

Cardiovascular Imaging

Anatomy

Cardiac Configurations

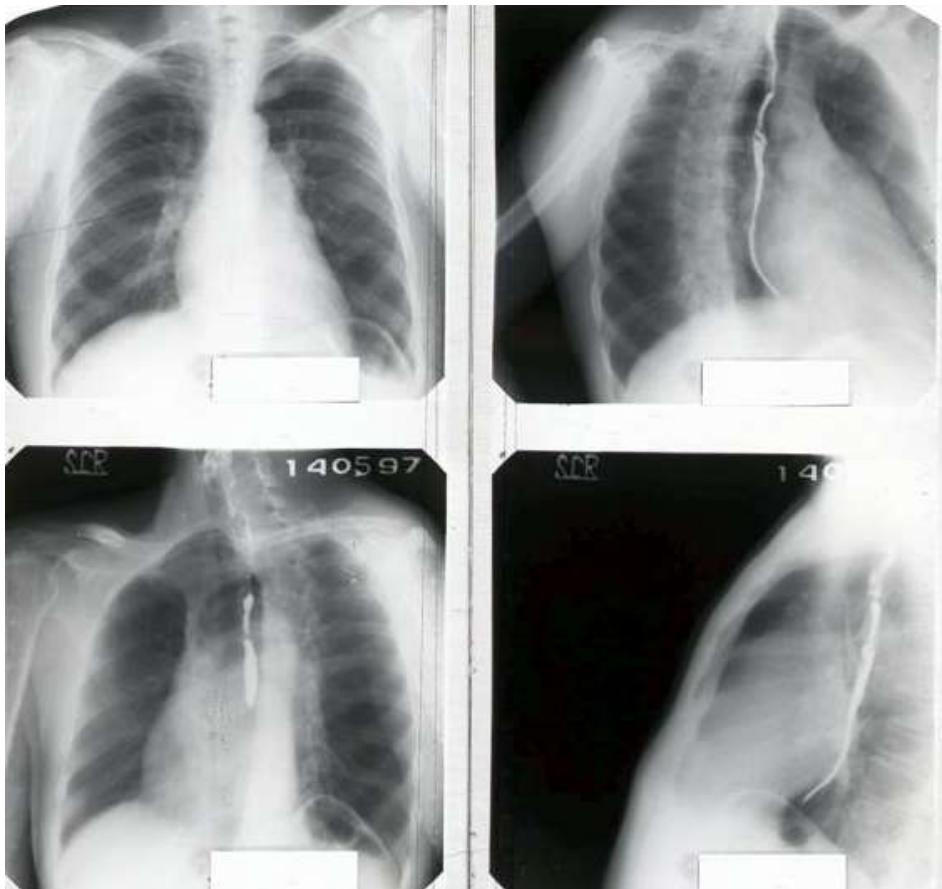
Chest radiograph value

- Cardiac position
- Cardiac dimensions assessment
- Cardiac configuration
- Pulmonary circulation (pulmonary vasculature)
- Mediastinal exploration

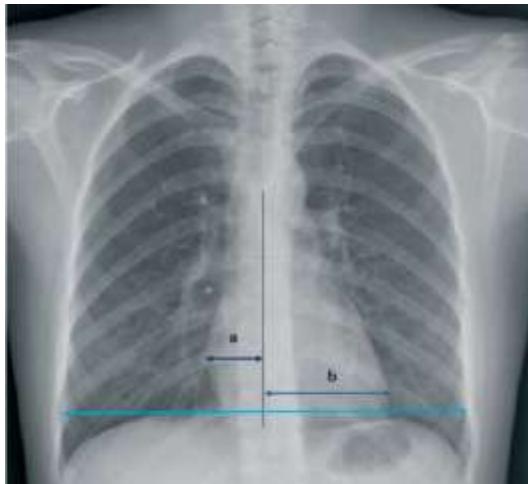
Radiography

- Conventional radiograph (Chest X-ray)
 - PA
 - LL
 - OBLIC
 - RAOP
 - LAOP





Topometry Cardiothoracic ratio



$$\text{CTR} = (A+B) / C$$

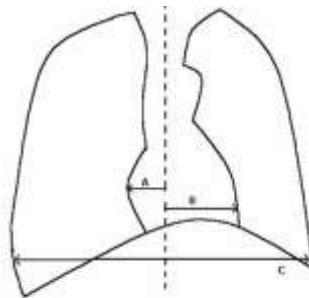


Fig.CXR: Measuring the CTR ($A + B/C$)

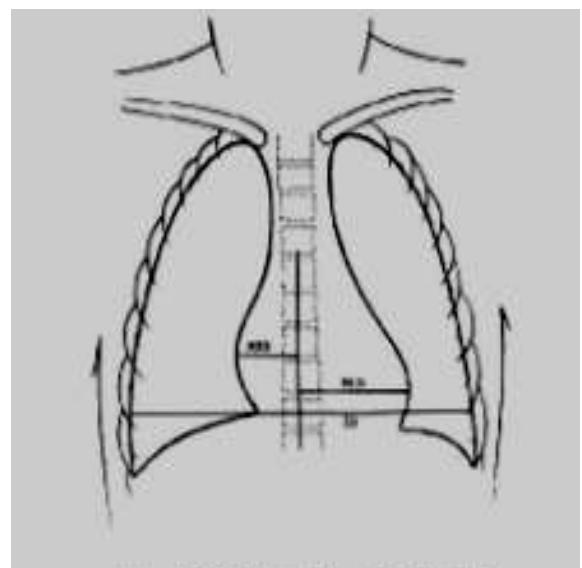
The cardiothoracic ratio (CTR) shown in figure is the transverse cardiac diameter (the horizontal distance between the most rightward and leftward borders of the heart seen on a PA chest radiograph = maximum extension of the heart to the left and right of the midline respectively) divided by the transverse chest diameter (measured from the inner rib margin at the widest point above the costophrenic angles on a PA chest film).

If the cardiac thoracic ratio is greater than 50%, pathology is suspected.

Cardio-toracic ratio

Normal CTR:

- new-born: $\leq 0,6$
- Teenagers and adults: $\leq 0,5$
- in elders: 0,50-0,55

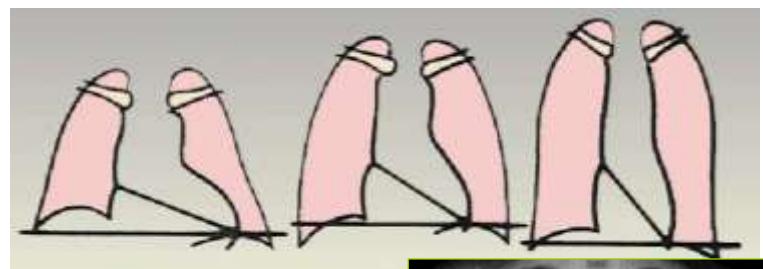




- The leftmost point of the heart shadow (formed by the left ventricle) is about 1-1.5cm medial to the left medioclavicular line (vertical line through the point of intersection of the left clavicle with the chest wall)
- The rightmost point of the heart shadow (normally formed by the right atrium) is about 1.5cm to the right of the right edge of the spine shadow.
- The highest point of the heart shadow (formed by the aortic club) is at the level of the third thoracic vertebra.

Variants of normal heart shadow

- a) hypersthenic
- b) normosthenic
- c) asthenic



a)



b)



c)

Cardiac silhouette

- **PA projection**

- **Left side:**

- **Convexities**

