEVAC**



УНИВЕРЗИТЕТ
У КРАГУЈЕВЦУ



Objectives

- ▶ Examination techniques
- ▶ X-ray anatomy of the heart
- ▶ Getting to know diagnostic procedures
- ▶ Radiological changes in heart diseases

Imaging modalities

- ▶ Radiography
- ▶ Echocardiography
- ▶ Computed tomography
- ▶ Magnetic resonance imaging
- ▶ Angiography

Imaging Techniques :

1- Plain Radiography :

- * The standard plain films for evaluation of cardiac diseases are the PA view & Lateral chest film, the PA view must be sufficiently penetrated to see the shadow within the heart, eg. The double contour of the Lt. atrium & valve & pericardial calcification.
- * It provides limited information's about the Heart.
- * It provides limited information's about the effect of the cardiac diseases on the lungs & pleural cavities.

Radiography



*** We should assess the following points :**

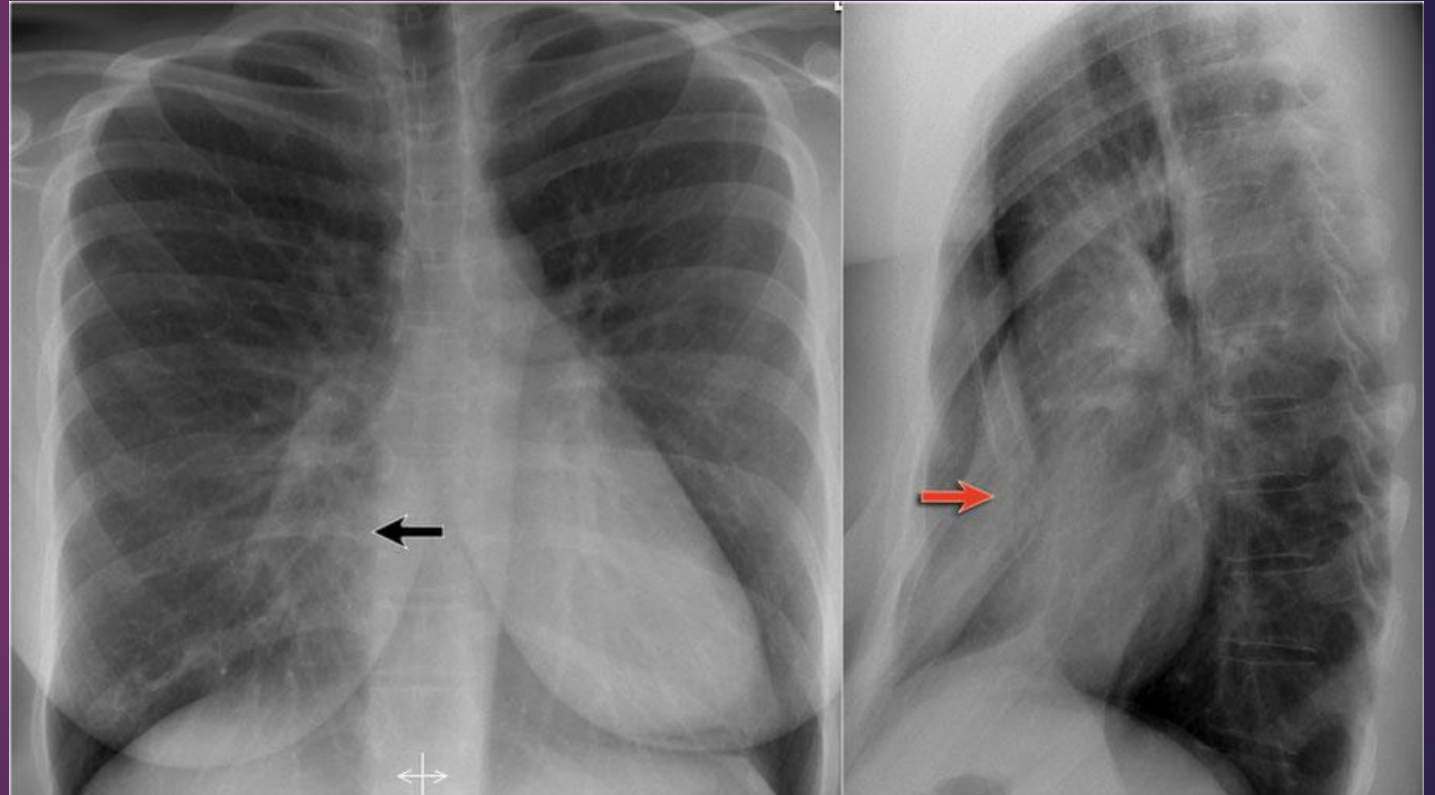
- a- Heart (shape & size).**
- b- Great vessels (size, shape), Aortic arch (normally located to the Lt. of the Trachea, we should exclude the signs of coarctation of aorta).**
- c- If there is any calcification.**
- d- The main point is the examination of the Lung field for altered blood flow & if there is any evidence of heart failure.**

**** Note :**

Look for any thoracic abnormality (such as Pectus Excavatum).

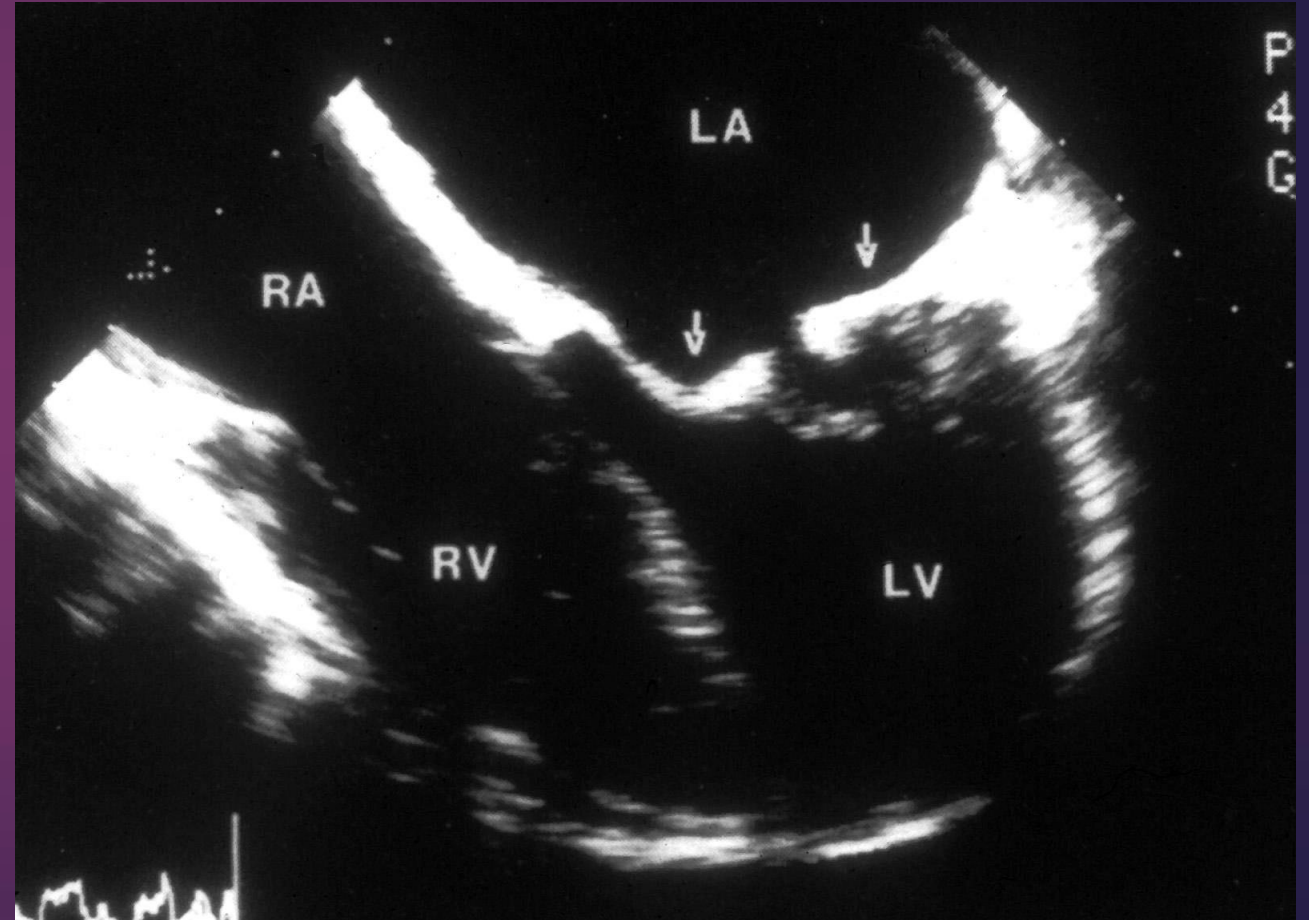
Pectus excavatum

- ▶ In patients with a pectus excavatum the right heart border can be ill-defined, but this is normal. It produces a silhouette sign and thus simulating a consolidation or atelectasis of the right middle lobe.
- ▶ The lateral view is helpful in such cases.
- ▶ Pectus excavatum is a congenital deformity of the ribs and the sternum producing a concave appearance of the anterior chest wall.

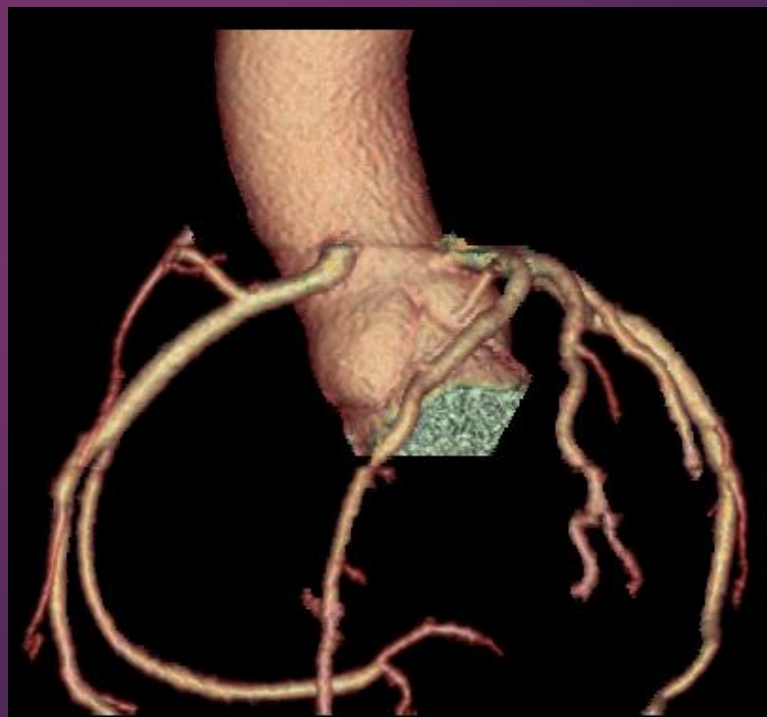
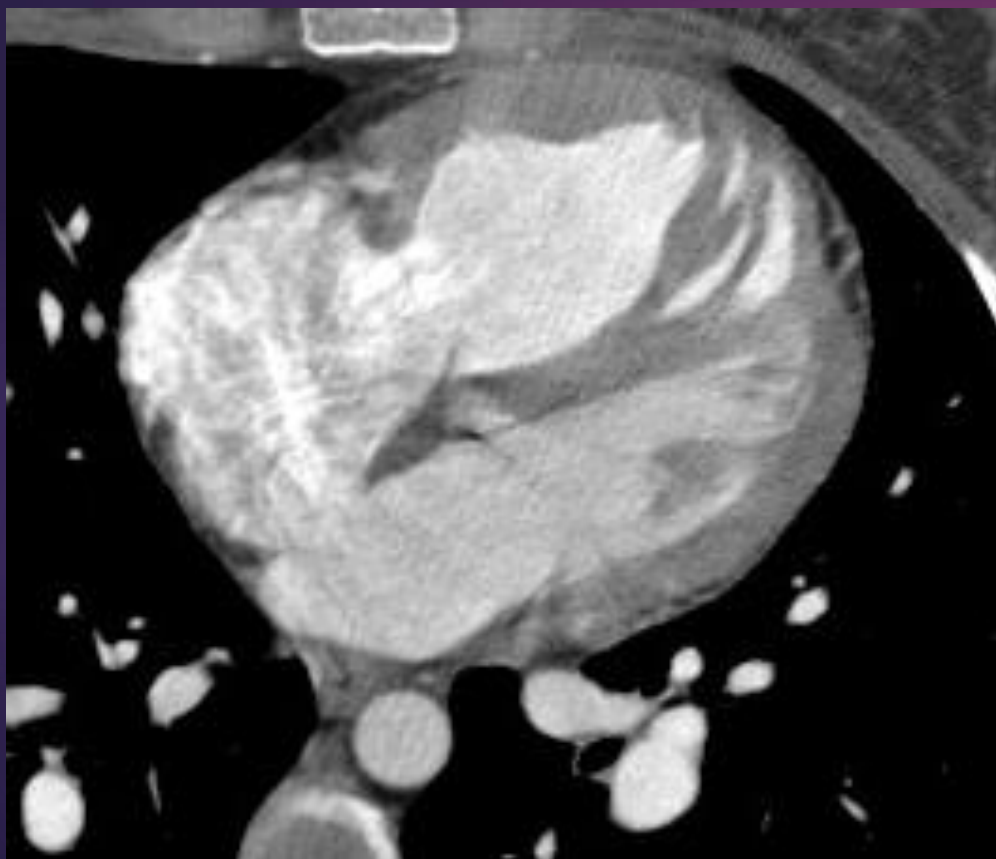


2- Echocardiography (Cardiac US) :

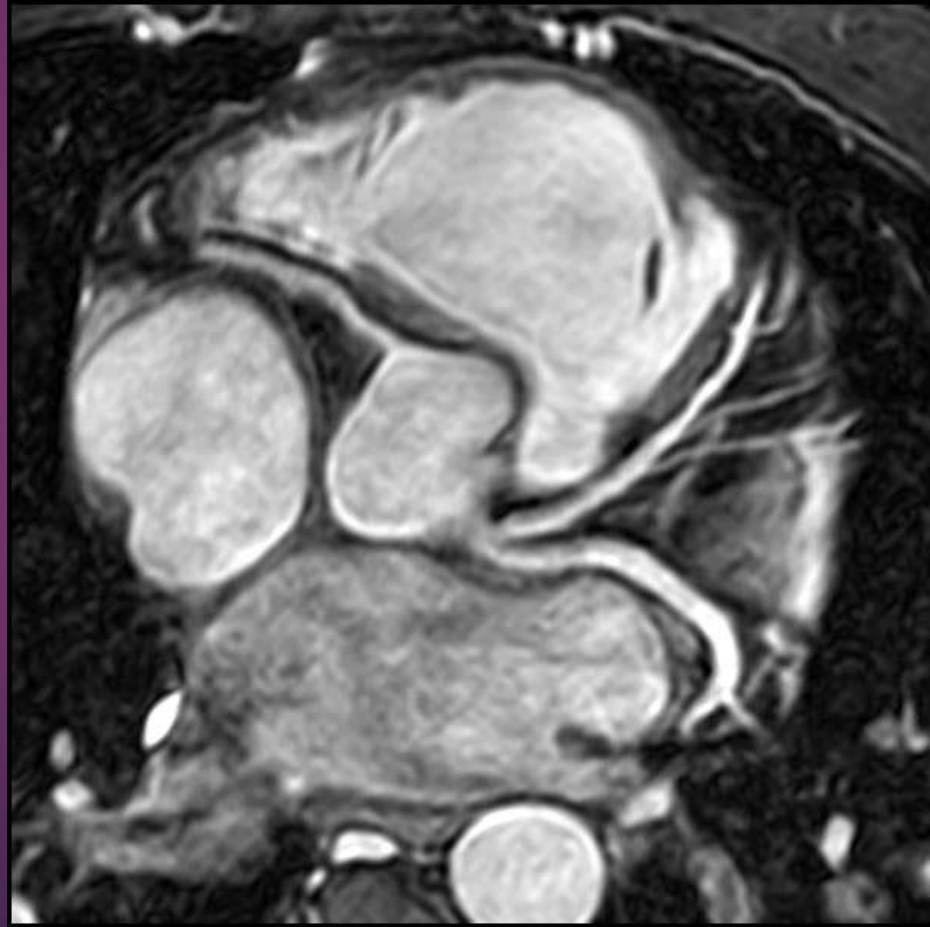
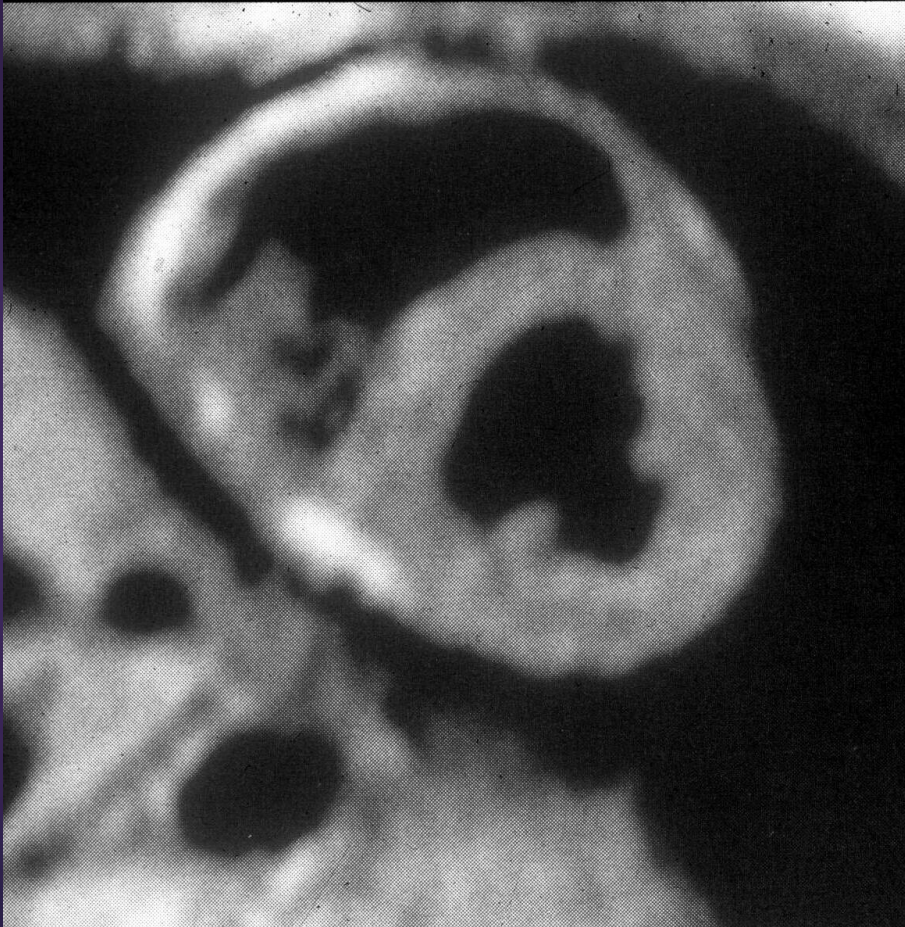
- * It is the major or basic imaging technique used in cardiology.
- * It gives important informations about the Morphology & Function of the heart.
- * It is an excellent technique to look for :
 - a- Heart valves.
 - b- Chamber morphology & volume.
 - c- Determining the ventricular wall thickness.
 - d- Any intra-luminal mass.



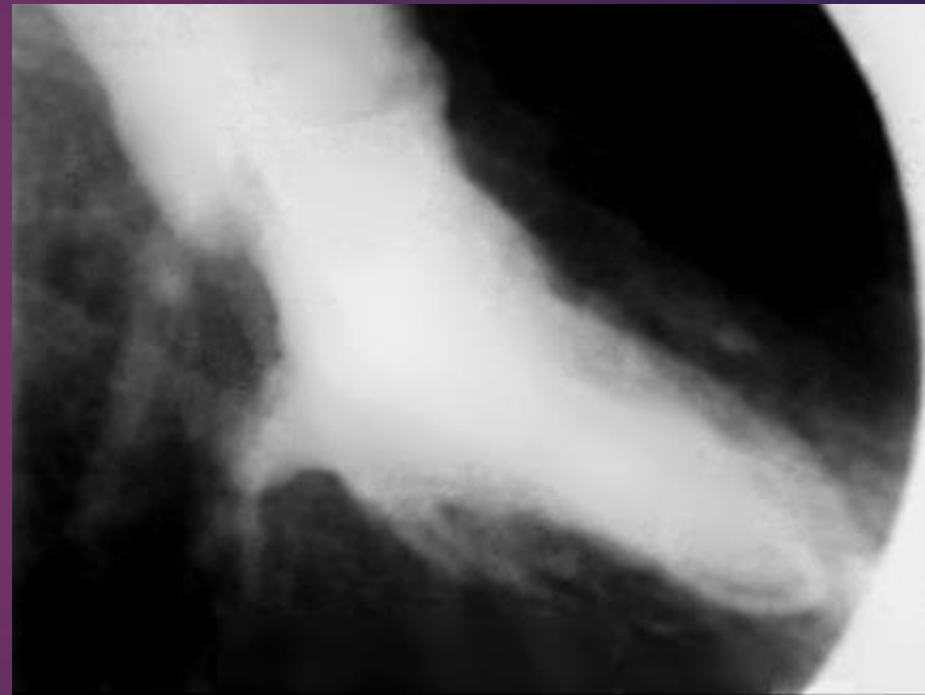
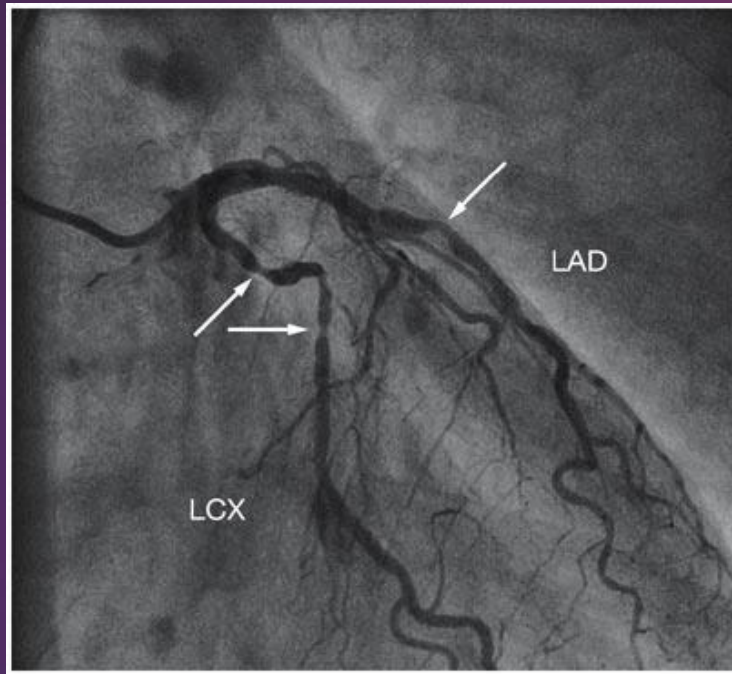
CT



MRI



DSA



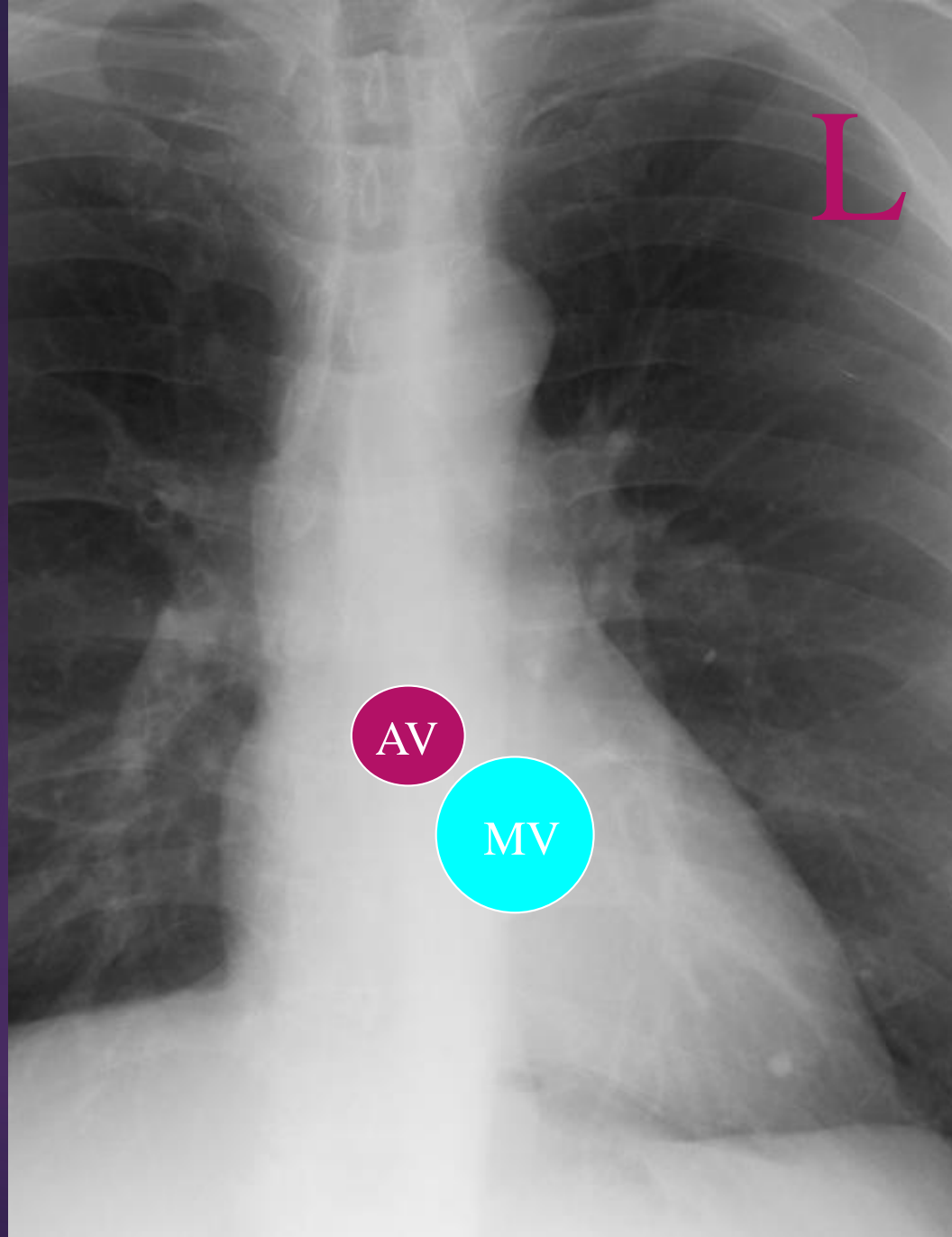
Diagnostic Approach

- Need to evaluate

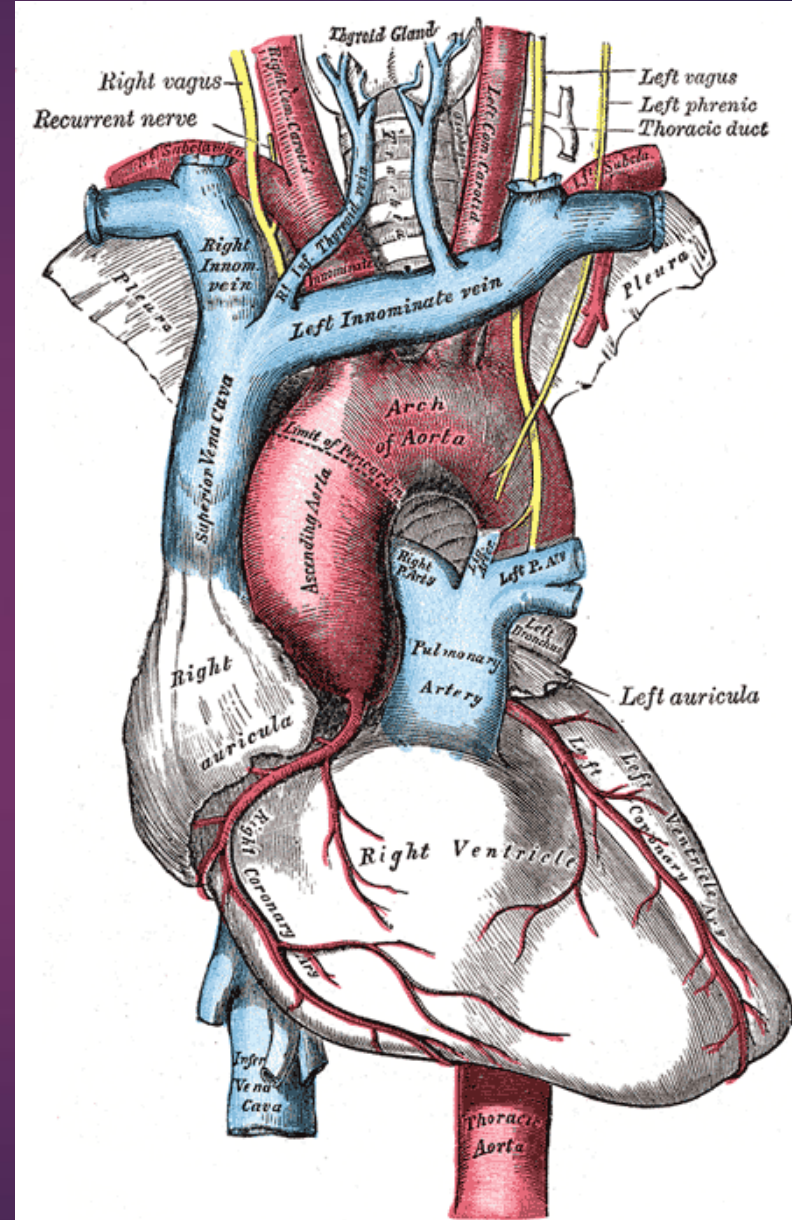
1. morphology

2. physiology

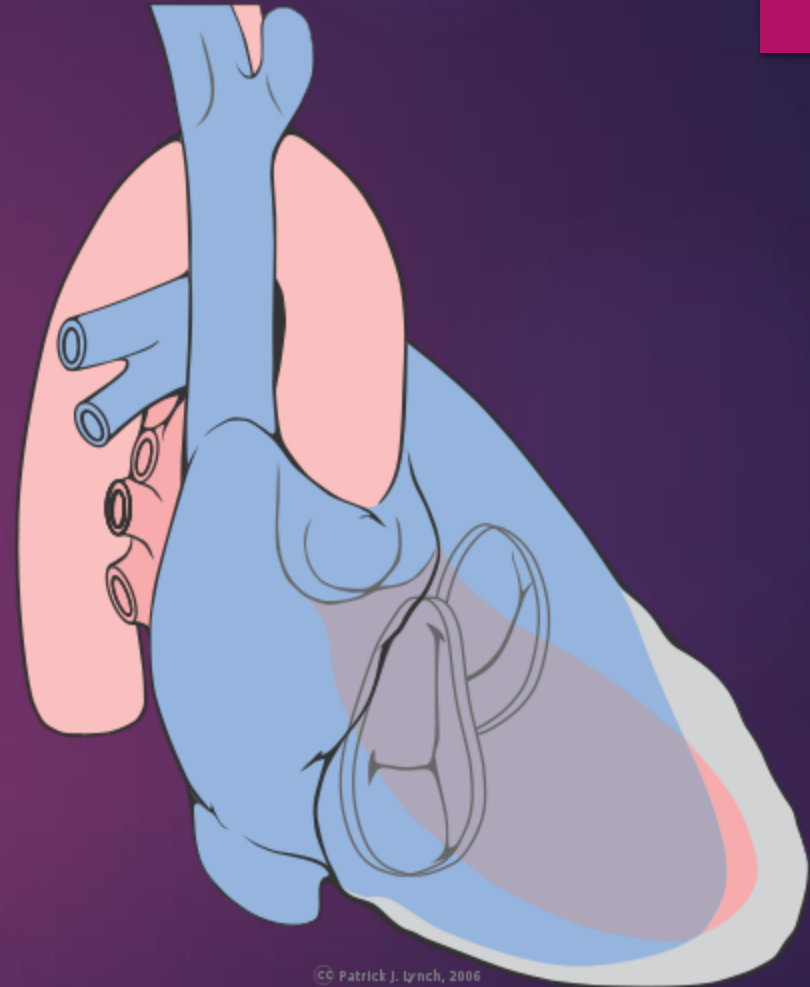
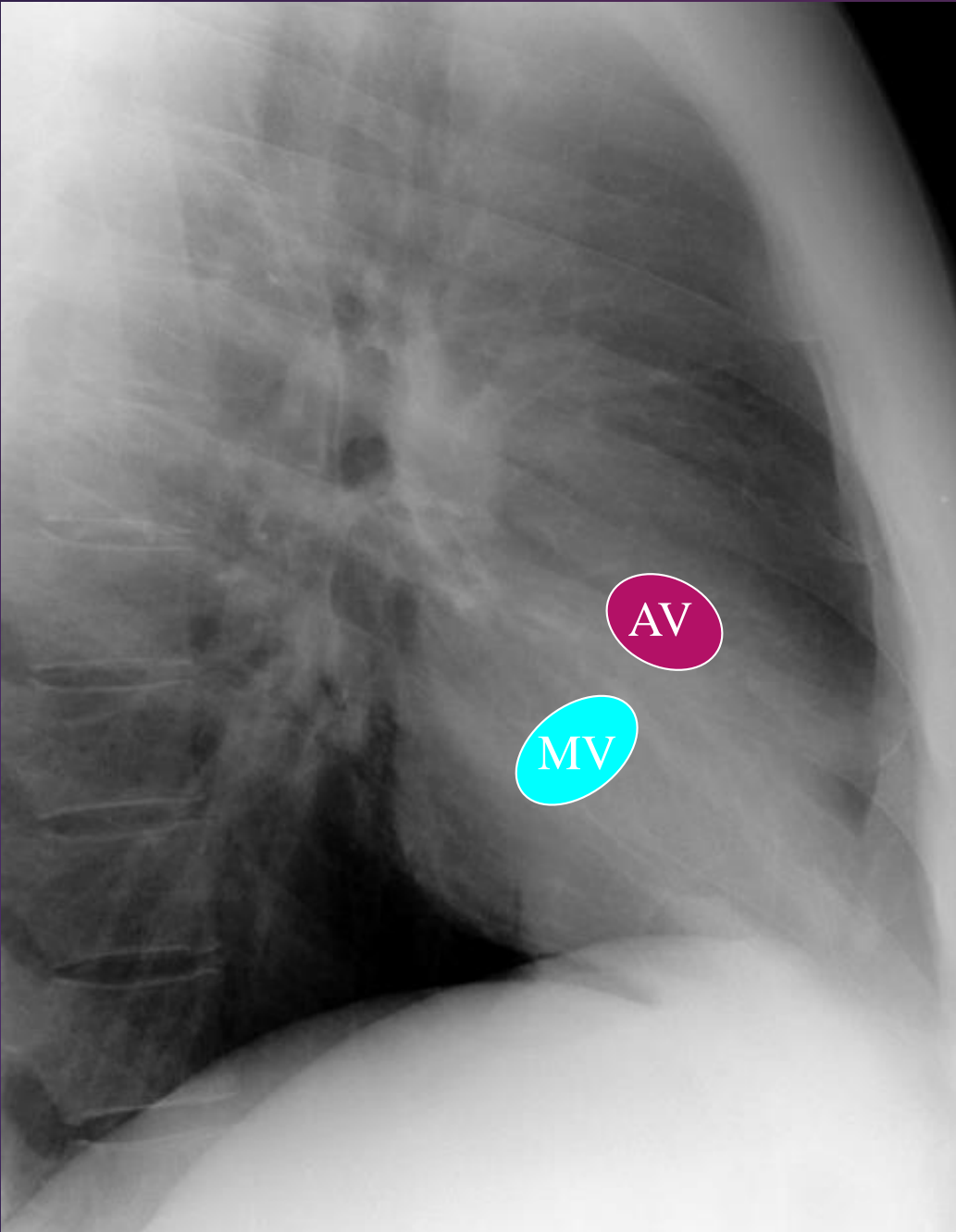
Normal Cardiac Contours

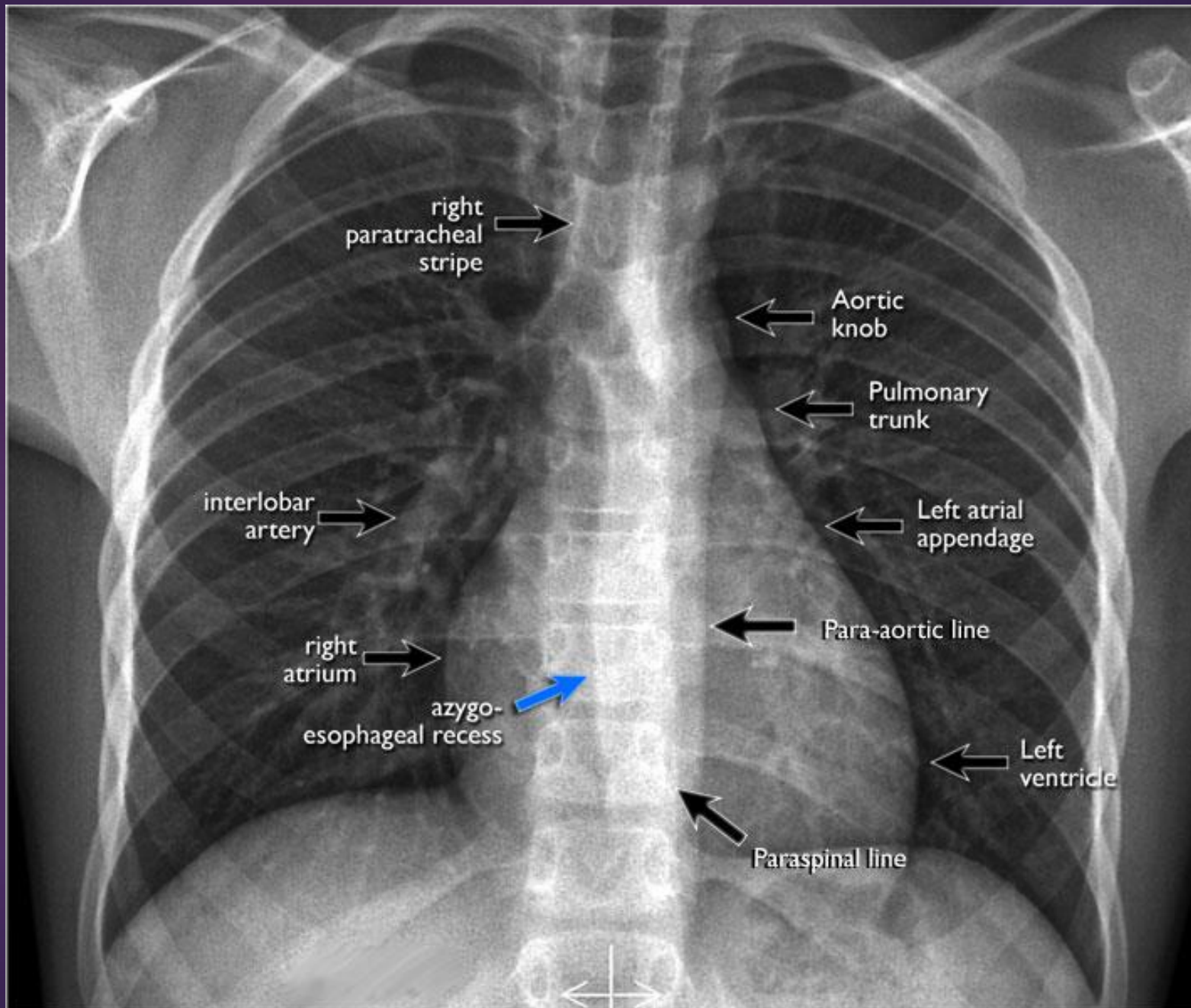


normal frontal view

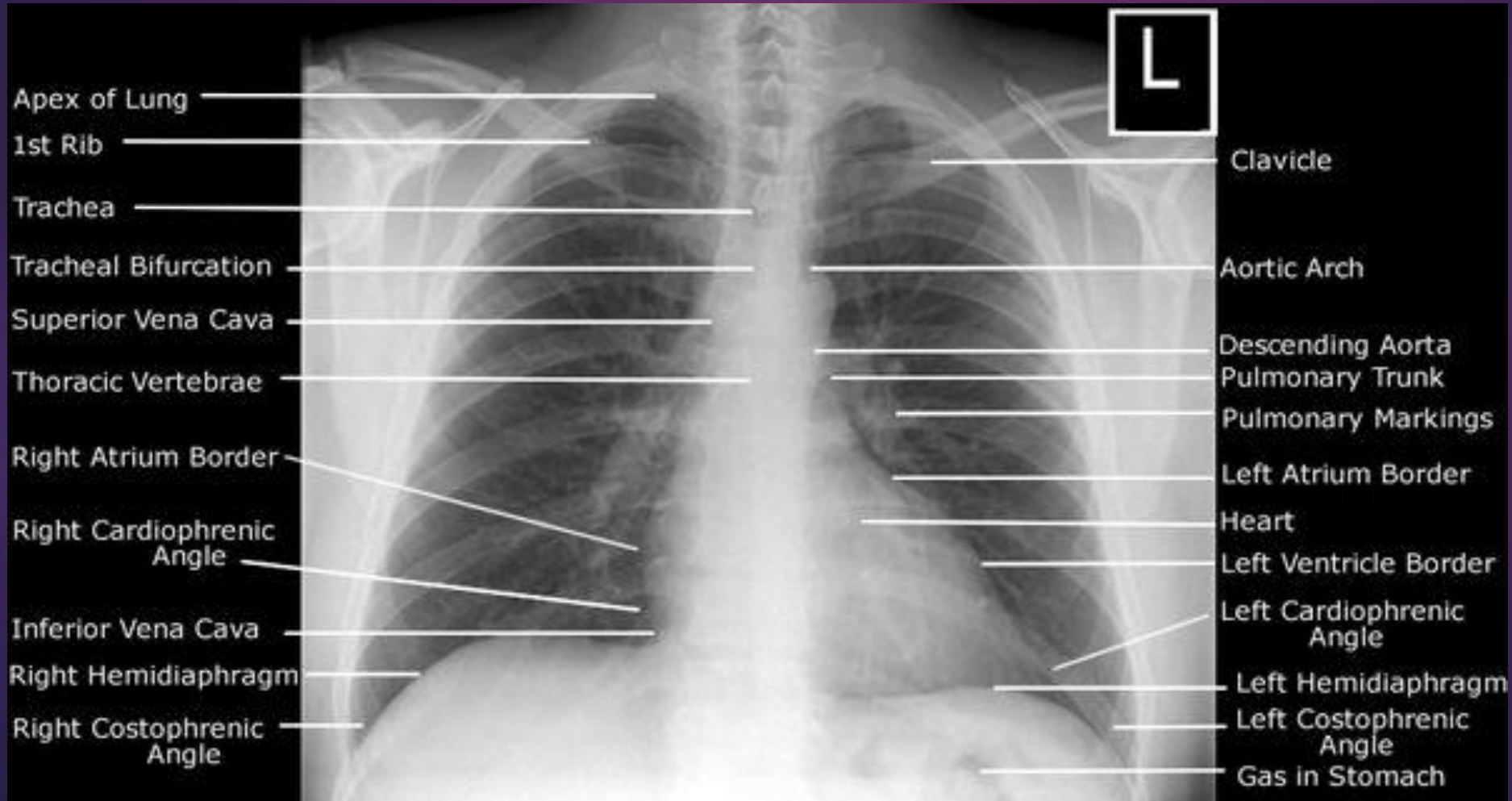


normal lateral view





CHEST X-RAY

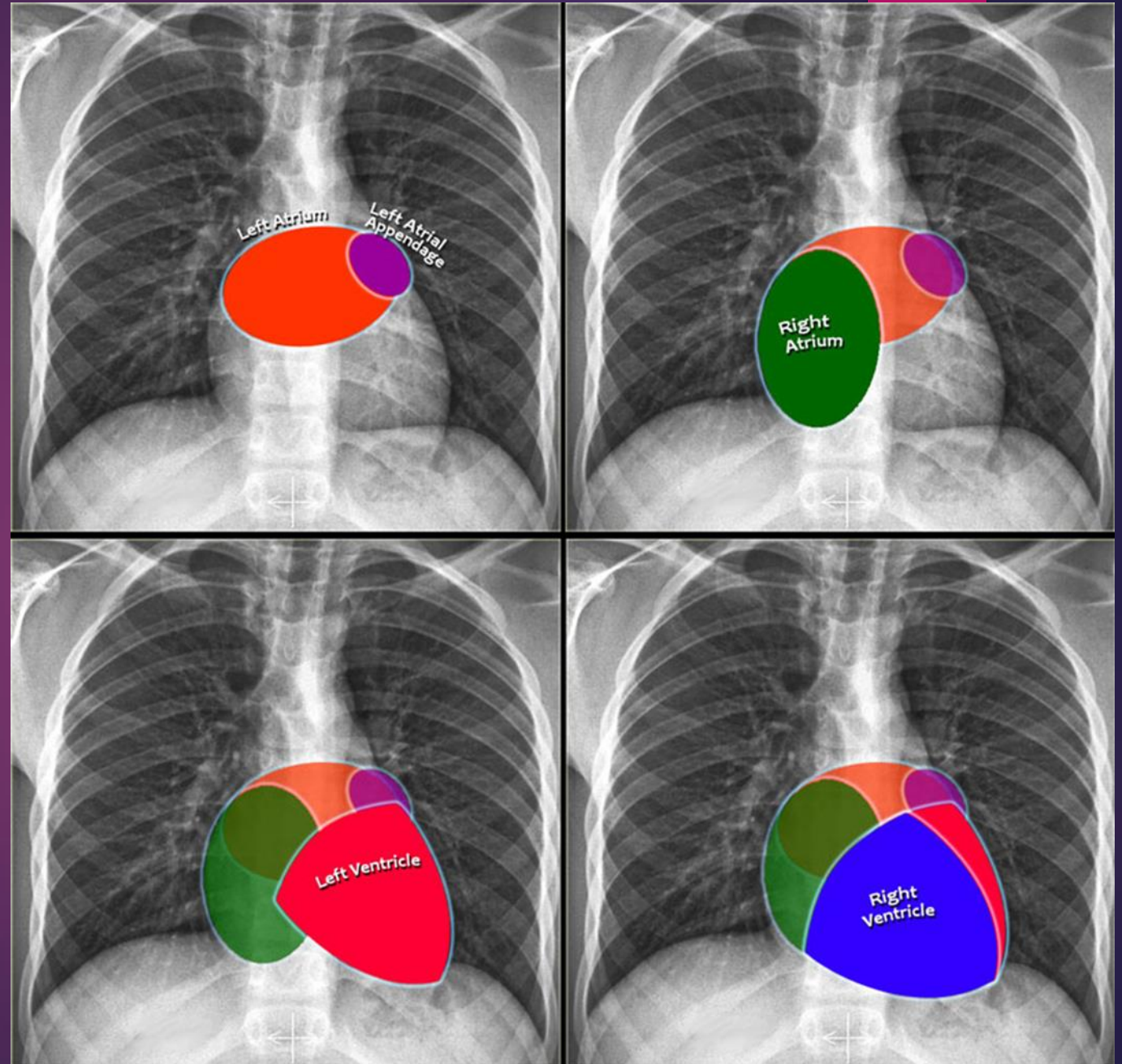


Cardiac silhouette - DEFINITION

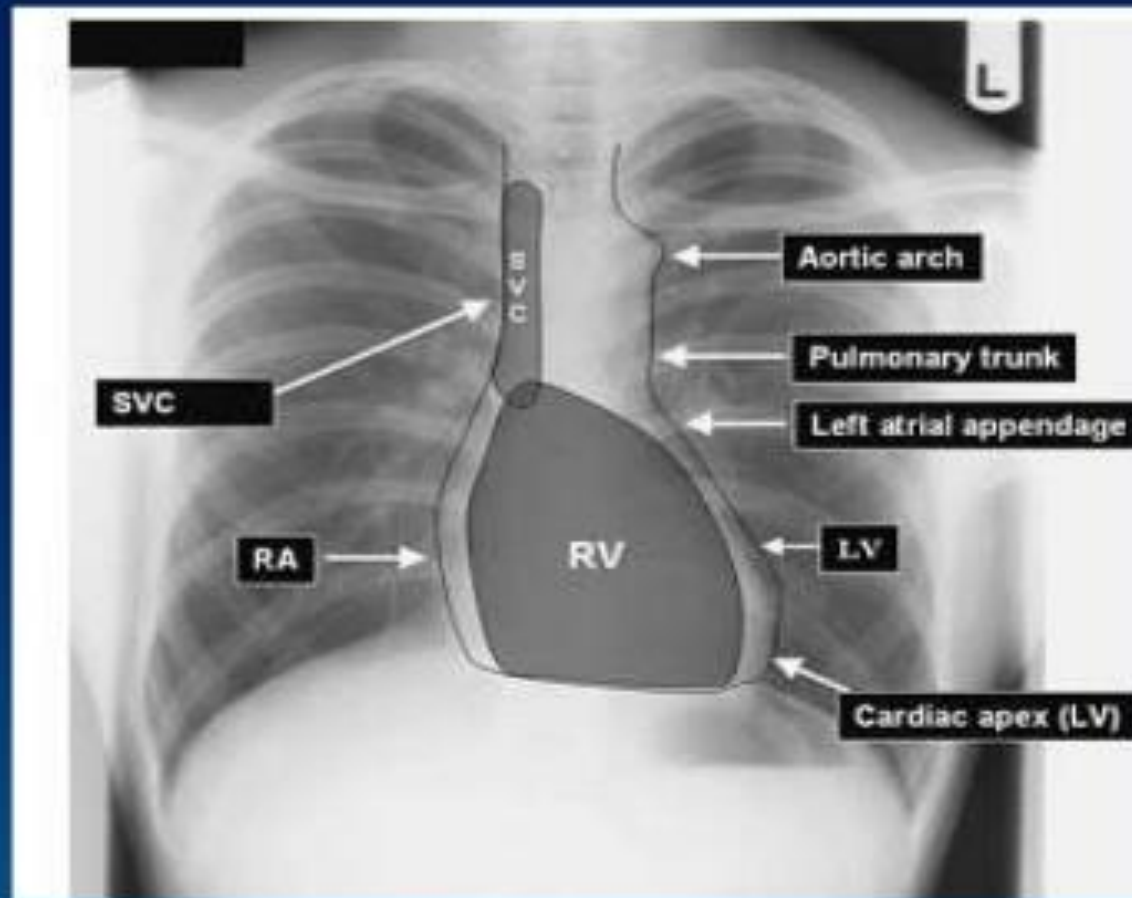
- ▶ Cardiac silhouette refers to the outline of the heart as seen on frontal and lateral chest radiographs and forms part of the cardiomediastinal contour. The size and shape of the cardiac silhouette provide useful clues for underlying disease.

CXR features

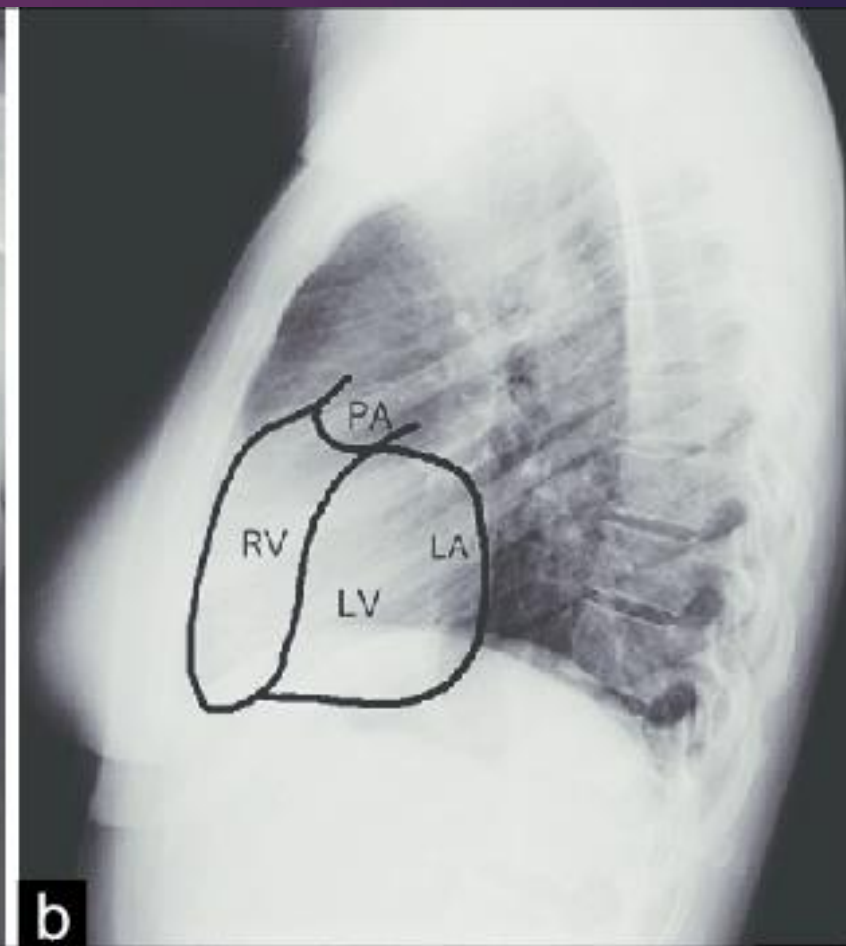
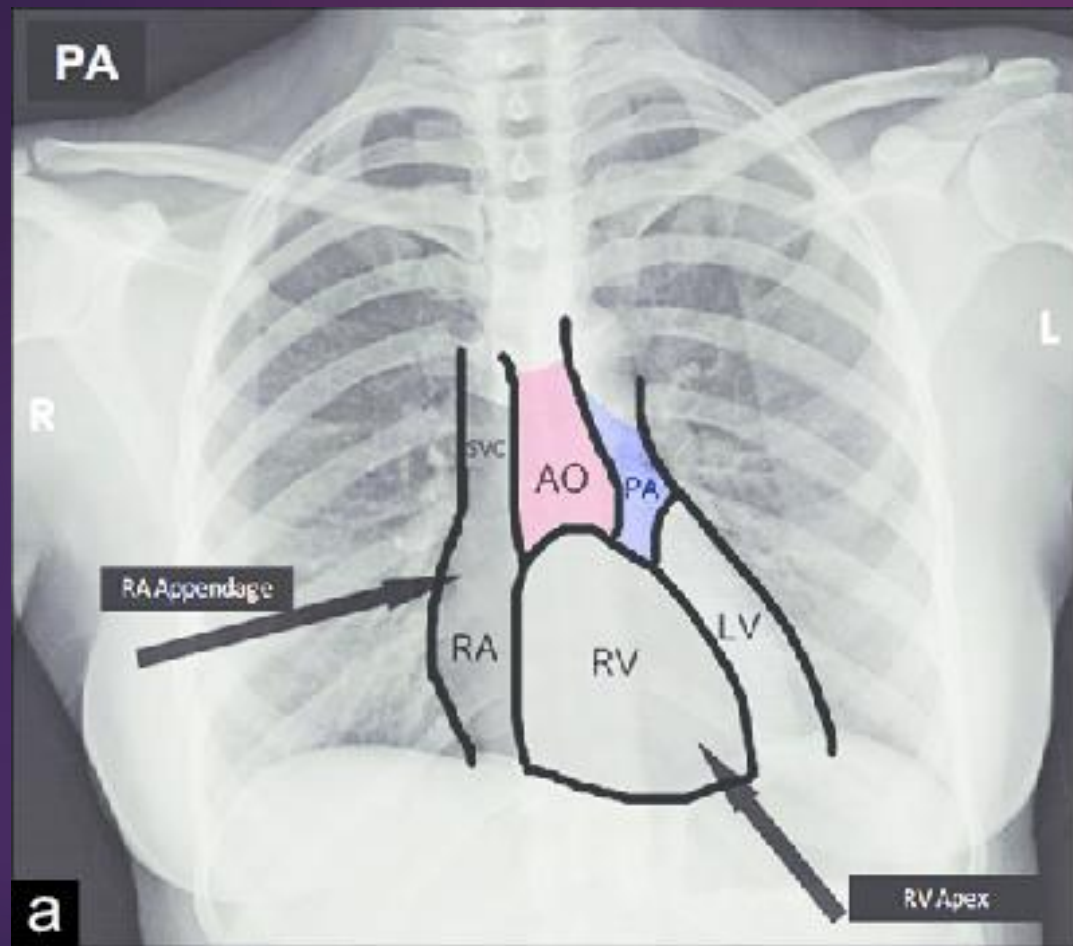
- ▶ From the frontal projection, the cardiac silhouette can be divided into right and left borders:
- ▶ the right border is formed by the right atrium
- ▶ the superior vena cava entering superiorly and the inferior vena cava often seen at its lower margin
- ▶ the left border is formed by the left ventricle and left atrial appendage
- ▶ the pulmonary artery, aortopulmonary window and aortic notch extend superiorly
- ▶ On the lateral projection the cardiac silhouette is formed by 1:
- ▶ the anterior border by right ventricle
- ▶ the posterior border by left atrium (superiorly) and left ventricle (inferiorly) and the inferior vena cava



STRUCTURES SEEN IN ANTERIOR VIEW

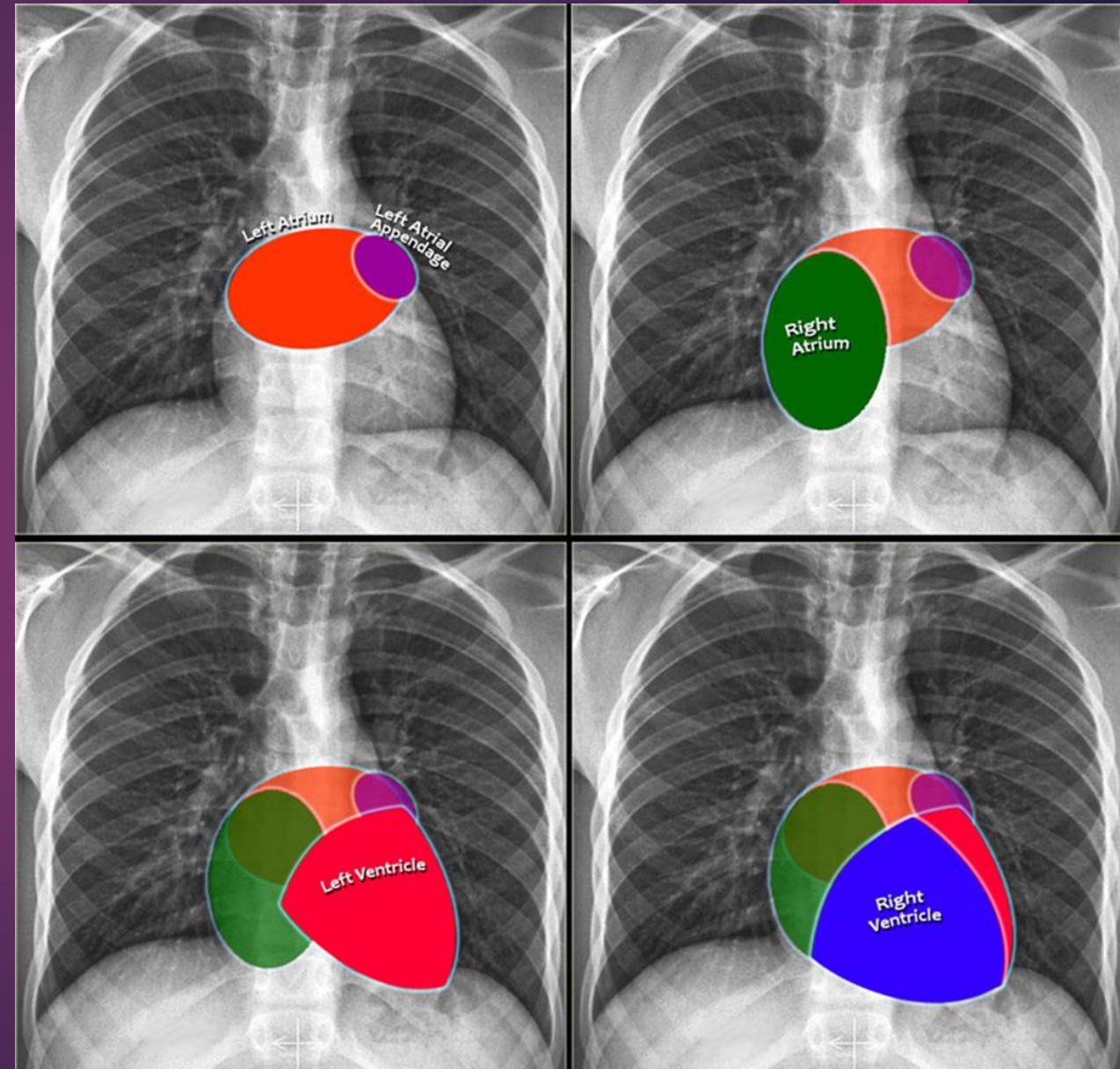






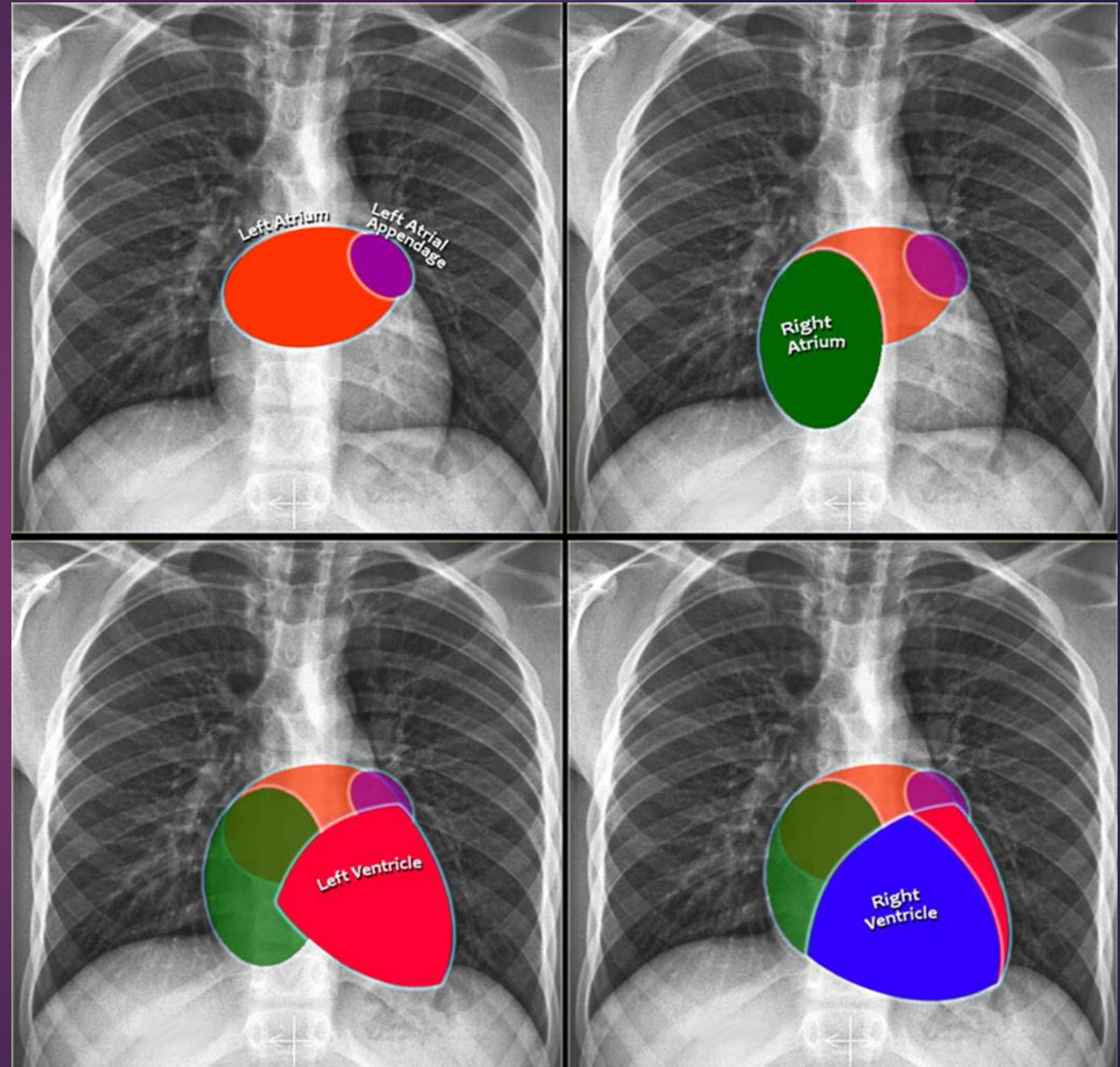
Left Atrium

- ▶ Most posterior structure.
- ▶ Receives blood from the pulmonary veins that run almost horizontally towards the left atrium.
- ▶ Left atrial appendage (in purple) can sometimes be seen as a small outpouching just below the pulmonary trunk.
- ▶ Enlargement of the left atrium results on the PA-view in outpouching of the upper heart contour on the right and an obtuse angle between the right and left main bronchus. On the lateral view bulging of the upper posterior contour will be seen.



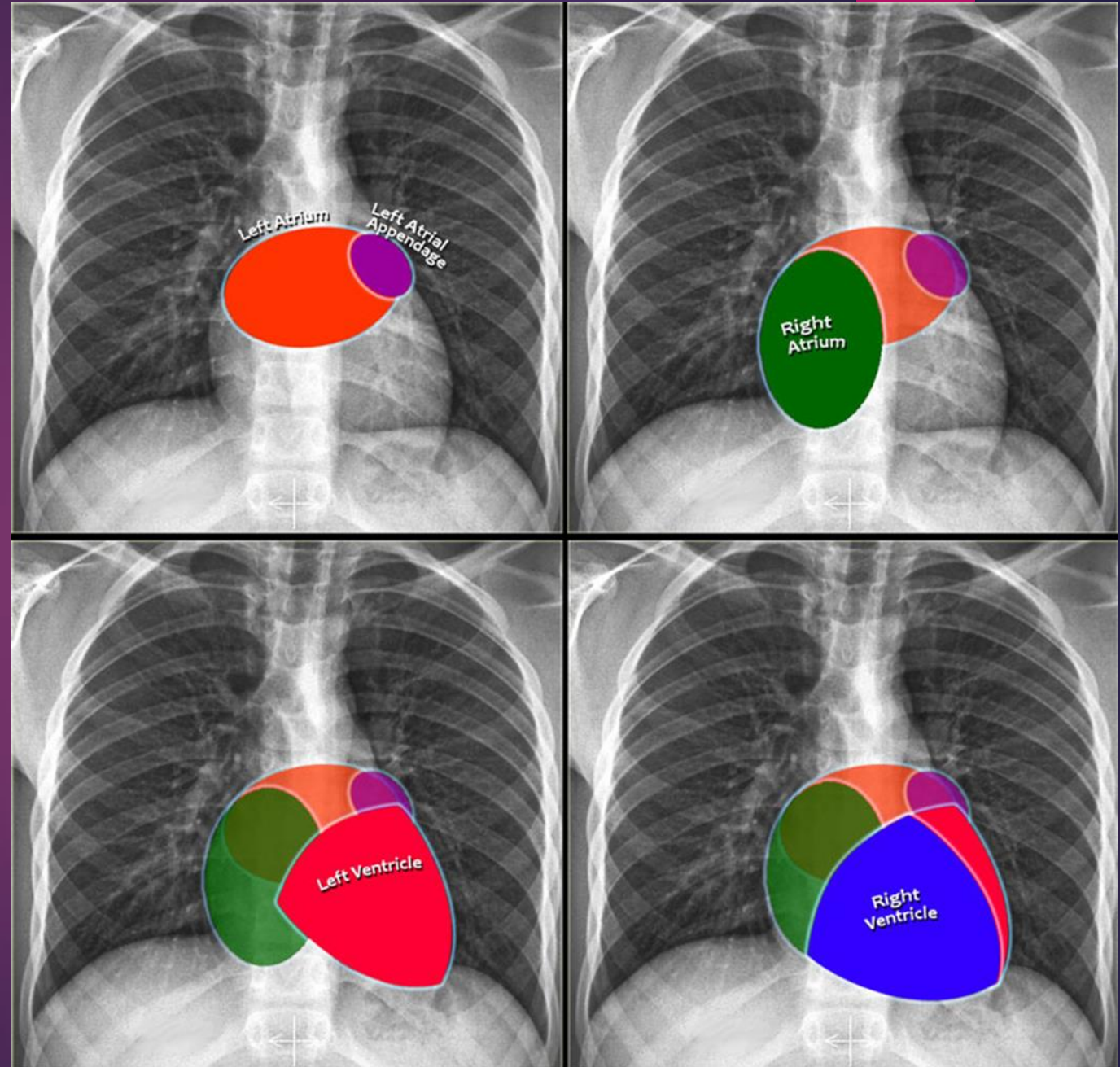
Right Atrium

- ▶ Receives blood from the inferior and superior vena cava.
- ▶ Enlargement will cause an outpouching of the right heart contour.



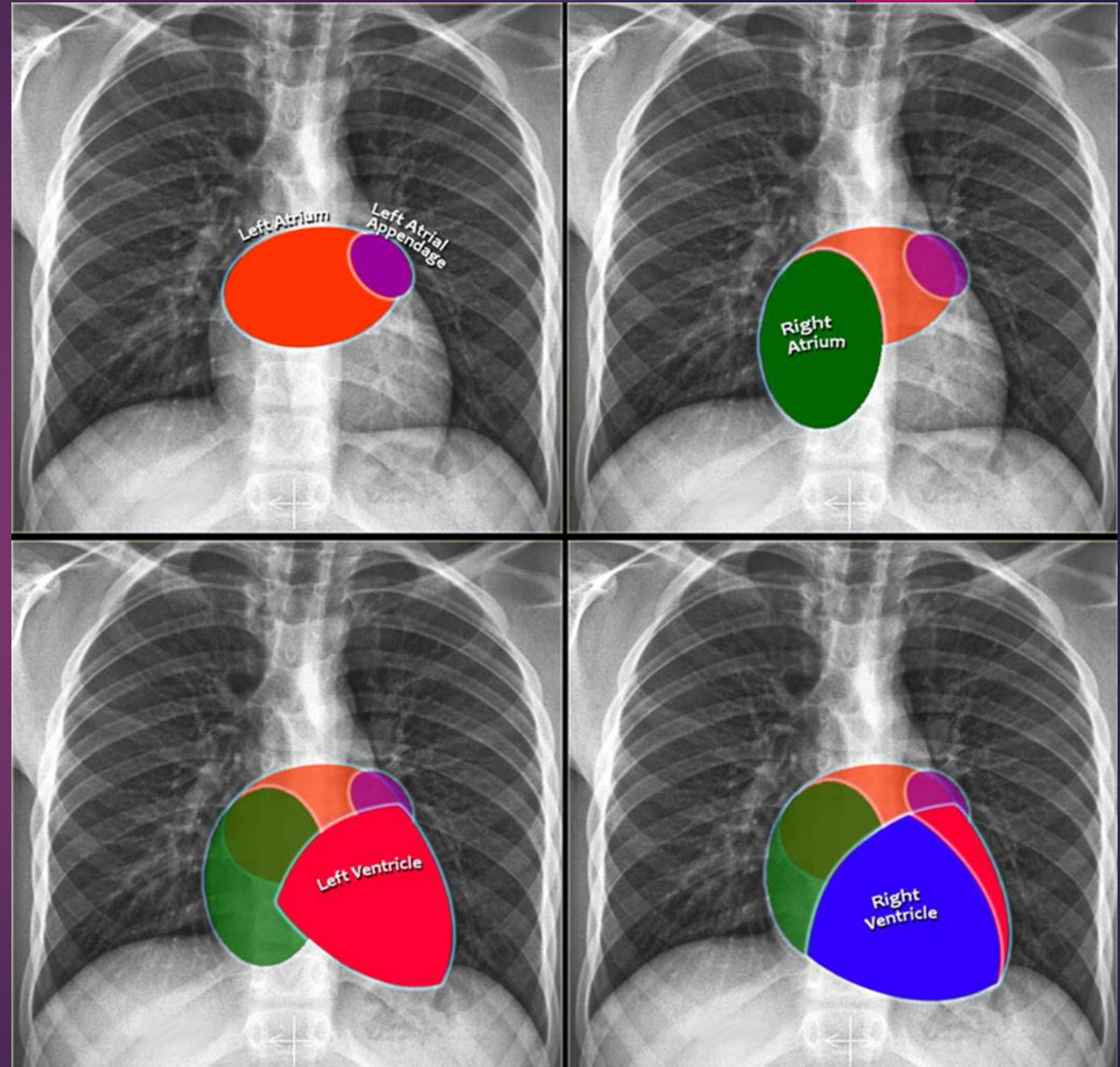
Left Ventricle

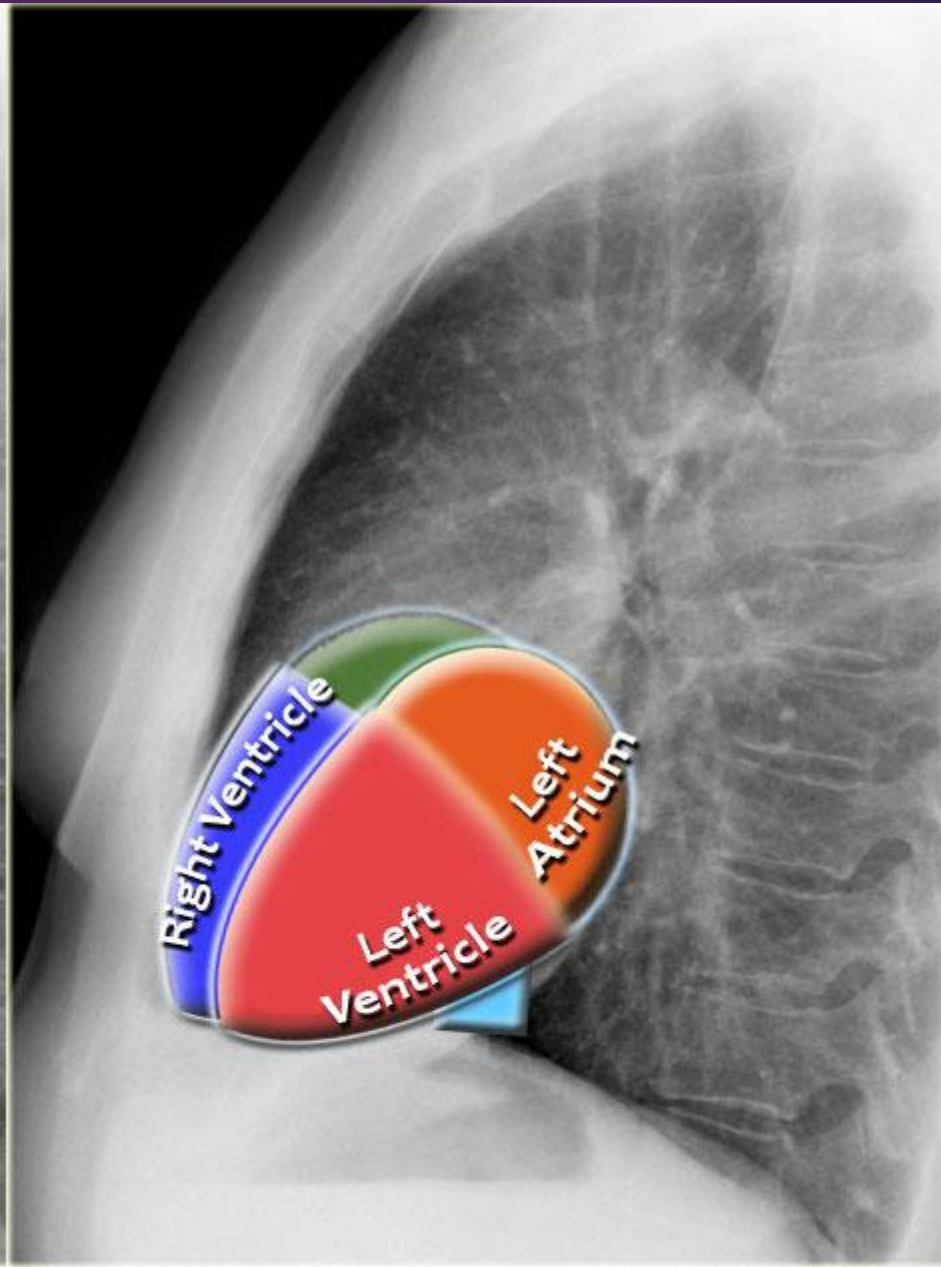
- ▶ Situated to the left and posteriorly to the right ventricle.
- ▶ Enlargement will result on the PA-view in an increase of the heart size to the left and on the lateral view in bulging of the lower posterior contour.



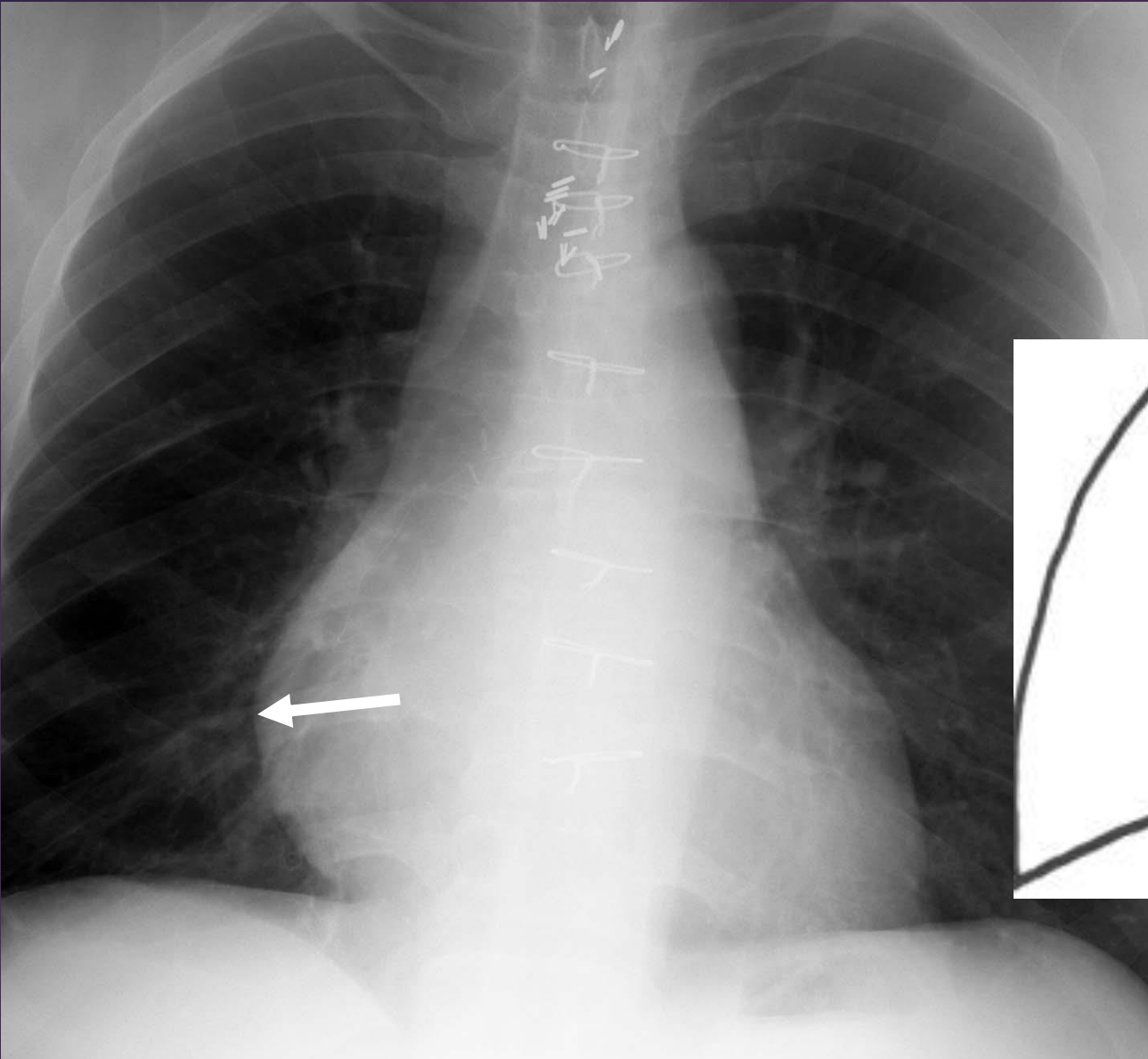
Right Ventricle

- ▶ Most anterior structure and is situated behind the sternum.
- ▶ Enlargement will result on the PA-view in an increase of the heart size to the left and can finally result in the left heart border being formed by the right ventricle.

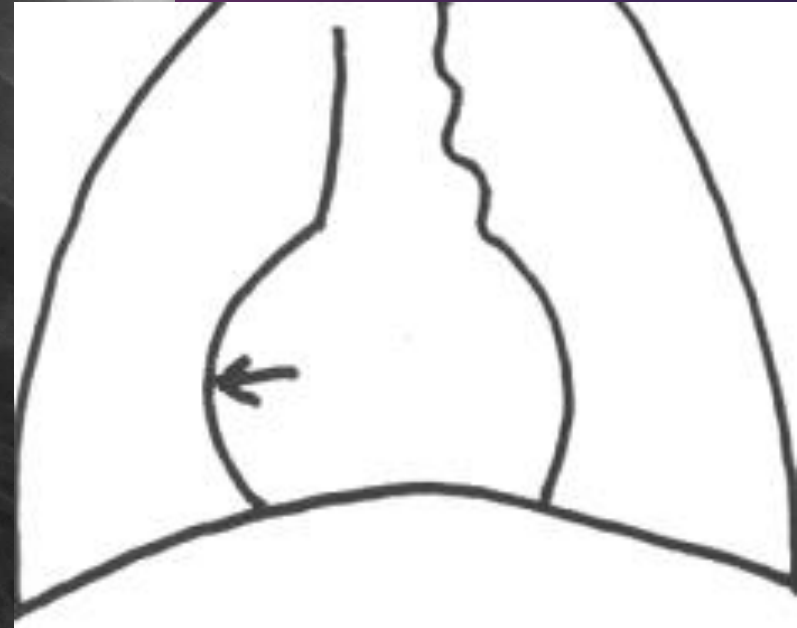




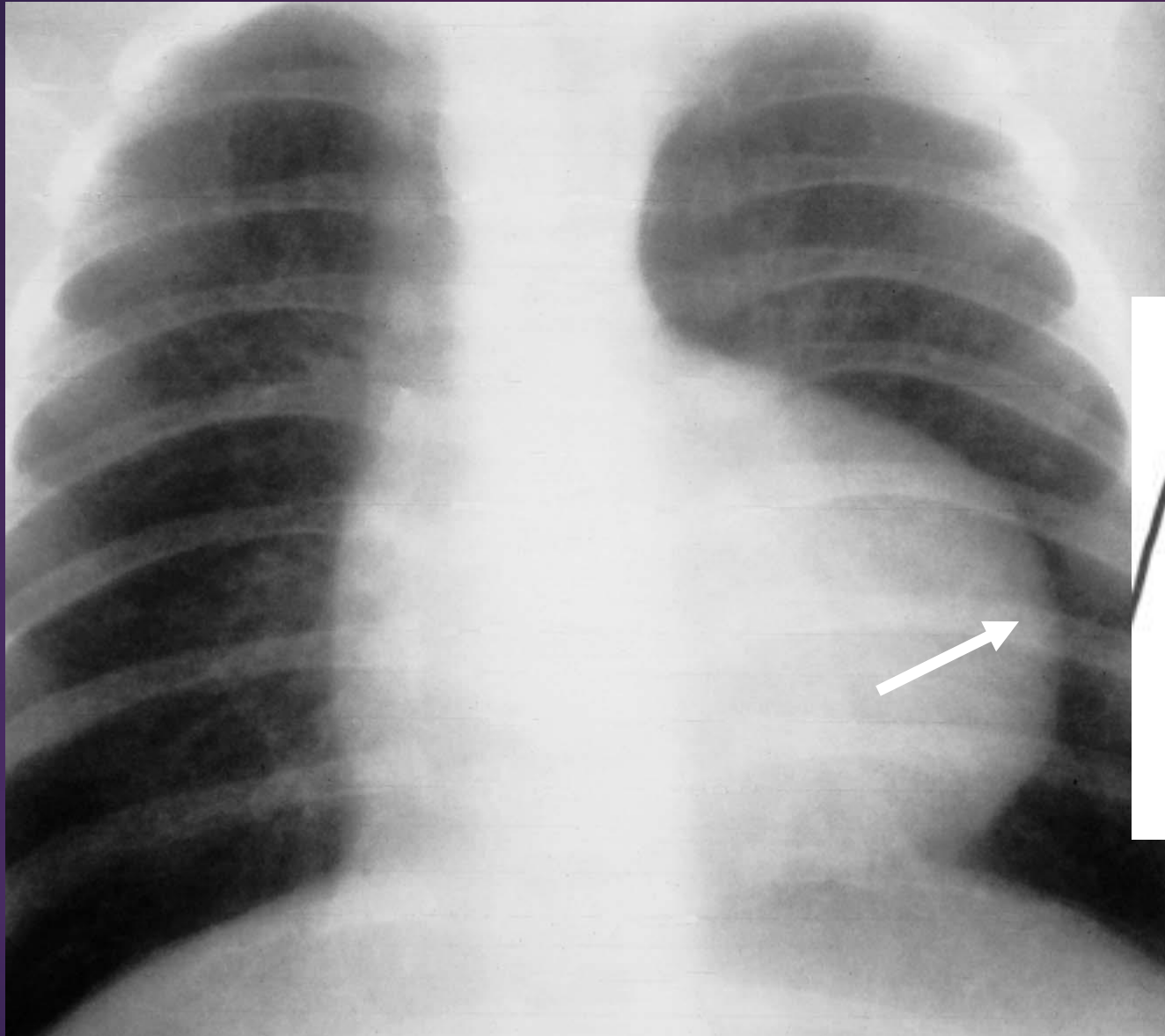
Abnormal Cardiac Contours



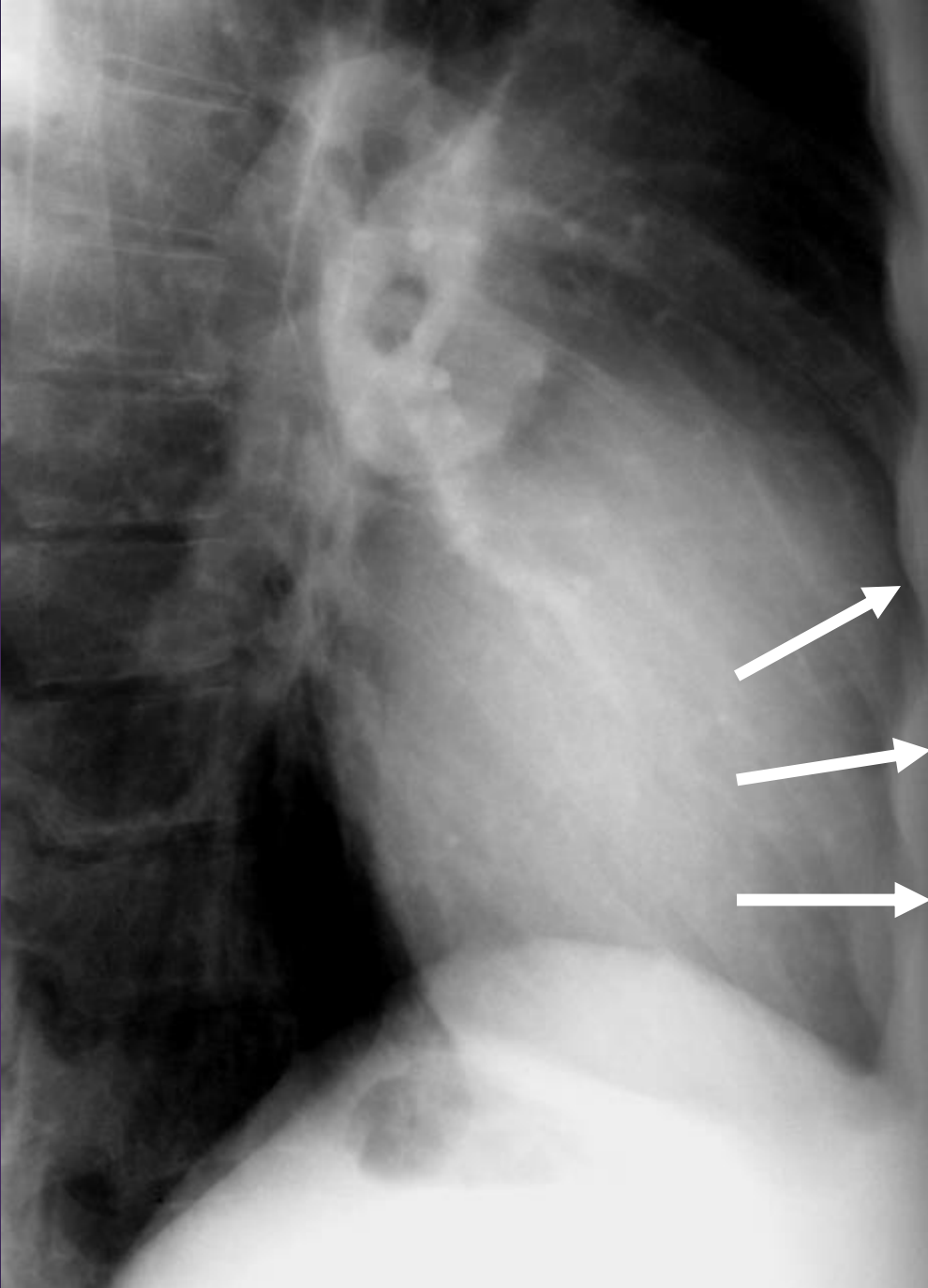
***Enlarged
Right Atrium***



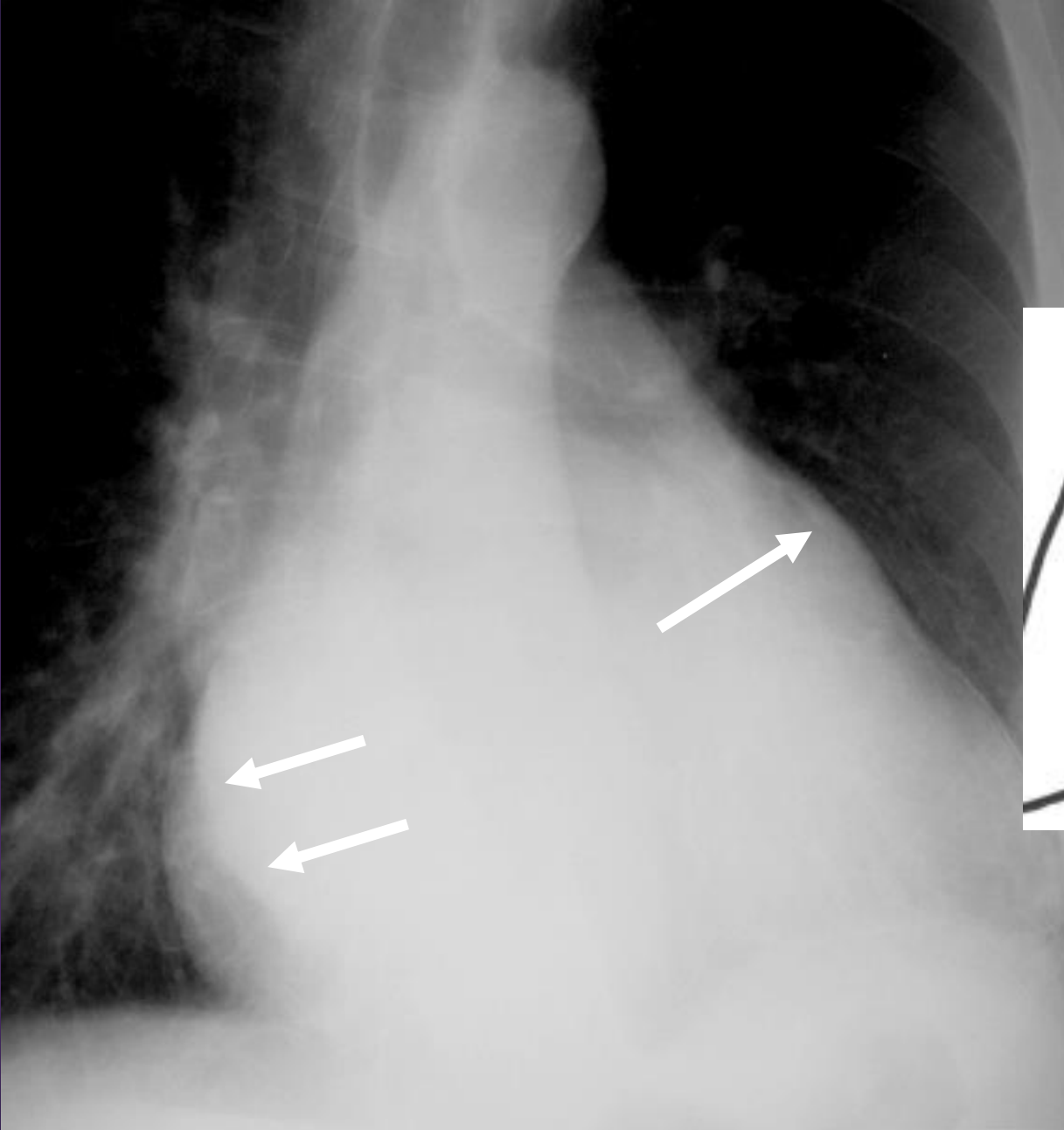
***Enlarged
Right Ventricle***



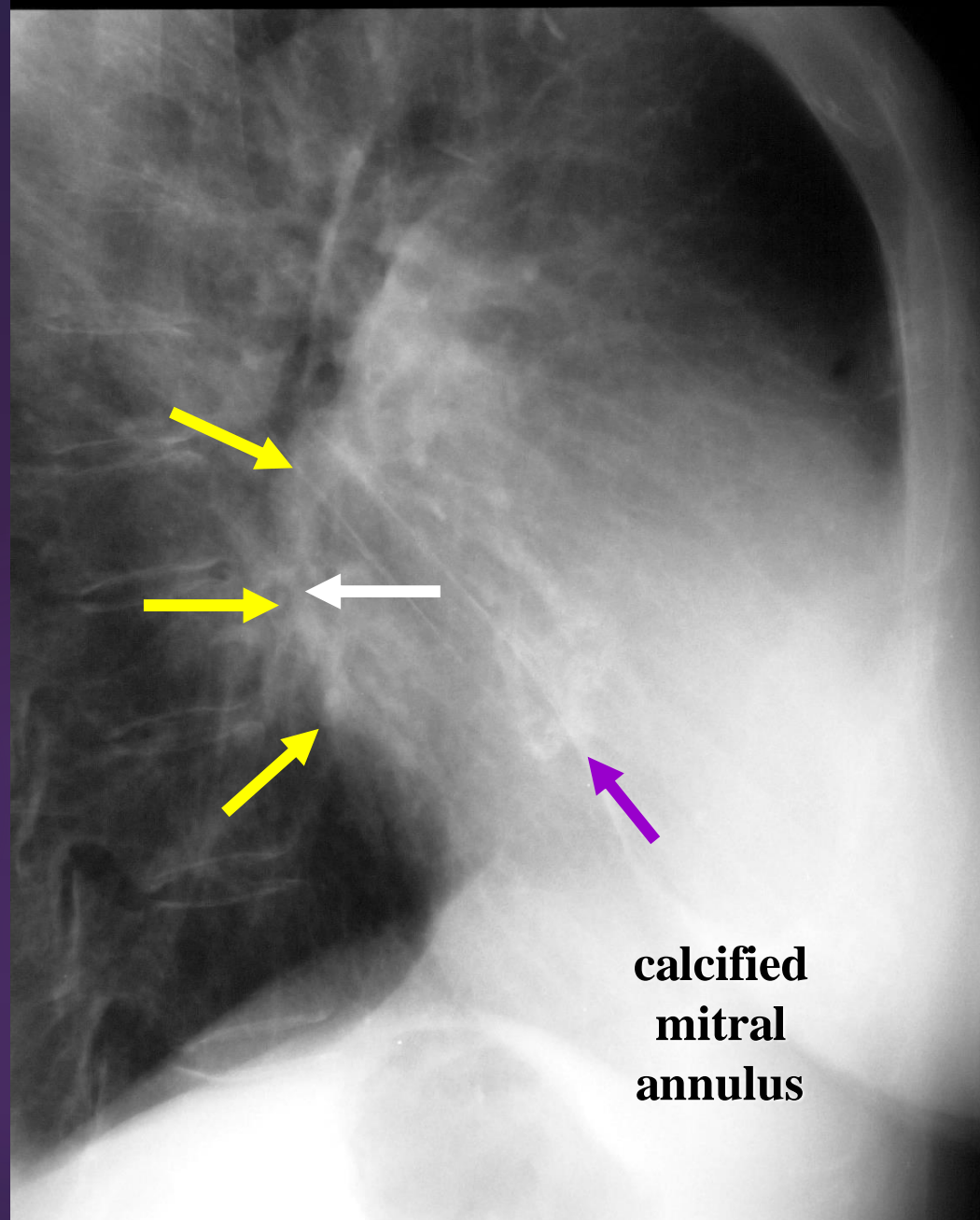
***Enlarged
Right Ventricle
(lateral CXR)***



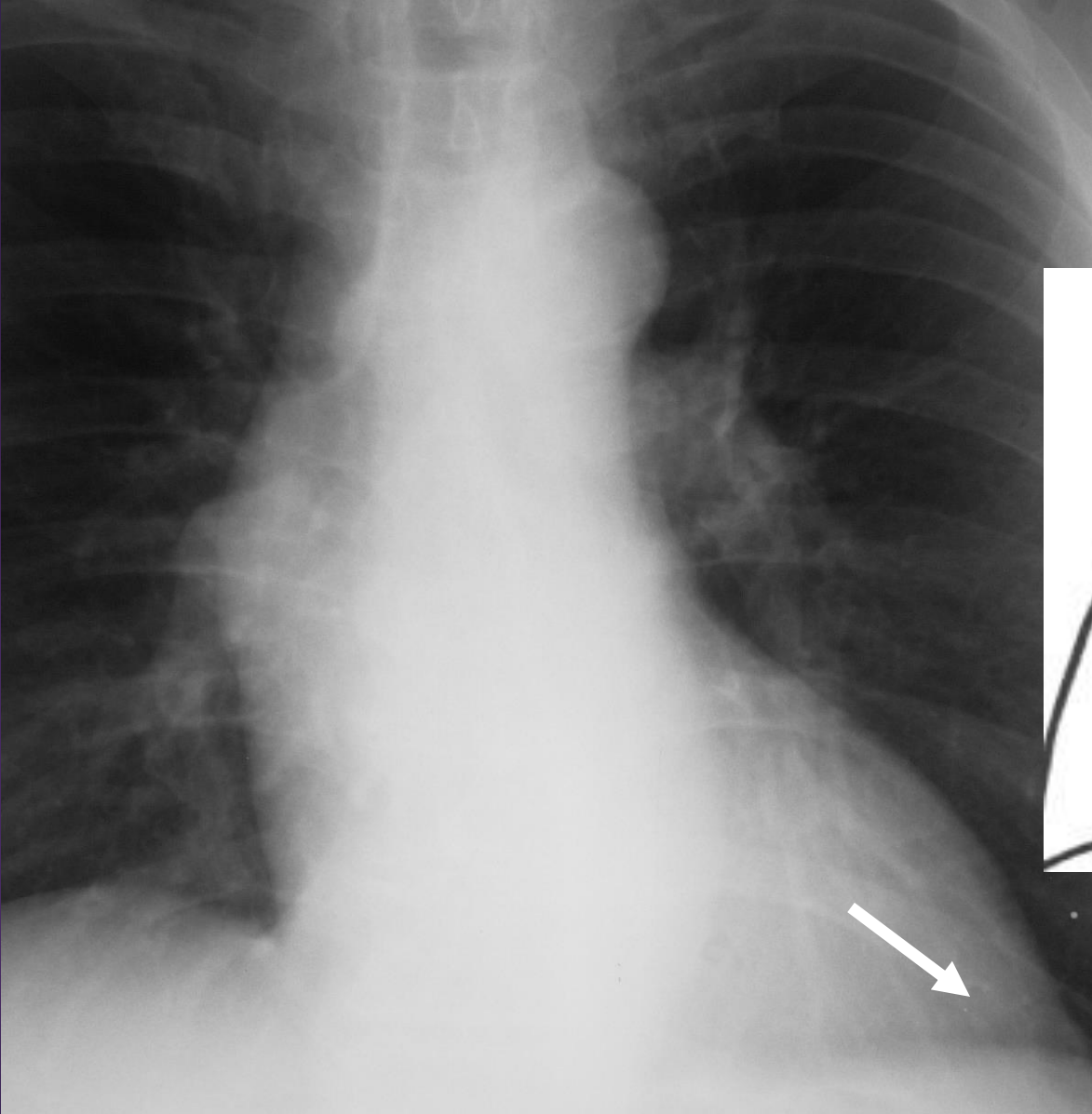
***Enlarged
Left Atrium***



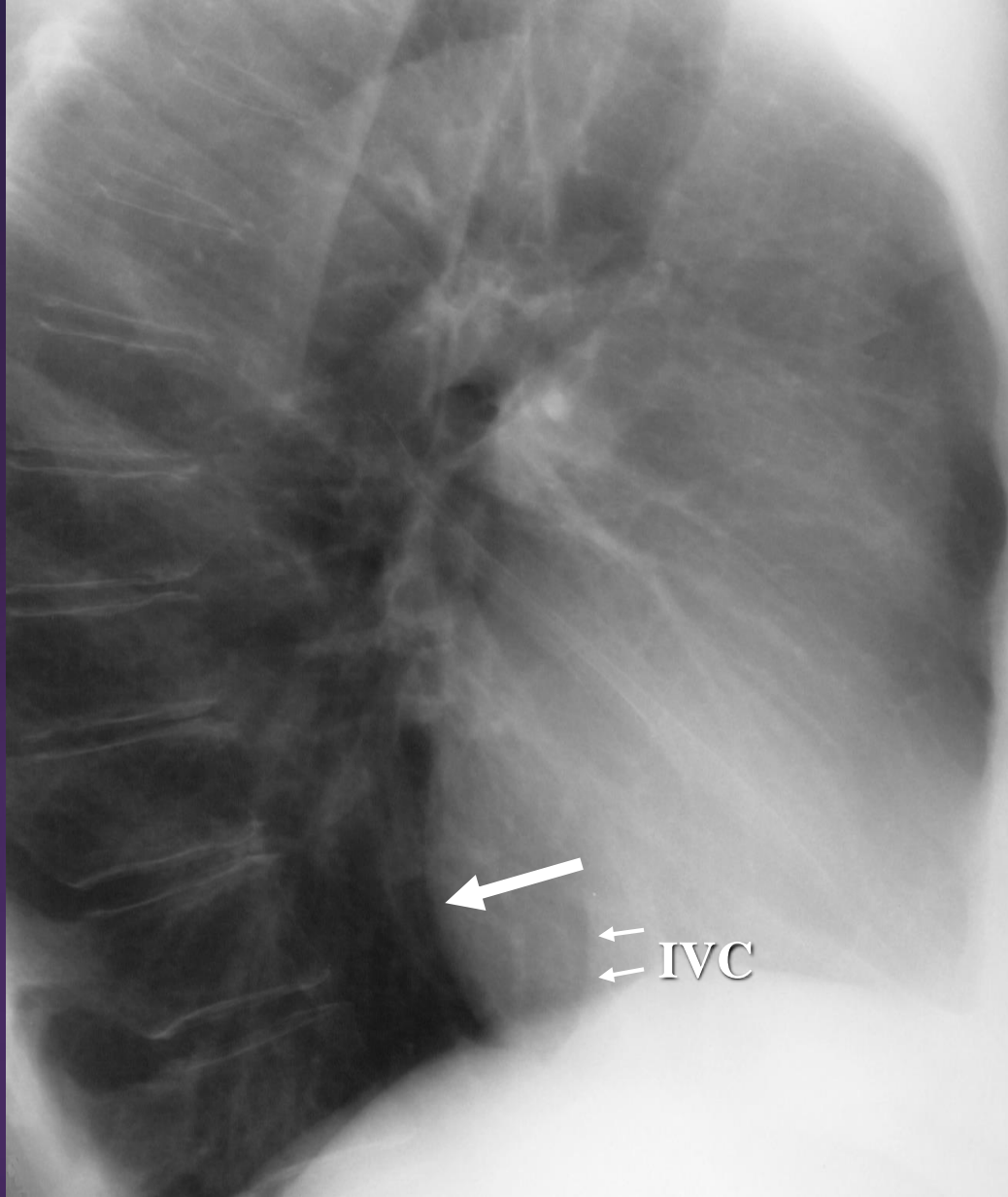
Enlarged Left Atrium



***Enlarged
Left Ventricle***



Enlarged Left Ventricle



Global heart enlargements

- Pericarditis
 - Cardiomyopathy
 - Heart failure
-
- CXR
 - PA view increase C/T ratio
 - Lat. decrease in size of retrocardiac & retrosternal spaces , backward displacement of esophagus
 -

Chest X-Ray

systematic
approach

Inside-Out approach

- Heart
- Mediastinum + Hili
- Lungs
- Thoracic wall
- Abdomen



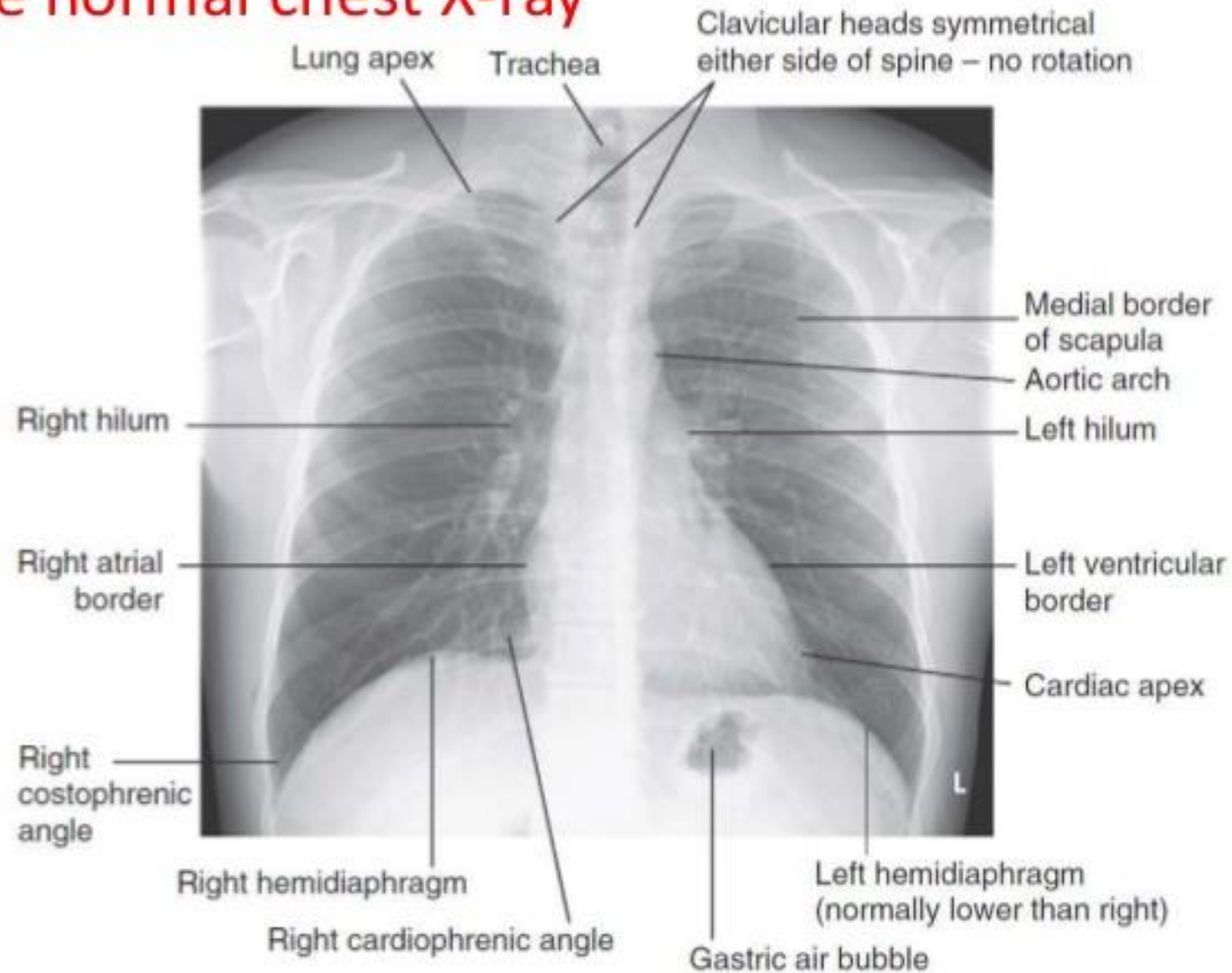
Abnormality

Pattern

Diff diagnosis



The normal chest X-ray



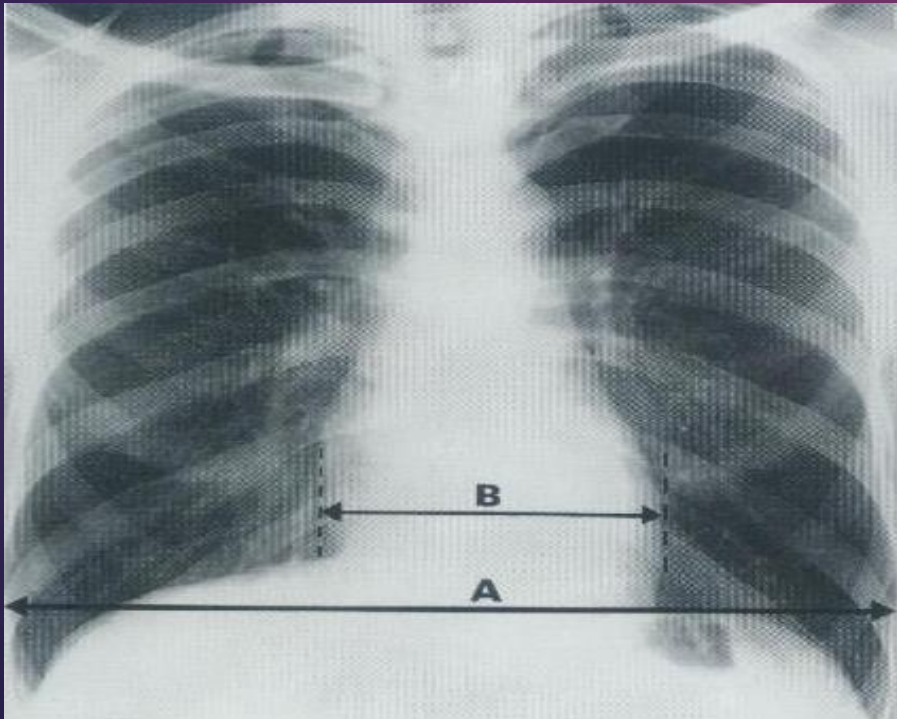
Heart Diseases

* Evidence of heart diseases is given by :

- 1- Size & shape of the heart.
- 2- Pulmonary vessels, which provide information about the blood flow.
- 3- The lungs, which may show pulmonary edema.

1- Heart size :

* Cardio - Thoracic Ratio (CTR), is the maximum transverse diameter of the heart divided by the maximum thoracic diameter, in adult CTR < 50% while in children CTR < 60%.



Size and shape

- ▶ The cardiac silhouette is considered enlarged if the cardiothoracic ratio is greater than 50% on a PA view of the chest.
- ▶ The shape of the cardiac silhouette can be used as clues to the underlying disease. For example :
 - ▶ a "water bottle" configuration occurs with pericardial effusion or generalized cardiomyopathy
 - ▶ left ventricular or "Shmoo" configuration describes lengthening and rounding of the left heart border with a downward extension of the apex resulting from left ventricular enlargement
 - ▶ "straightening" of the left heart border is seen with rheumatic heart disease and mitral stenosis

1- Heart size :

- * Comparing with previous films chest-x-ray films is often more useful.
- The transverse cardiac diameter varies with the phase of respiration & with cardiac cycle, so if the change in the cardiac size is < 1.5 cm; this is negligible because the heart size is affected by breathing & cardiac cycle.
- * Overall increase in the heart size means :
 - Dilatation of more than one cardiac chamber.
 - Pericardial effusion.

2- Chamber hypertrophy & dilatation :

a) Plain X-ray films :

*** Pressure overload (as in : Hypertension, Aortic Stenosis, Pulmonary Stenosis), this will lead to ventricular wall hypertrophy, & such change will produce little change in the external contour of the heart, until the ventricle fails.**

a) Plain X-ray films :

*** Volume overload (as in : Mitral Incompetence, Aortic Incompetence, Pulmonary Incompetence, Lt. to Rt. Shunt, & Damage of the heart muscle), this will lead to dilatation of the relevant ventricle, & this will cause an overall increase in the size of the heart (increase in the transverse cardiac diameter).**

*** Because enlargement of one ventricle affects the shape of the other, so it is only occasionally possible to get the classical feature Lt. or Rt. Ventricular enlargement.**

a) Plain X-ray films :

- Lt. Ventricular enlargement, the cardiac apex is displaced downward & laterally.**

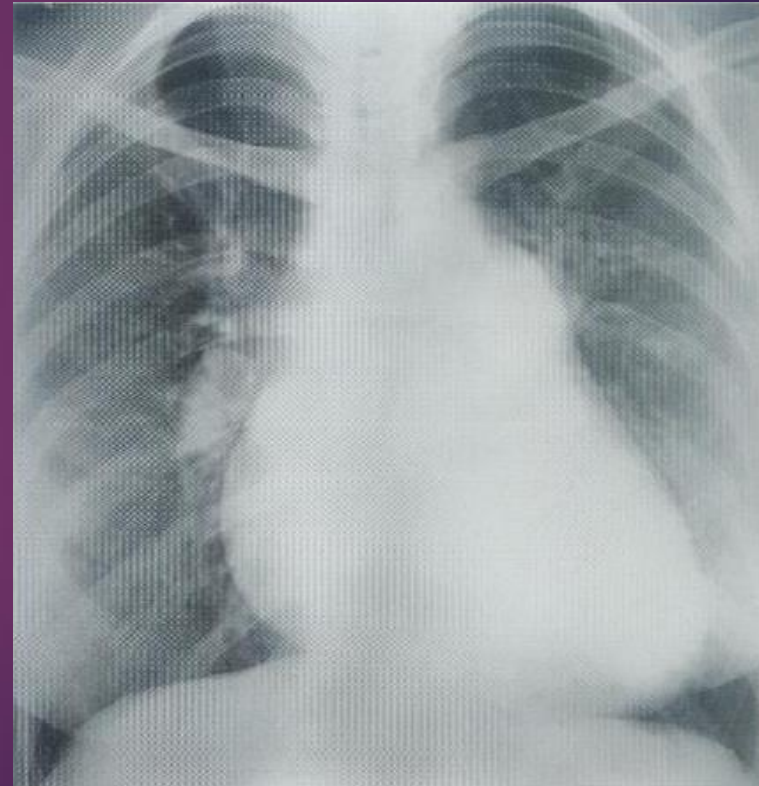
**Lt. Ventricular enlargement
in a patient with Aortic
Incompetence**



a) Plain X-ray films :

- **Rt. Ventricular enlargement**, the cardiac apex is displaced upward (to the Lt. of diaphragm).

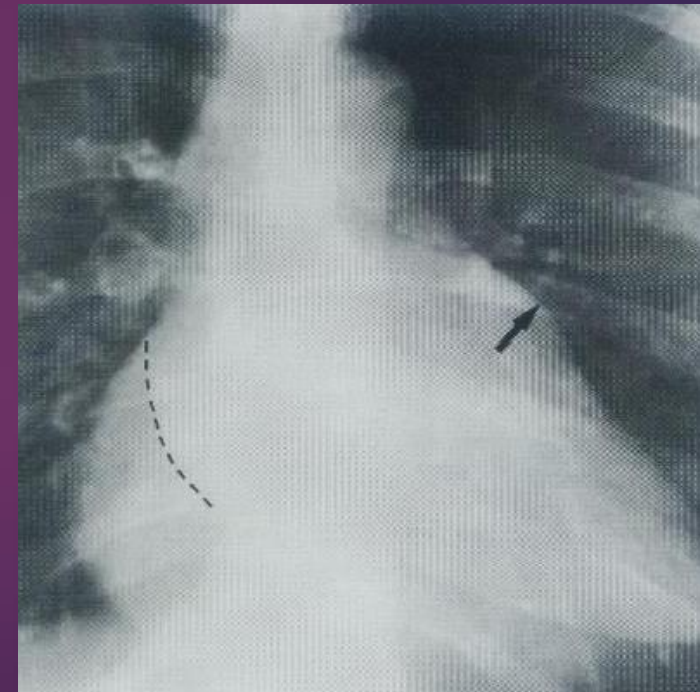
Rt. Ventricular enlargement in a patient with Primary Pulmonary Hypertension



Lt. Atrial Enlargement :

- * When it produces Double Contour, the Rt. border of the enlarged Lt. atrium is seen adjacent to the Rt. Cardiac border within the main cardiac shadow.

Lt. Atrial Enlargement in a patient with Mitral Valve Disease showing the “Double Contour Sign”



Lt. Atrial Appendage : Bulge below the main pulmonary artery (MPA) on PA-view.

Rt. Atrial Enlargement

- * Will produce an increase of the Rt. cardiac border, & often accompanied by enlargement of Superior Vena Cava (SVC).

Valve movement deformity & calcification

Plain X-ray films :

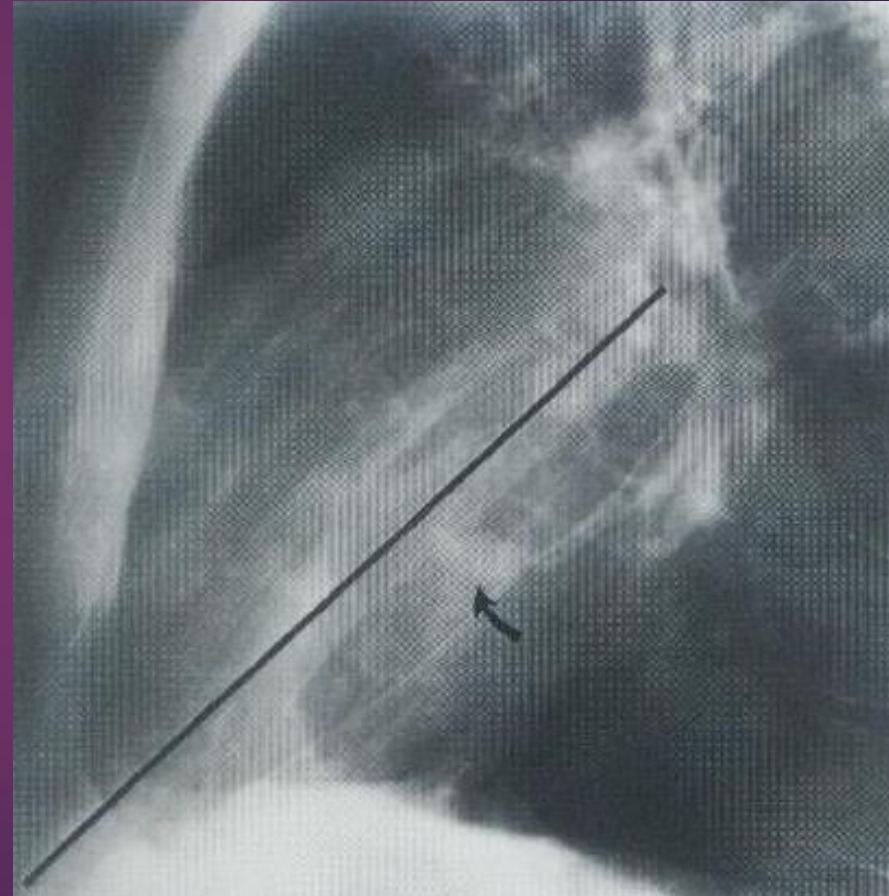
- * Calcification is the only information could be obtained directly related to the morphology of the valve.
- * Calcification is better seen by fluoroscopy.
- * It occurs in mitral valve &/or aortic valve in rheumatic heart diseases; & if it occurs in aortic valve alone (especially in adults) it is mainly congenital aortic stenosis.

Plain X-ray films :

- * It is the easiest & the best to see calcification by the lateral view by drawing a line from the junction of the diaphragm & the sternum to the Lt. main bronchus, so :
 - If the calcification is below & behind, means mitral valve.
 - If the calcification is above & in front, means aortic valve.
- * If the line dissects the calcification, both valves (mitral & aortic) are calcified.
- * Calcification of the mitral valve ring + elderly patient is occasionally seen in mitral regurgitation.

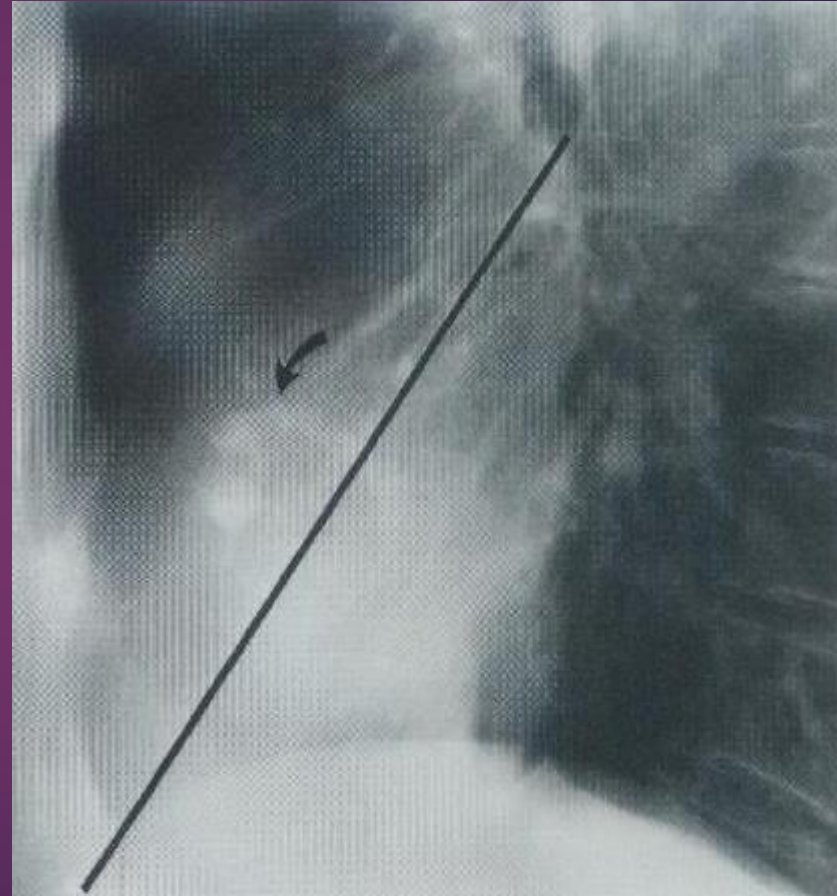
Valve calcifications

**Mitral Valve
Calcifications**



Valve calcifications

**Aortic Valve
Calcifications**



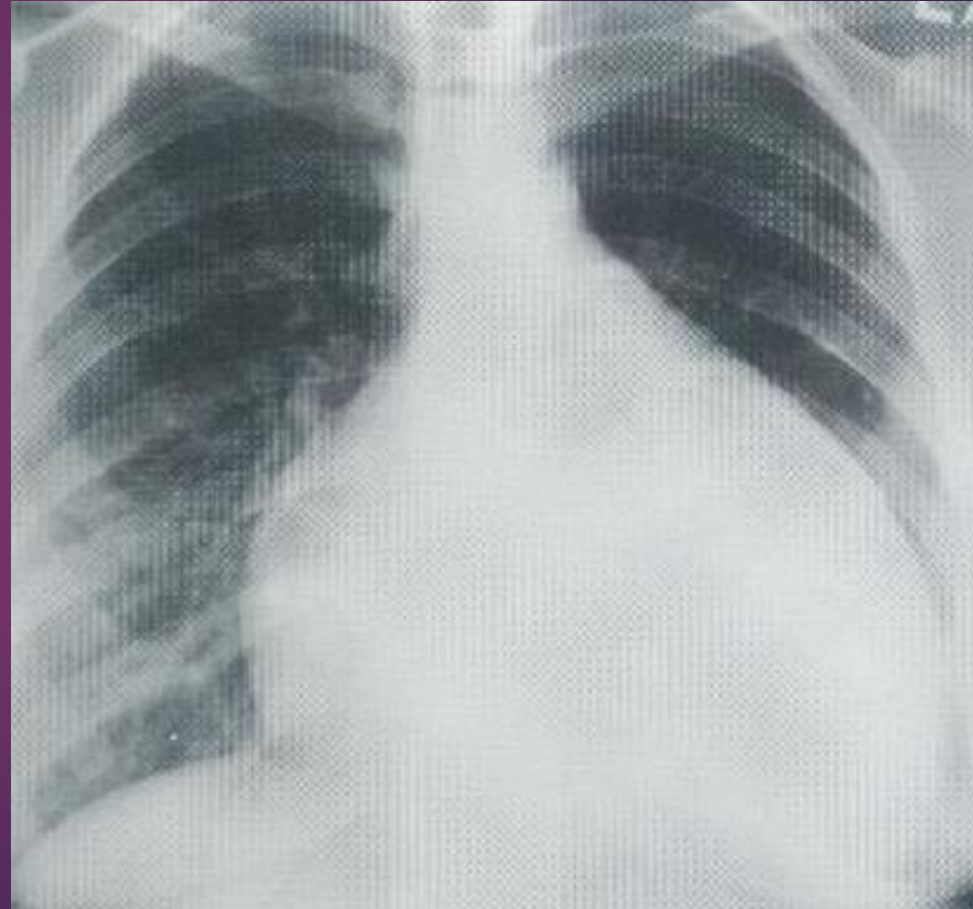
Pericardial Diseases

- * 20 – 50 ml of pericardial fluid is diagnosed by echo.**
- * Needle aspiration is needed to insure the nature of the fluid.**
- * CT scan & MRI can show the pericardial effusion; but more important is to measure the thickness of the pericardium where thickness of the pericardium by echo. is poor.**
- * Unusual to diagnose pericardial effusion by plain-X-ray because the patient may have pericardial effusion to cause a life-threatening tamponade; but only mild heart enlargement with otherwise normal contour.**

- * **Marked increase or decrease in the transverse diameter of the cardiac shadow within one or two weeks + No pulmonary edema is virtually diagnostic of pericardial effusion.**
- * **Marked increase in the cardiac size + no specific chamber + normal pulmonary vasculature (flask shape) (& the outline of the heart become very sharp) is diagnostic of pericardial effusion.**
- * **Pericardial calcification is seen in 50% of patient within constrictive pericarditis, which is usually due to TB or Coxsackie's virus infection.**
- * **Best seen on lateral CXR, along the anterior & inferior surface, & it may possible on frontal CXR.**
- * **Usually the calcification is an important sign for constrictive pericarditis.**

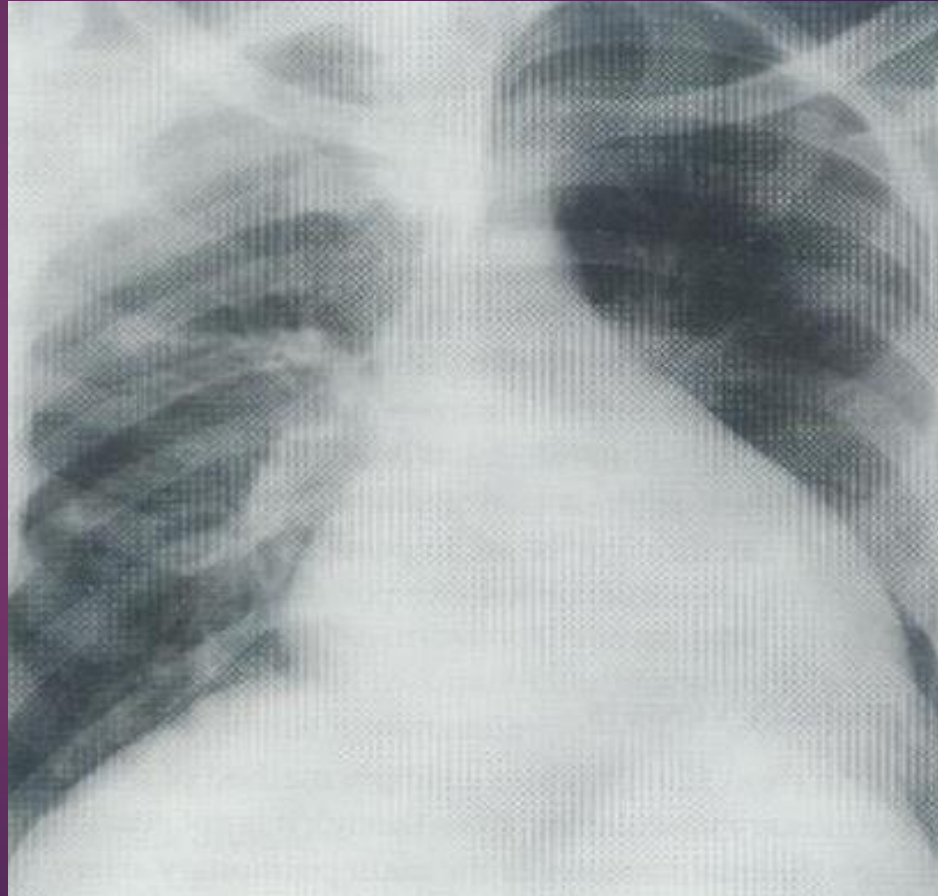
Pericardial Effusion

**Pericardial Effusion due to Viral
Pericarditis**

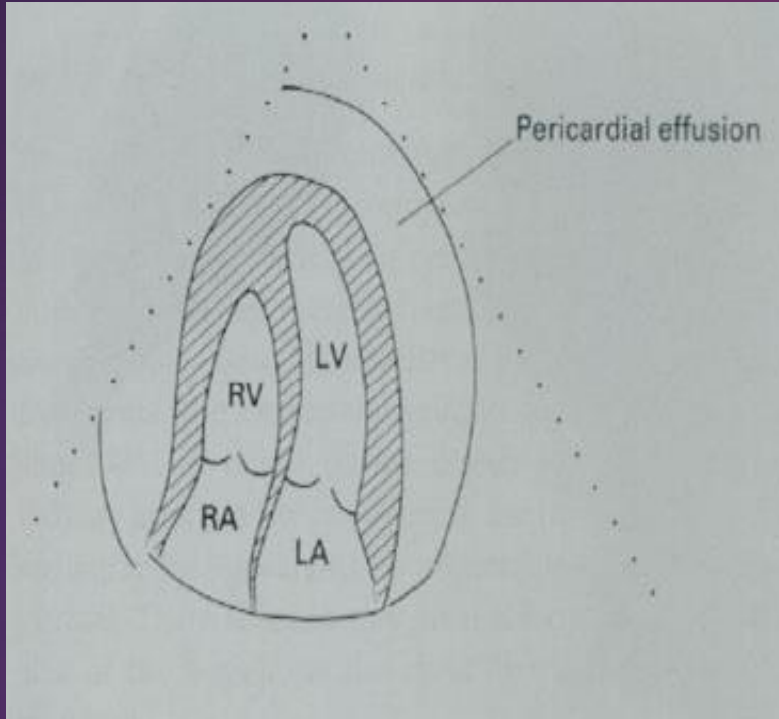


Pericardial Effusion

**Congestive Cardiomyopathy,
this appearance usually
confused with Pericardial
Effusion**

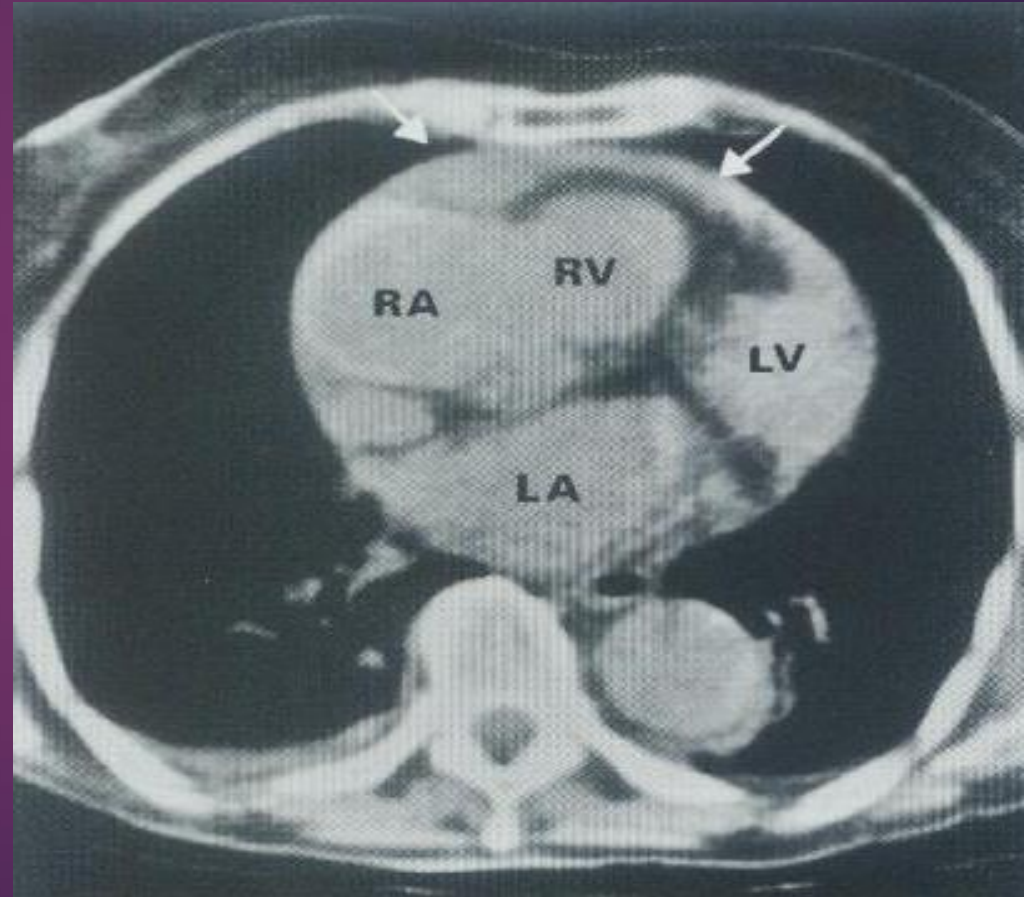


Pericardial Effusion



**Large Pericardial Effusion
on an apical 4-chamber
view echocardiogram**

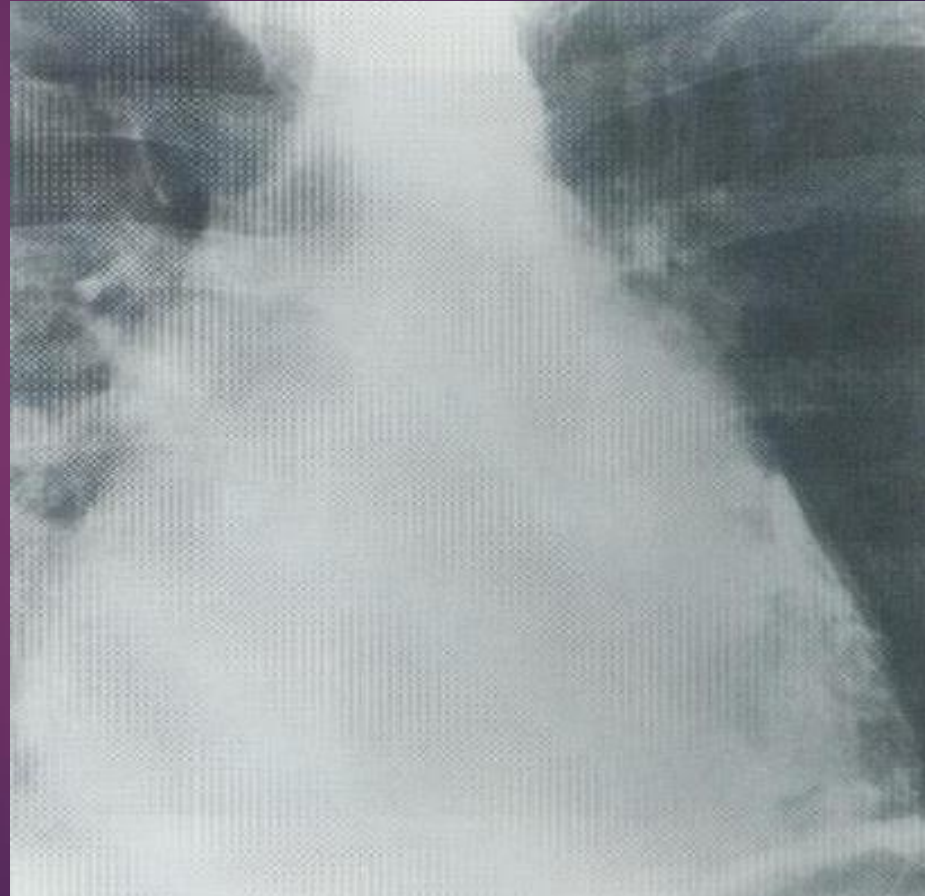
Pericardial Effusion



CT-scan shows fluid density (arrows) in the Pericardium

Pericardial Calcifications

**Pericardial Calcification in a
patient with Severe Constrictive
Pericarditis**



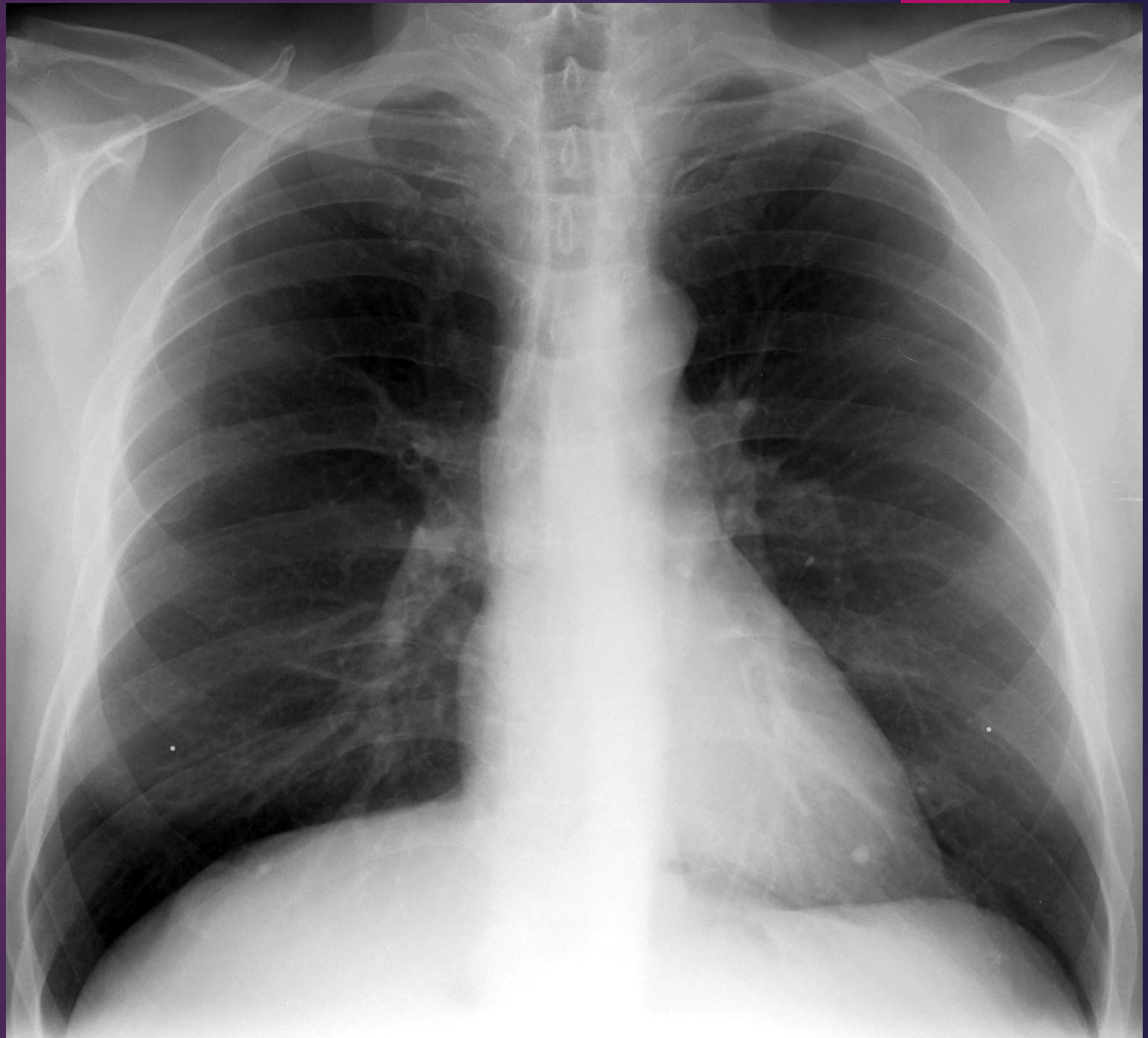
Pericardial Calcifications

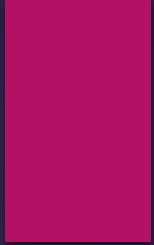
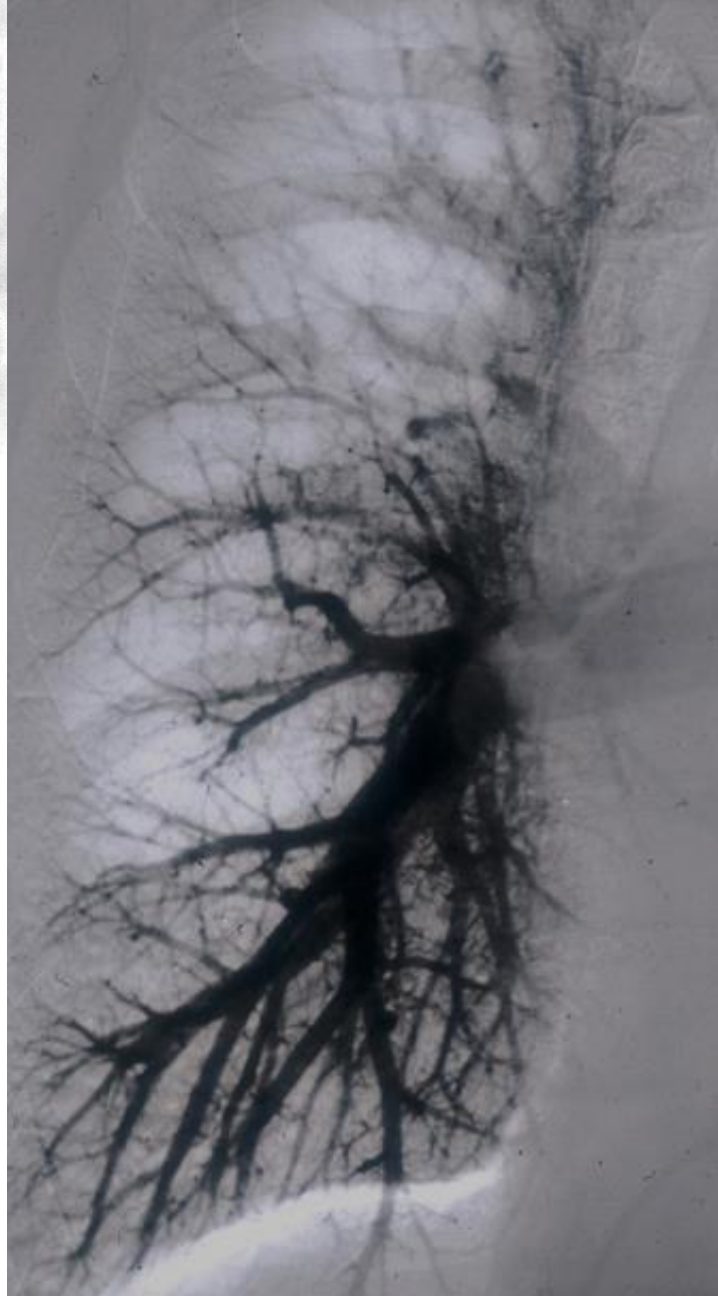
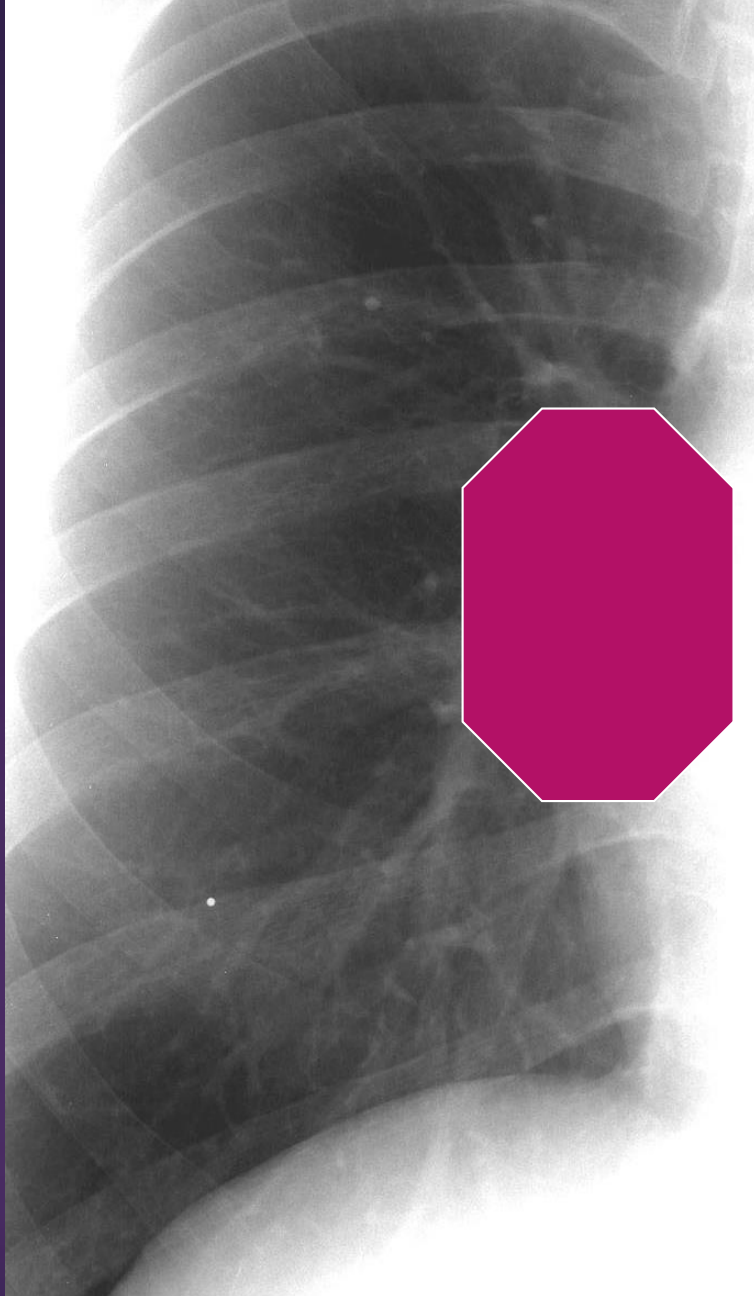
**Pericardial Calcification in a
patient with Severe Constrictive
Pericarditis**



Pulmonary Blood Flow

NORMAL FLOW PATTERN





Pulmonary vascular pattern

1. **Normal**
2. **Increase pul. blood flow(pulmonary plethora). Due to Lt.-Rt shunt**
3. **decrease pul. blood flow(pulmonary oligemia). Ex. TOF**
4. **Pul. Venous hypertension .**
 - ▶ upper zone vessels equal or enlarge than lower zone vessels
 - ▶ Pulmonary edema.

5. **Pul. arterial hypertension”**

Causes:

Core pulmonale

Pul. Emboli

Mitral valve disease, or LT.-RT shunt.

idiopathic

Features:

enlargement of pulmonary A.& hilar arteries

Normal

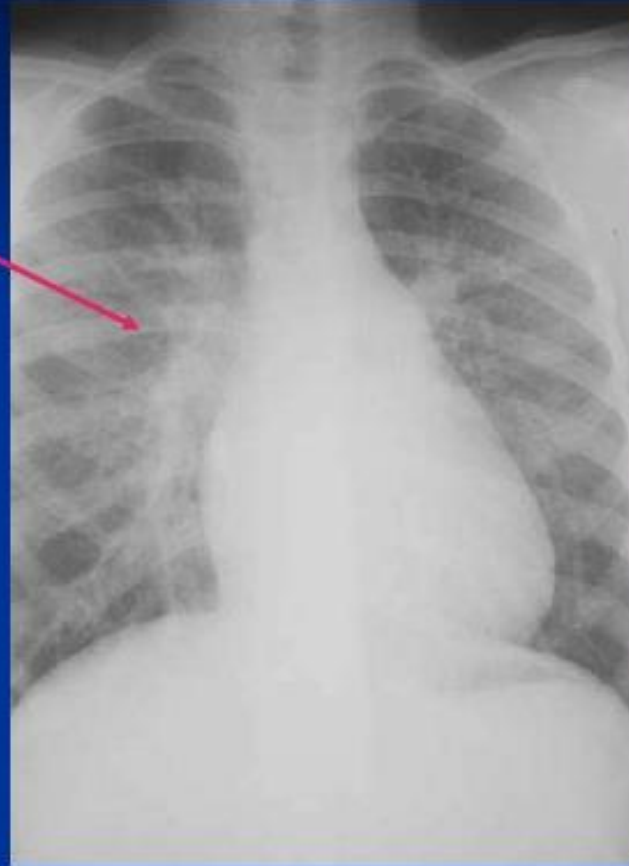


Increased Flow



Increased Flow

RDPA usually
> 17 mm



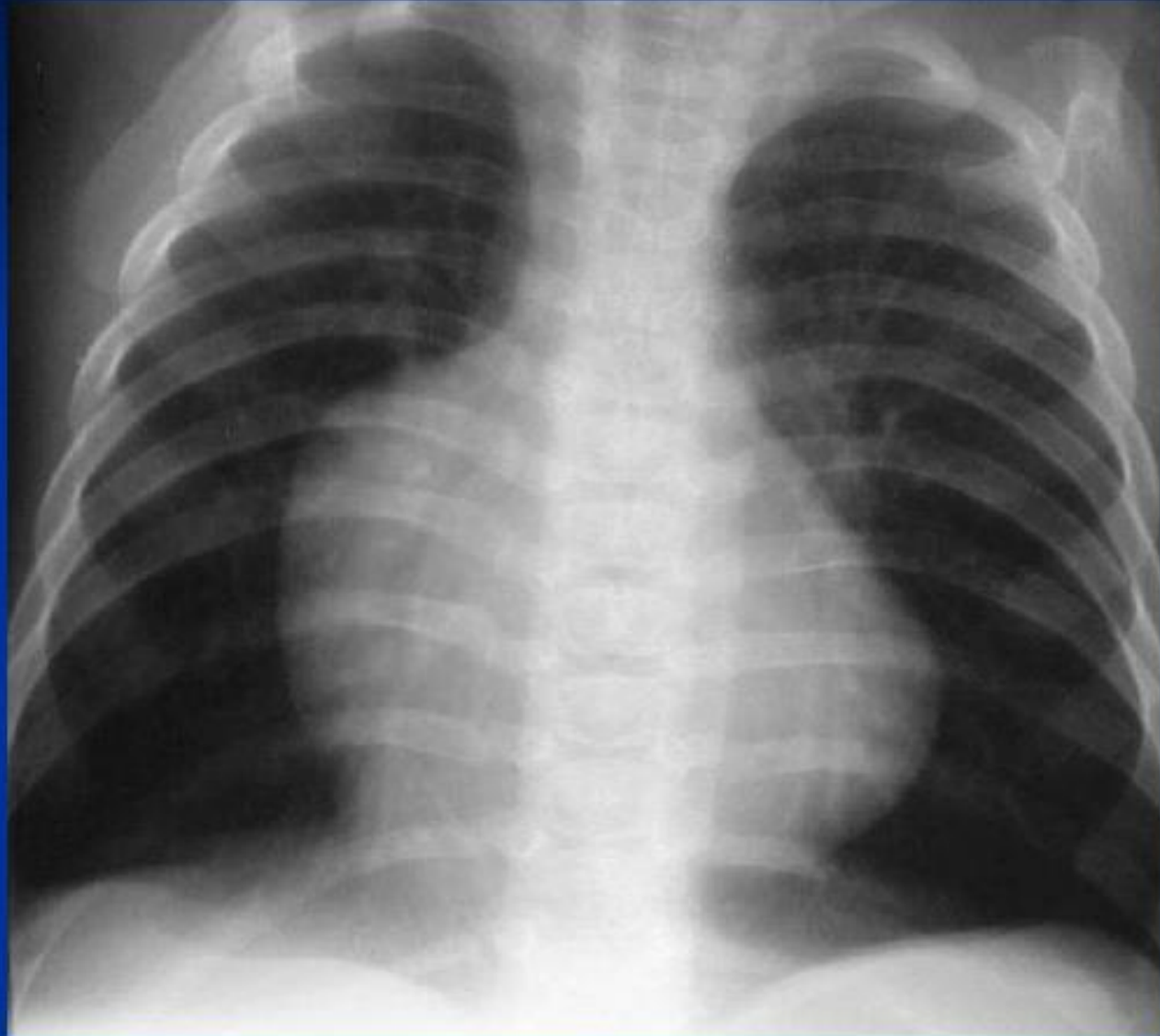
All of blood vessels everywhere in
lung are bigger than normal

Decreased Flow

Unrecognizable
most of the
time

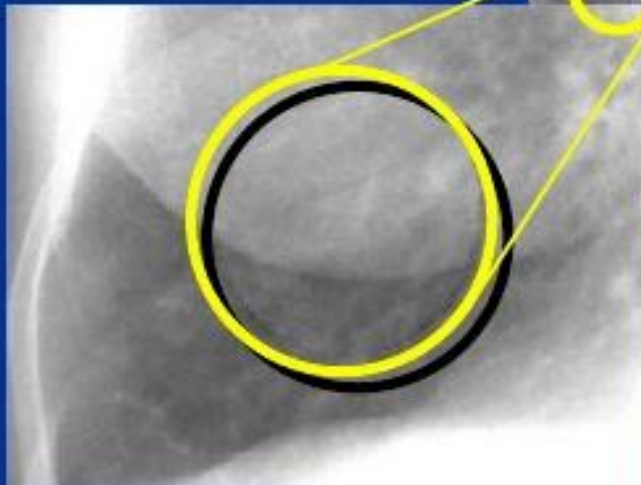
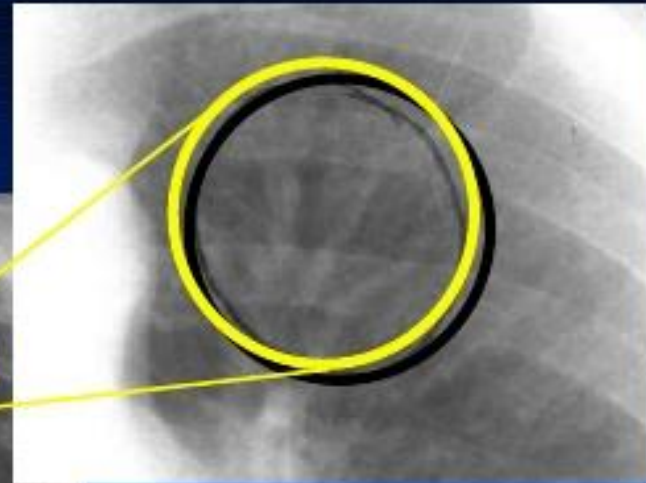
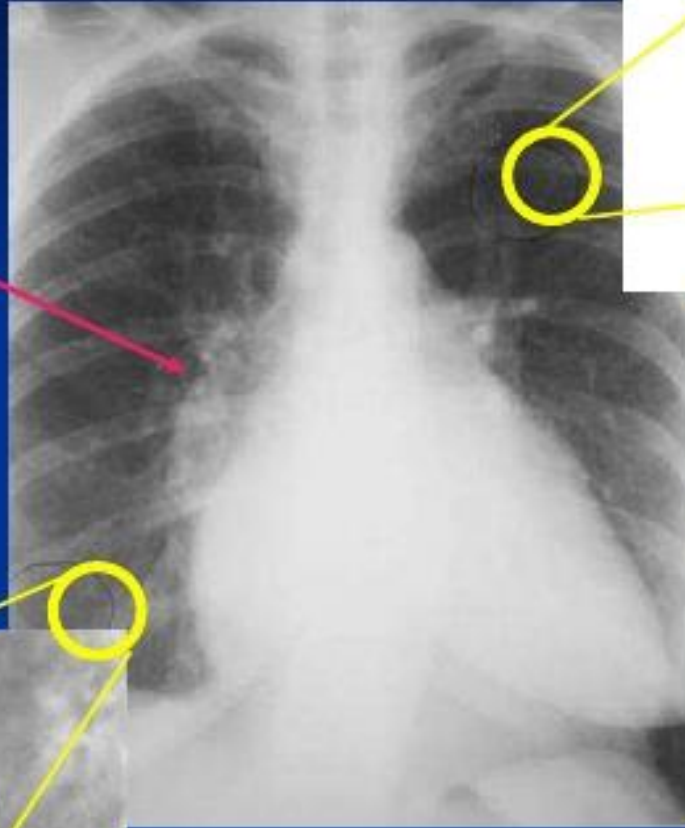
Small hila

Fewer than
normal blood
vessels



Venous Hypertension

RDPA usually
> 17 mm



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

Pulmonary Vessels

- * It is not possible to measure the diameter of the MPA from the plain film (usually subjective); but if there are variable degrees of bulging, means enlarged MPA.
- * Assessment of the hilar pulmonary arteries is more objective & the diameter of the Rt. lower lobe artery at its mid-point (normally 9 – 16 mm).
- * The size of pulmonary vessels with the lung reflects the pulmonary blood flow.
- * Increase pulmonary blood flow is seen in ASD, VSD, & PDA, & all of these will lead to Systemic to Pulmonary (Lt. to Rt. shunt) & these will to increase pulmonary blood flow.

Pulmonary Vessels

- * Hemodynamically significant Lt. to Rt. shunt is (2/1 ratio or more) & this will produce CXR findings; if less ratio there will be no CXR findings & all the pulmonary vessels will (from the MPA to the periphery of the lung) will be enlarged, & this is called "Pulmonary Plethora".
- * There is good correlation between the size of the vessel on CXR & degree of the shunt.
- * Decrease pulmonary blood flow, all the vessels are small "Pulmonary Oligemia".
- * The commonest cause of decrease pulmonary blood flow is TOF & pulmonary stenosis.

Pulmonary Vessels

- * Obstruction of the Rt. ventricle outflow + VSD will lead to Rt. to Lt. shunt.**
- * Pulmonary stenosis will cause oligemia only in severe cases & babies or very young children.**

Pulmonary Arterial Hypertension

*** The pressure in the pulmonary artery depends on :**

1- Cardiac output.

2- Pulmonary vascular resistance.

Pulmonary Arterial Hypertension

*** Conditions that cause significant pulmonary arterial hypertension all increase the resistance of blood flow through the lungs, examples :**

- 1- Various lung diseases (cor pulmonale).**
- 2- Pulmonary embolism.**
- 3- Pulmonary arterial narrowing in response to mitral valve diseases or Lt. to Rt. shunt.**
- 4- Idiopathic pulmonary hypertension.**

Pulmonary Arterial Hypertension

- * By CXR :

There will be enlargement of the main pulmonary artery + the hilar pulmonary artery, vessels within the lung tissue are normal or small.

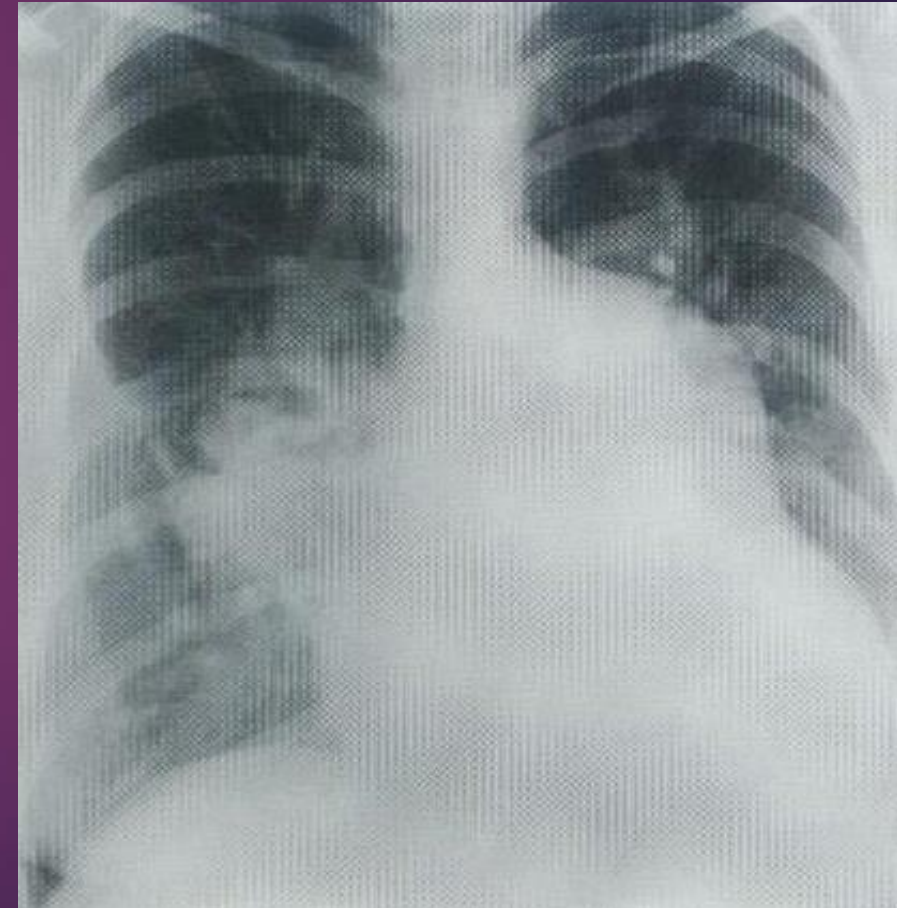
- * Eisenmenger's syndrome :

Greatly raised pulmonary artery resistance in association with ASD, VSD, & PDA leading to reverse shunt (i.e. : Rt. to Lt. shunt).

Pulmonary Arterial Hypertension

*** The cause of pulmonary arterial hypertension may be visible on the CXR as cor pulmonale & mitral valve diseases.**

**Pulmonary Arterial Hypertension
due to ASD & Eisenmenger's
syndrome**



Pulmonary Venous Hypertension

- * The commonest causes of pulmonary venous hypertension are :
 - 1- Mitral valve diseases.
 - 2- Lt. ventricular failure.
- * In normal upright person (by CXR) the lower zone vessels are larger than the upper zone.
- * In pulmonary venous hypertension the upper zone vessels are enlarged.
- * In severe cases, the upper zone vessels become larger than that of the lower zone, & eventually Pulmonary Edema will supervene & may obscure the blood vessels.

Pulmonary Venous Hypertension

**Pulmonary Venous Hypertension
in a patient with Mitral Valve
Disease**



Aorta

*** Aortic dilatation of the ascending aorta is due to :**

- 1- Aneurysm.**
- 2- Aortic regurgitation or aortic stenosis.**
- 3- Systemic hypertension.**

*** The two common causes of descending aortic aneurysm are :**

- 1- Atheroma.**
- 2- Aortic dissection. (Also, there is a rare cause as previous trauma following decelerating injury).**

Aorta

* By CXR :

- 1- The diagnosis of aortic aneurysm may be obvious, but substantial dilatation may be needed before the bulge of Rt. mediastinal border can be recognized.
- 2- Atheromatous aneurysm invariably shows calcification of their walls.

Note :

- * CT scan with IVCM or CT angiography or MRA are very useful to assess the aneurysm.

IVCM = I.V. Contrast Media.
MRA = Magnetic Resonance Angiography.

Aortic aneurysm

- Normal aortic dimensions
 1. Ascending=5cm
 2. Arch=4cm
 3. Descending=3cm
 4. Abdominal =2cm

Aneurysms are focal abnormal dilatation of a blood vessel. They typically occur in arteries, venous aneurysms are rare. Aneurysms may also occur in the heart. Pathological types: true aneurysm and false aneurysm (or pseudoaneurysm)

Causes

- ◉ congenital
- ◉ atherosclerosis
- ◉ hypertension
- ◉ vasculitis
- ◉ hereditary connective tissue disorders
- ◉ Marfan syndrome
- ◉ Ehlers-Danlos syndrome
- ◉ fibromuscular dysplasia
- ◉ infection: mycotic aneurysm, syphilis (luetic aneurysm)
- ◉ trauma
- ◉ iatrogenic
- ◉ myocardial infarction: may cause left ventricular aneurysm
- ◉ flow related (in cerebral AVM, contralateral ICA occlusion etc)

Morphology:

- ◉ saccular aneurysm: eccentric, involving only a portion of the circumference of the vessel wall
- ◉ fusiform aneurysm: concentric, involving full circumference of the vessel wall

Complications

- ◉ rupture
- ◉ distal thromboembolism
- ◉ pressure effects

Dissecting Aortic Aneurysm

It is important to know the extent of the dissecting aneurysm as those involving the ascending aorta are treated surgically & those confined to the descending aorta are treated with hypotensive drugs.

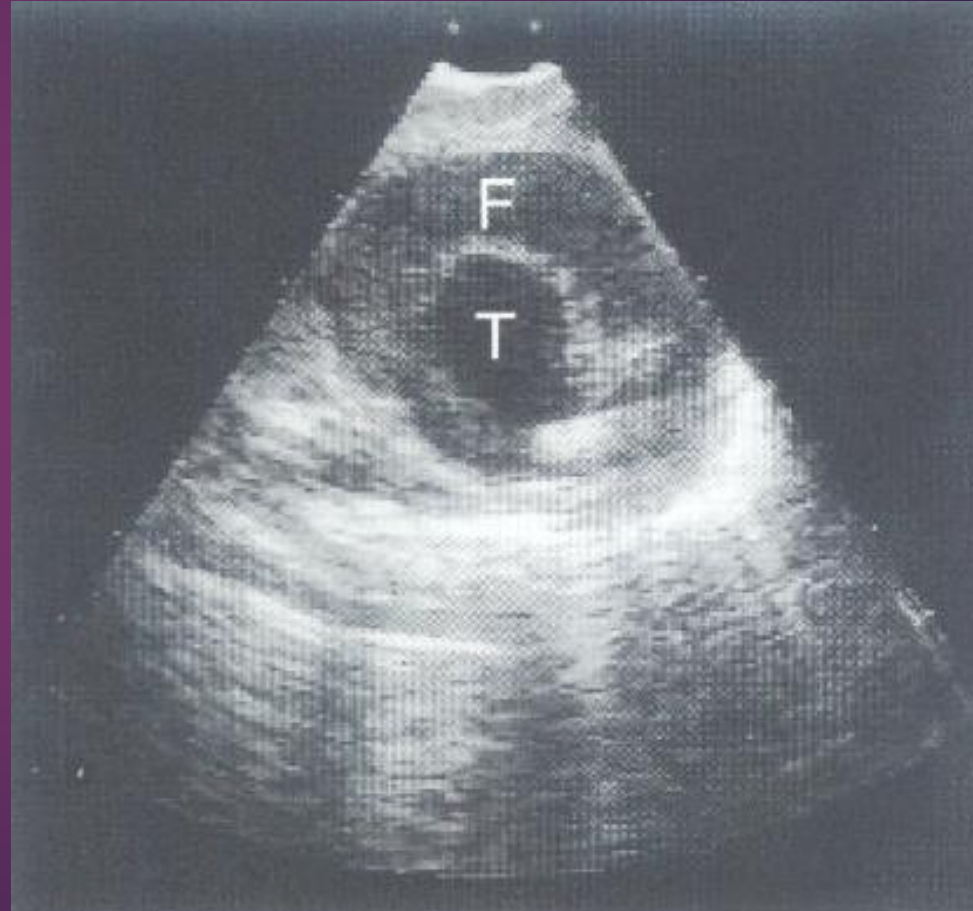
* By CXR :

Two congenital aortic anomalies can be seen, & they are :

- 1- Coarctation of Aorta.
- 2- Rt. sided aortic arch, in association with TOF, Pulmonary Atresia, & Truncus Arteriosus, or it also can be isolated with no clinical significance.

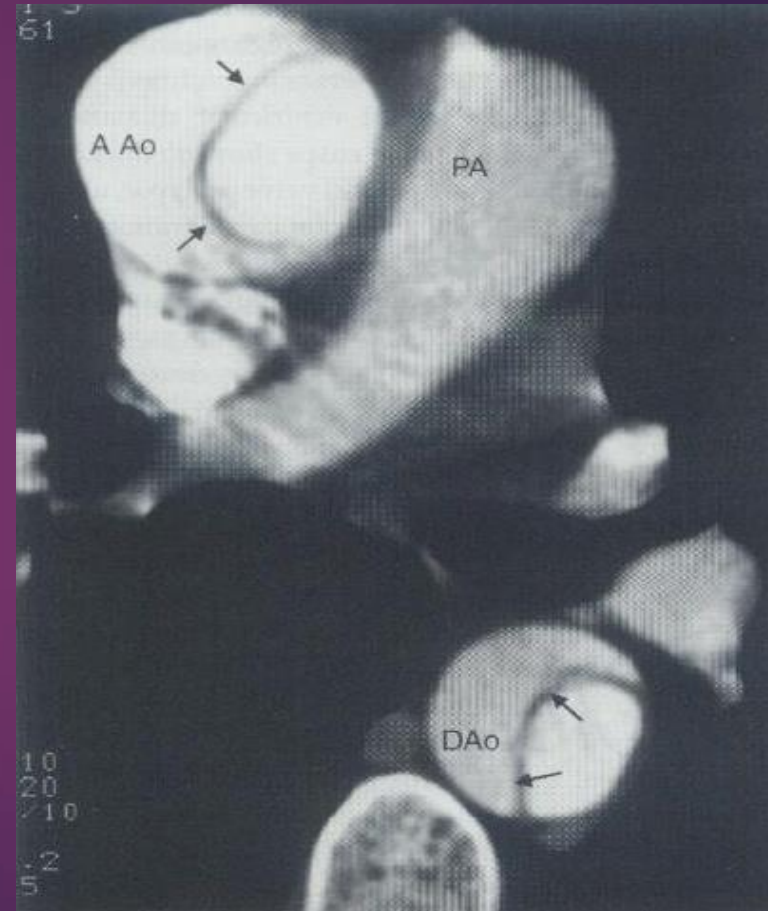
Dissecting Aortic Aneurysm

**Trans-Esophageal
Echocardiogram showing
the True (T) & False (F)
lumina in the descending
aorta**



Dissecting Aortic Aneurysm

CT-scan showing the displaced intima (arrows) separating the true & false luminae in the ascending & descending aorta



Heart failure

- ▶ Cardiac enlargement+/- selective chamber enlargement
- ▶ Increased pulmonary venous pressure (increase vascularity in upper lung zones)
- ▶ Pulmonary edema
- ▶ pleural effusion. usually bilateral RT. Larger than LT. but if unilateral its almost always Rt.side.

Heart Failure

* The plain X-ray findings include the followings :

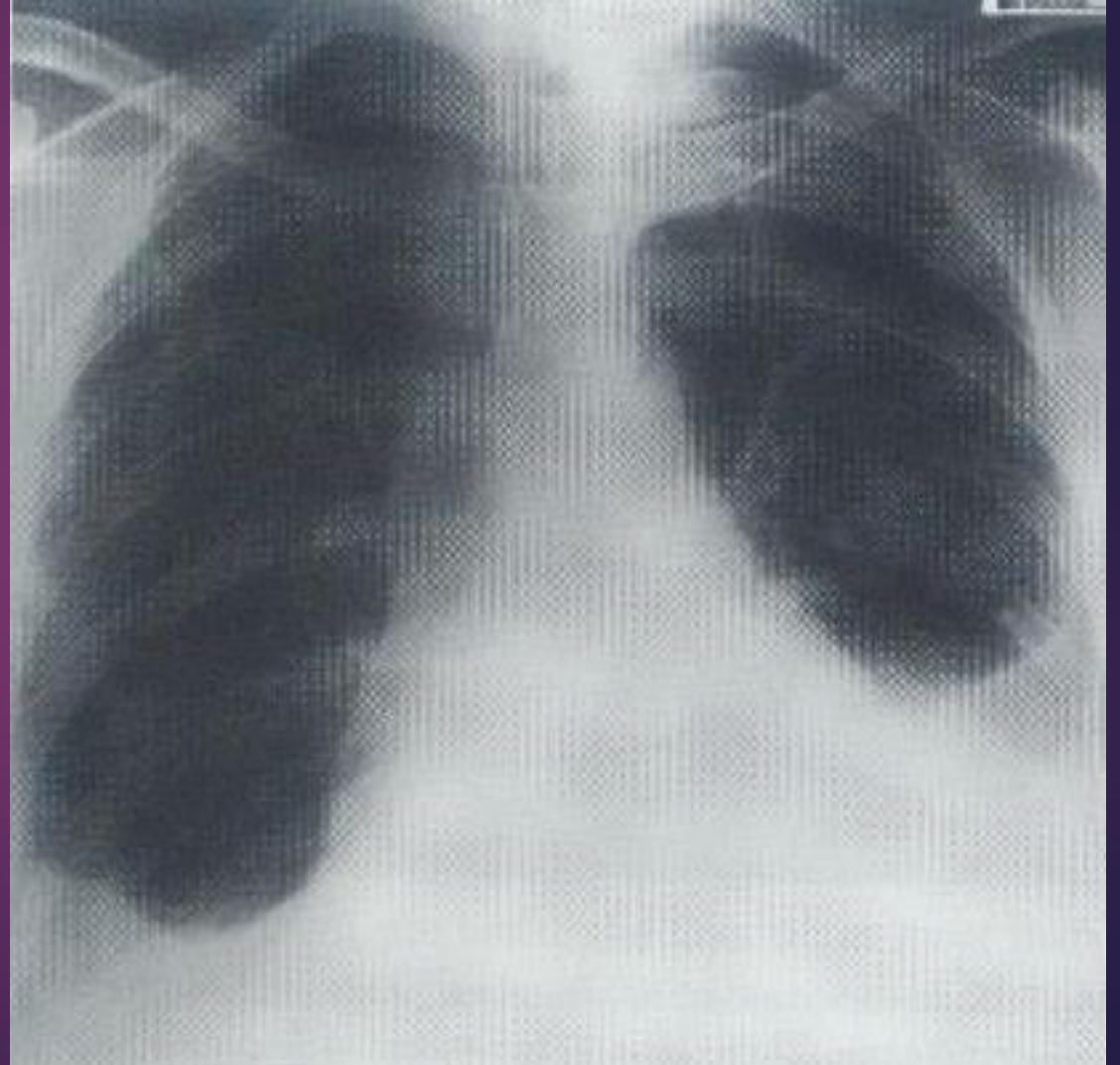
- a) Enlarged cardiac shadow +/- specific chamber enlargement.
- b) Evidence of pulmonary venous hypertension (enlargement of the vessels in the upper zone).
- c) Evidence of pulmonary edema.
- d) Pleural Effusion : It is usually bilateral, often larger on the Rt. than on the Lt. side; but if it is unilateral it is almost always on the Rt. side.

Note :

Acute Lt. ventricular failure, small effusion is seen at the costo-phrenic angle, running up the lateral chest wall; (this fluid may, in fact, be edema of the lungs rather than true pleural effusion).

Heart Failure

**Congestive Heart Failure with
bilateral Pleural Effusion**



Valvular Heart Diseases

Mitral Valve Diseases

They Include :

1- Mitral Stenosis (MS)

2- Mitral Regurgitation (MR)

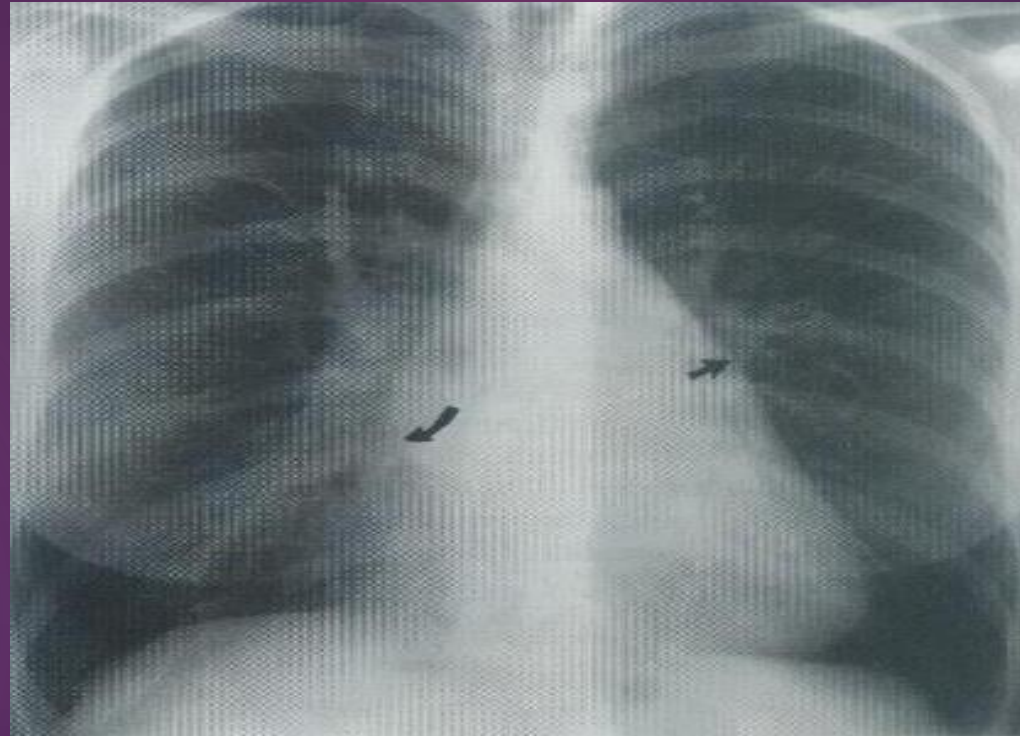
Mitral Stenosis (MS)

The pathophysiological findings are :

1) By CXR :

- * Lt. atrial enlargement + normal cardiac size.
 - * Mitral calcification.
 - * Pulmonary venous hypertension.
 - * Pulmonary edema.
-
- * Pulmonary arterial hypertension, will lead to enlarged cardiac size (Rt. ventricle is enlarged).

Mitral Stenosis (MS)



Plain X-ray of Mitral Stenosis, showing enlarged Lt. atrium as a double contour at the Rt. heart border (curved arrow), & enlarged Lt. atrial appendage (straight arrow)

Mitral Regurgitation (MR)

The pathophysiological findings are :

1) By CXR :

- * Lt. atrium & Lt. ventricle are enlarged, so cardiac size will be enlarged in its Lt. ventricular configuration.
- * Pulmonary venous hypertension.
- * Pulmonary edema.

Note :

Lt. atrial enlargement & pulmonary venous hypertension are the important signs of MR, which differs from MS by Lt. ventricular enlargement.

Valvular Heart Diseases

Aortic Valve Diseases

They Include :

1- Aortic Stenosis (AS)

2- Aortic Regurgitation (AR)

Aortic Stenosis (AS)

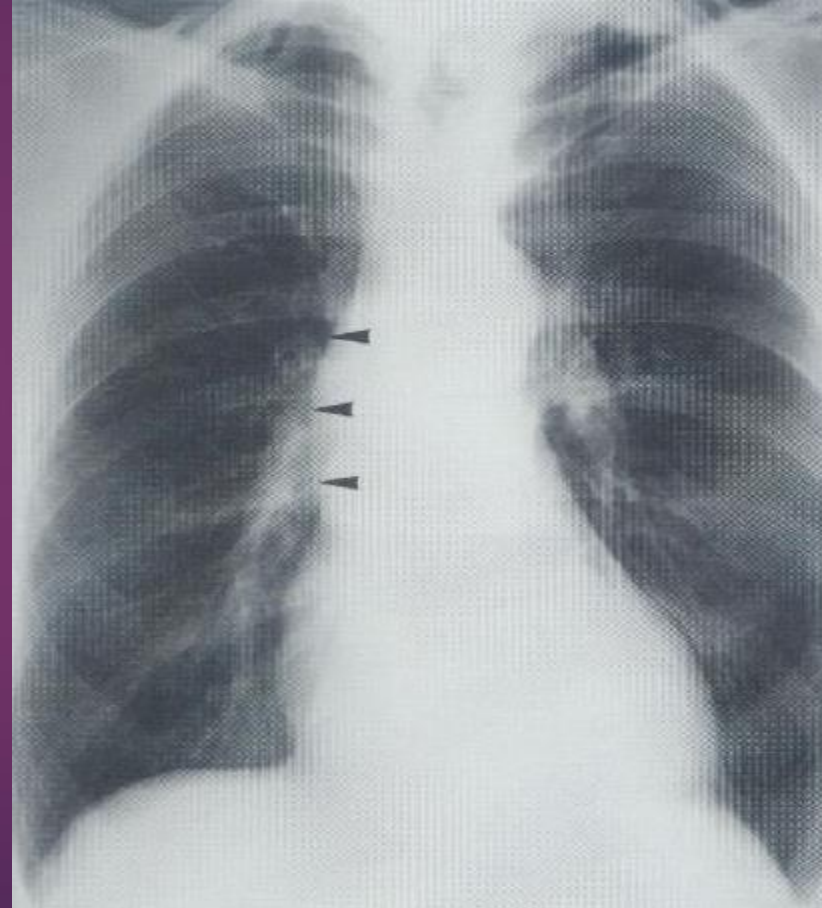
The pathophysiological findings are :

1) By CXR :

- * Aortic valve calcification.
 - * Post stenotic dilatation of the ascending aorta (the major feature).
 - * Lt. ventricular enlargement (Late feature).
 - * Increase pulmonary venous pressure (Late feature).
- Both late features will lead to Lt. ventricular failure.

Aortic Stenosis (AS)

**Aortic Stenosis (AS)
showing post-stenotic
dilatation of the aorta
(arrows)**



Aortic Regurgitation (AR)

The pathophysiological findings are :

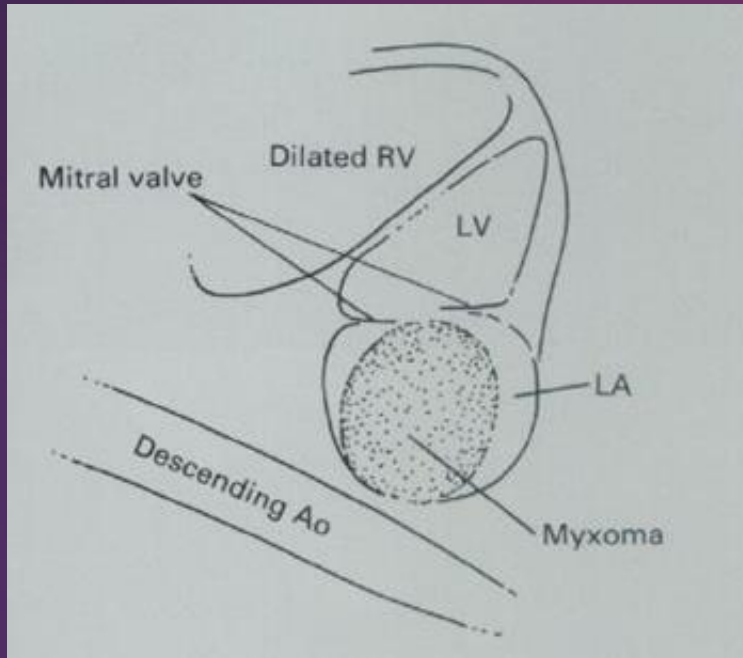
1) By CXR :

- * Dilatation of the ascending aorta.
- * Increase in the cardiac size due to enlarged Lt. ventricle, & this occurs in the early course of the disease.

Lt. Atrial Myxoma & Other Intra-cardiac Masses

- * Intracardiac tumors are extremely rare.**
- * Lt. atrial myxoma is the most frequently encountered, it is a benign tumor which arises from :**
 - a) Interatrial septum.**
 - b) Lt. atrial walls.**
- * As it enlarges, it becomes pedunculated to float in the Lt. atrial cavity, & therefore it will interfere with mitral valve function & mimic MS or MR in both ways (clinically & by CXR).**
- * It can be differentiated from other intra-cardiac masses by MRI & Echo., & the only differential Dx is Lt. atrial thrombus in patient with Rheumatic MS.**

Lt. Atrial Myxoma & Other Intra-cardiac Masses



**Lt. Atrial Myxoma shown by 2-dimentional
echocardiography – modified apical 4-
chamber view**

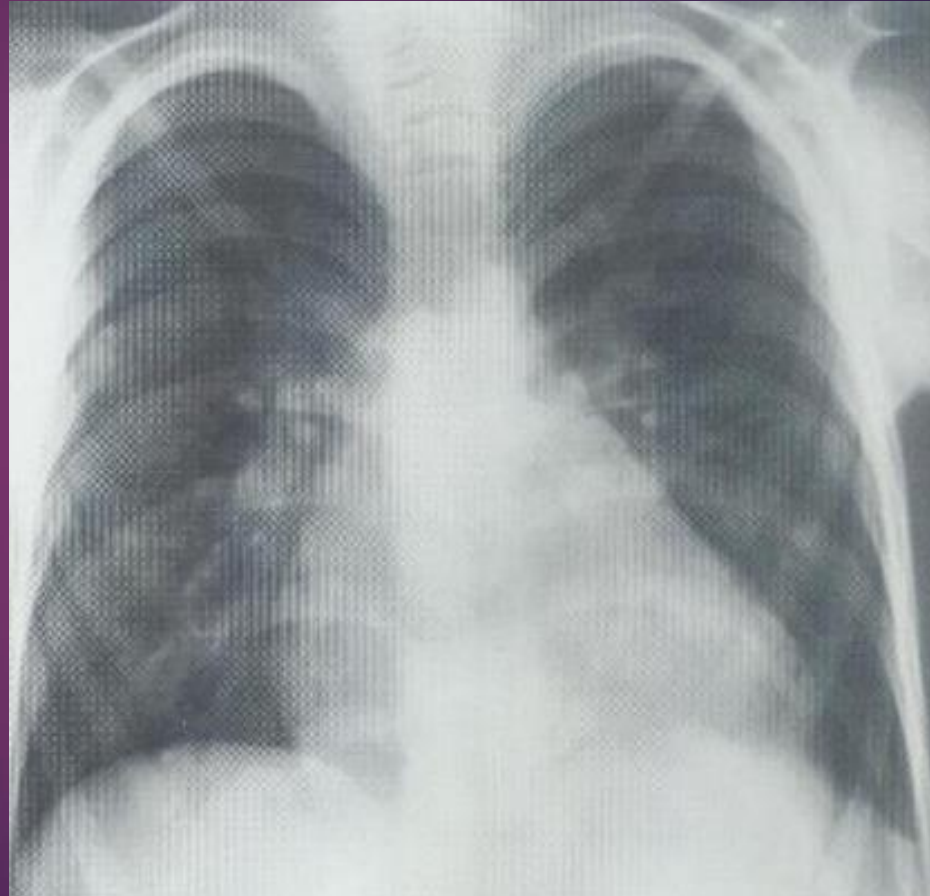
Congenital Heart Diseases

A- Lt. to Rt. Shunt (as in ASD, VSD, & PDA) :

- * When the shunt is 2/1 or more, the following CXR findings will be seen :**
 - a) Enlarged cardiac size (cardiomegally).**
 - b) Enlarged Mean Pulmonary Artery (MPA), hilar pulmonary arteries.**
 - c) Pulmonary plethora.**
- * Absent of Lt. ventricular enlargement in the presence of increase pulmonary flow is mainly indicate ASD.**

Congenital Heart Diseases

VSD in a child



Congenital Heart Diseases

B- Pulmonary Stenosis (PS) :

* BY CXR : there will be :

- a) Normal heart size.
- b) Enlargement of MPA Lt. pulmonary artery (Post-Stenotic Dilatation).

Congenital Heart Diseases

C- Coarctation Of Aorta (COA) :

*** It is an abnormal aortic arch due to presence of narrowing, just distal to the origin of the Lt. subclavian artery.**

*** CXR findings include :**

- a) Indentation of the aortic arch.**
- b) Dilatation above (dilatation of the Lt. subclavian artery), & below (post-stenotic dilatation).**
- c) Enlarged cardiac size & ascending aorta due to long standing hypertension.**
- d) Rib notching is due to enlargement of the intercostal arteries which act as a collateral, & there will small cortical indentation on the inferior margin of the posterior halves of the ribs from the 3rd or 4th rib, & downward.**

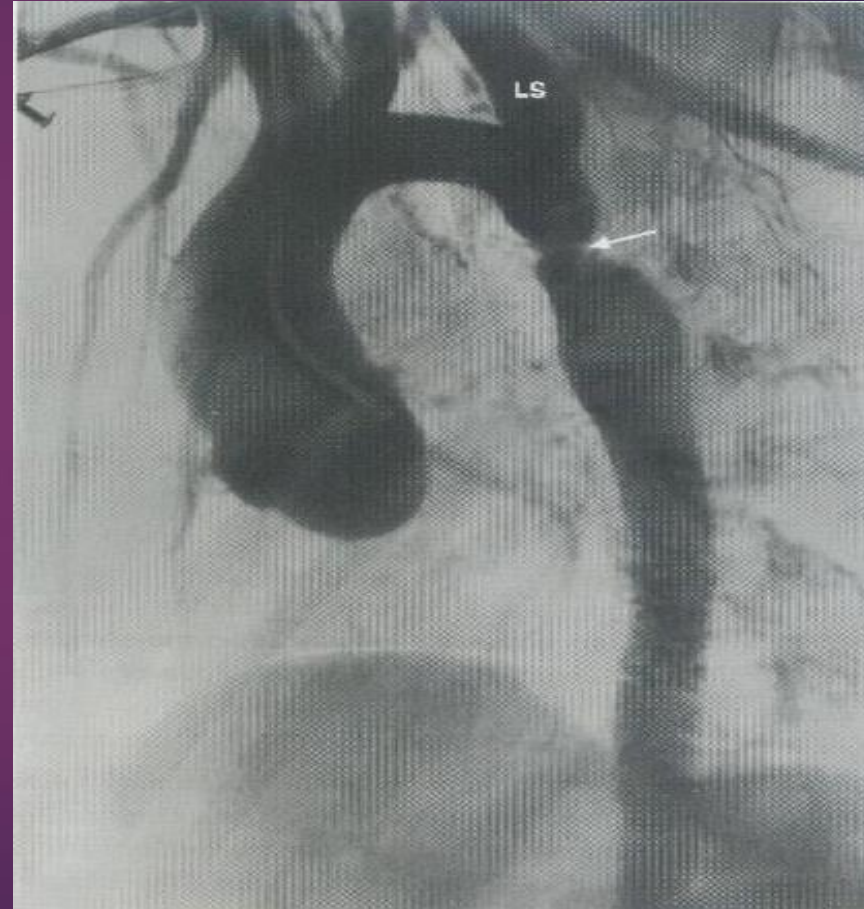
Note : COA itself can be seen by angiography or MRI.

Congenital Heart Diseases

Rib notching in COA



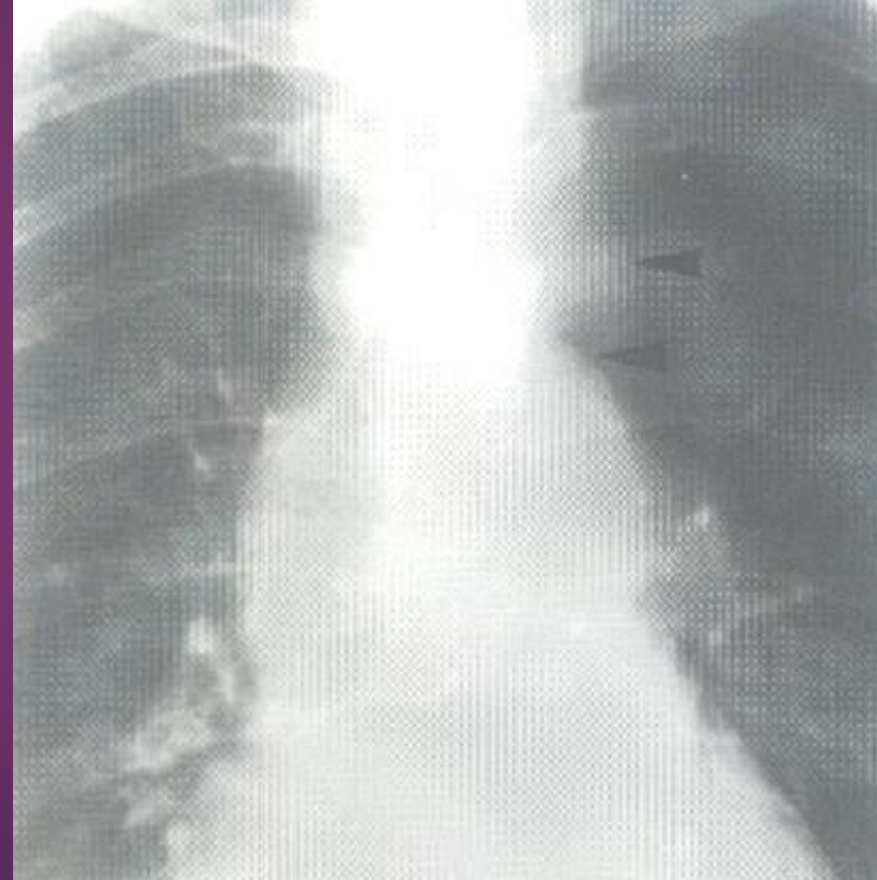
Congenital Heart Diseases



Angiogram showing COA (arrow)

Congenital Heart Diseases

Abnormal Aortic knuckle (arrow)



Congenital Heart Diseases

D- Tetralogy Of Fallot (TOF) :

* & they are :

- a) VSD.
- b) Rt. ventricular outflow obstruction (valvular or subvalvular).
- c) Rt. ventricular hypertrophy.
- d) Overriding of aorta over the VSD.

Congenital Heart Diseases

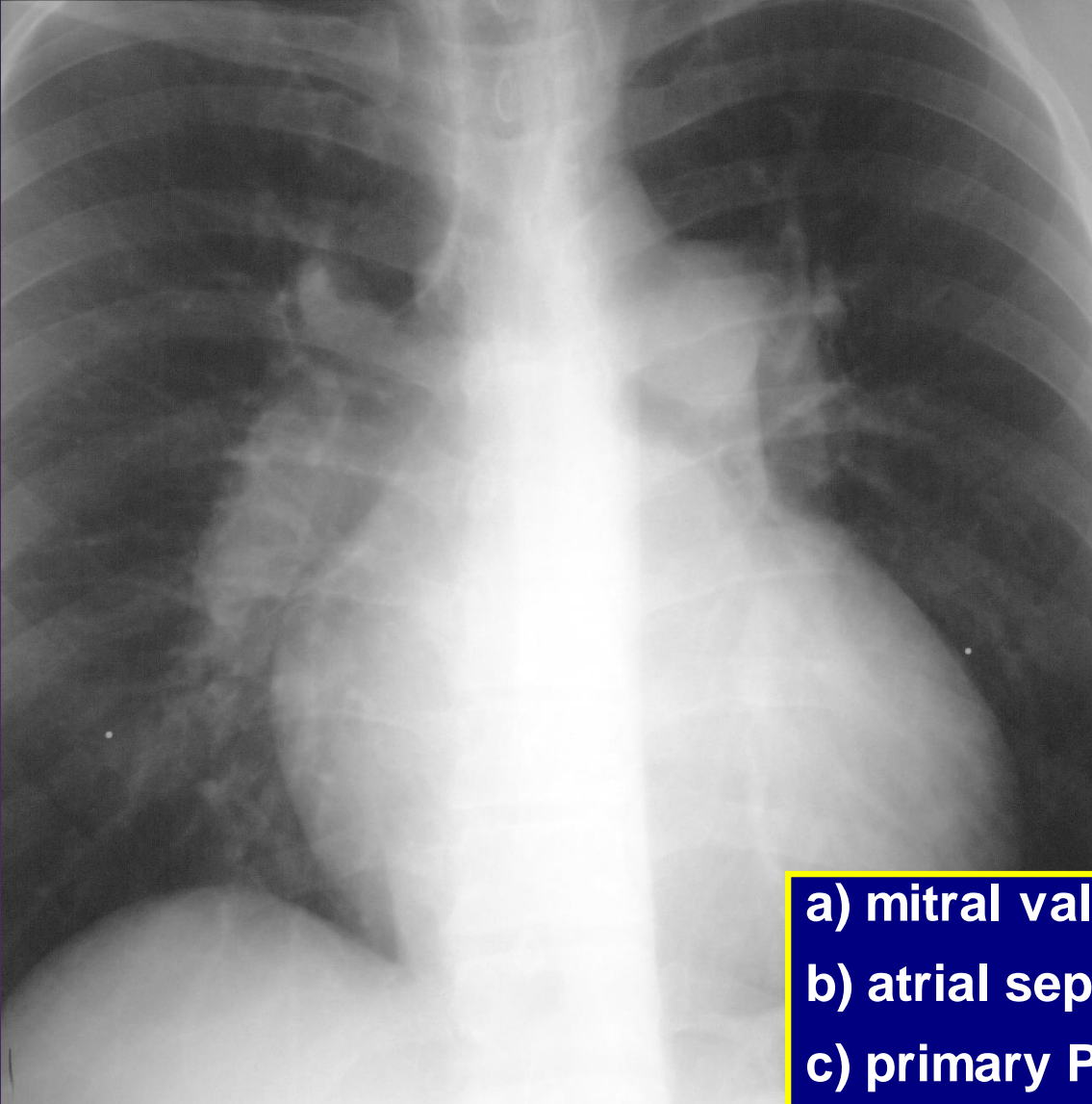
D- Tetralogy Of Fallot (TOF) :

* BY CXR :

- a) 50% of patients have normal CXR.
- b) Upturned cardiac apex.
- c) Pulmonary bay at the region of the MPA, gives the Boot-Shaped Heart.
- d) Oligemia of the lung.
- e) 25% Rt. sided aortic arch.

CASES

54 year old with dyspnea on exertion



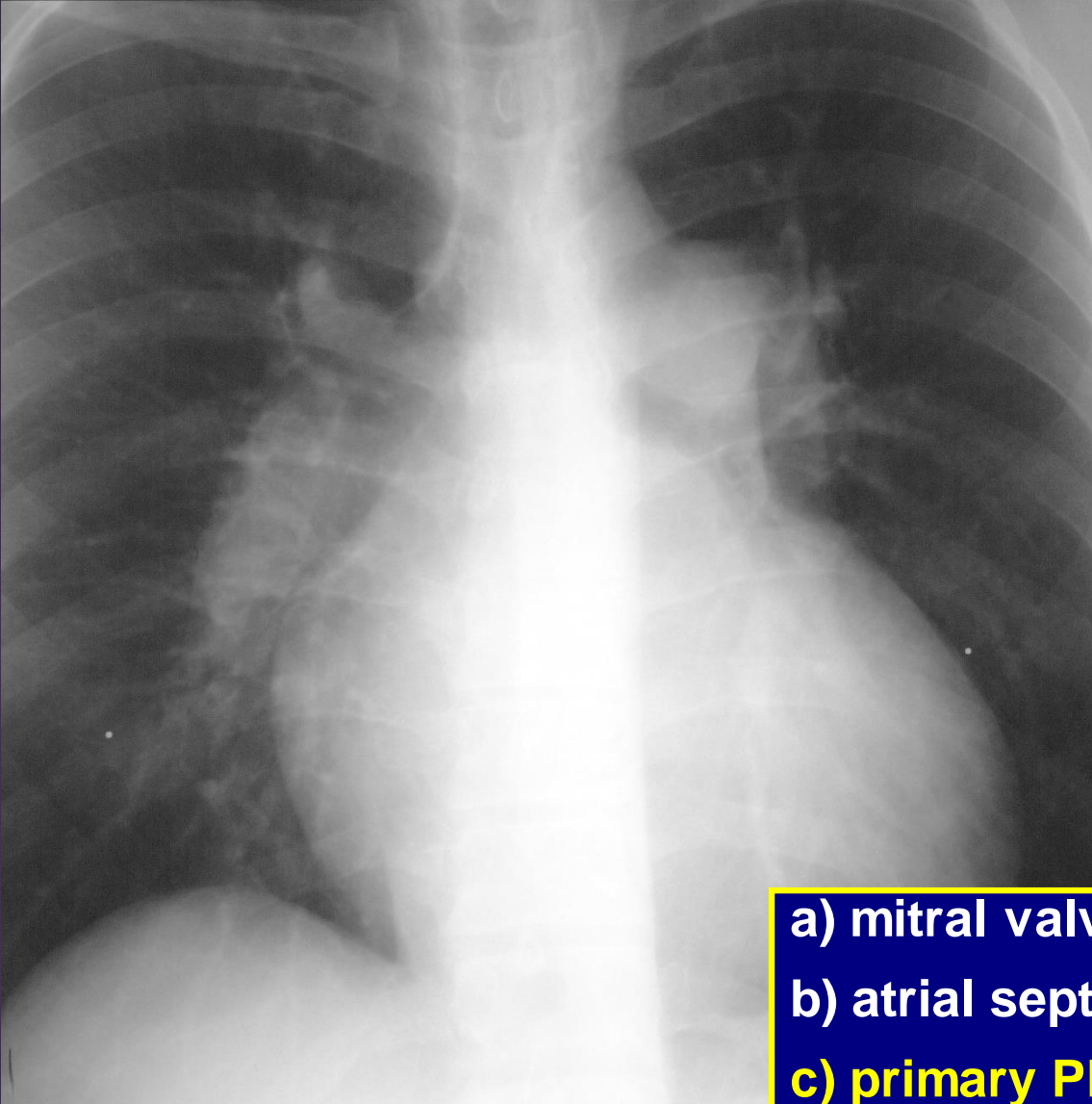
PD-INEL Source Undetermined



PD-INEL Source Undetermined

- a) mitral valve disease
- b) atrial septal defect
- c) primary PHTN
- d) pulmonary edema

54 year old with dyspnea on exertion

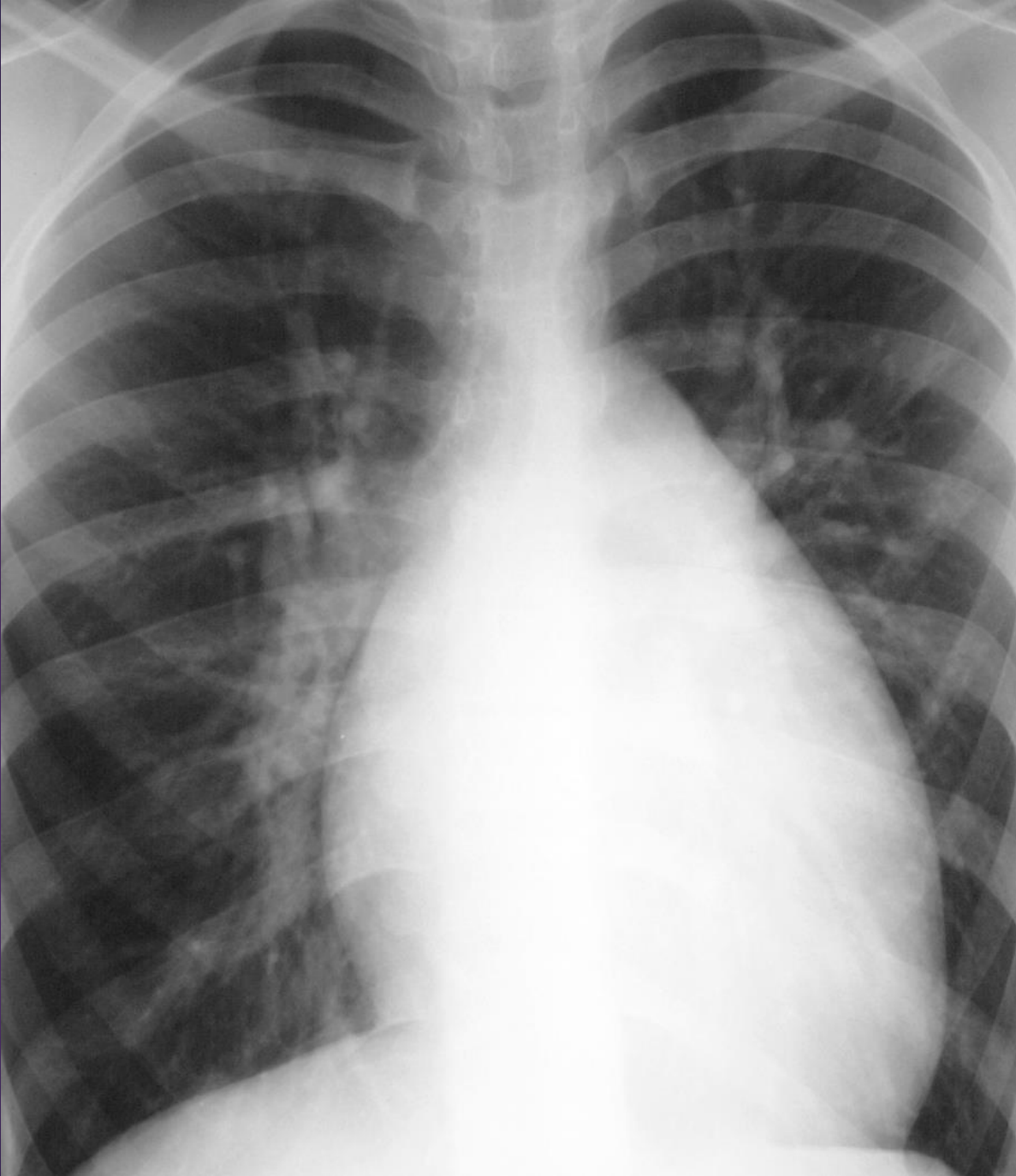


PD-INEL Source Undetermined



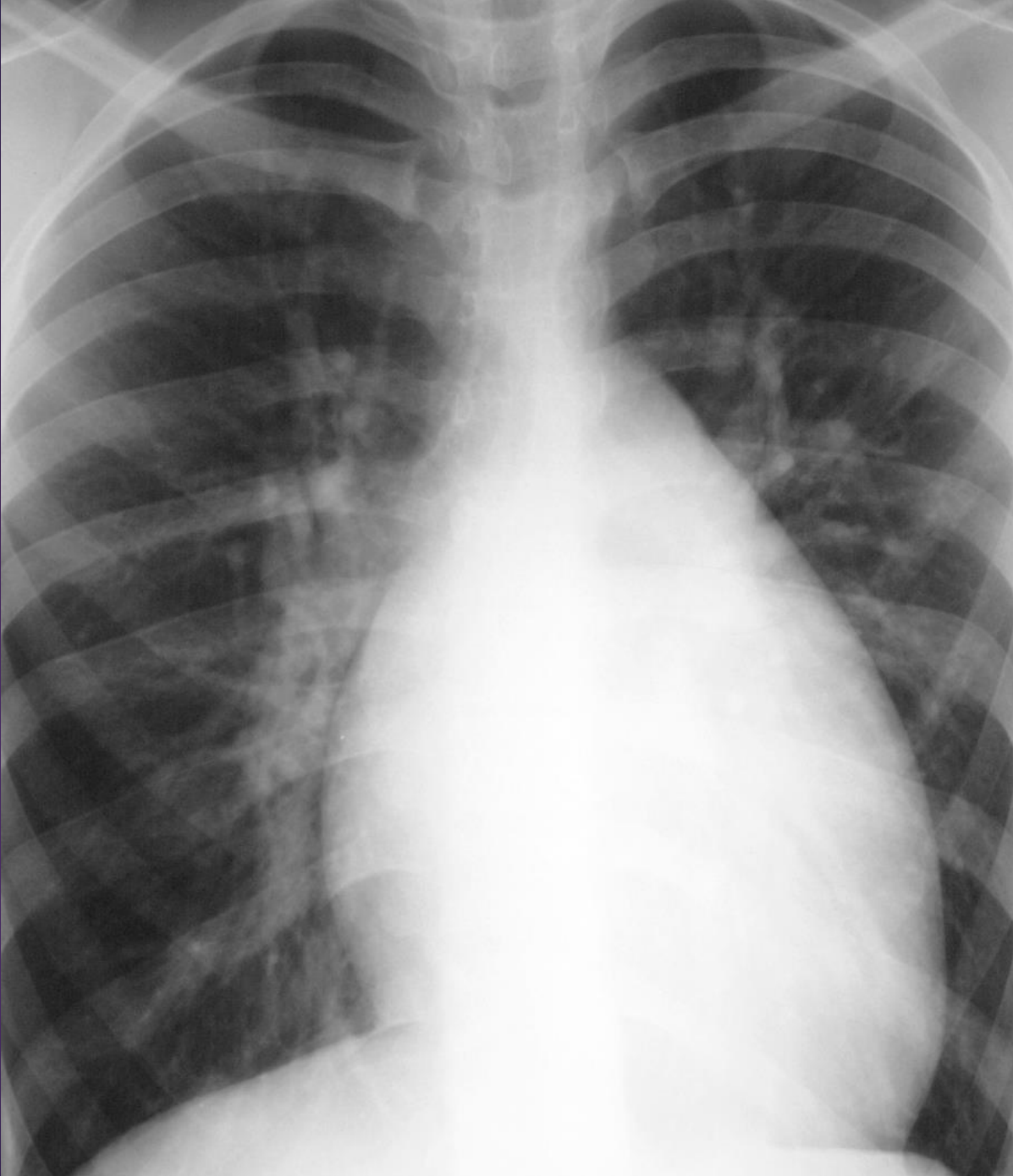
PD-INEL Source Undetermined

- a) mitral valve disease
- b) atrial septal defect
- c) **primary PHTN**
- d) pulmonary edema



24 year-old with heart murmur

- a) pulmonic stenosis
- b) ASD
- c) fluid overload
- d) primary PHTN



**24 year-old
with heart
murmur**

- a) pulmonic stenosis
- b) ASD**
- c) fluid overload
- d) primary PHTN



Thank You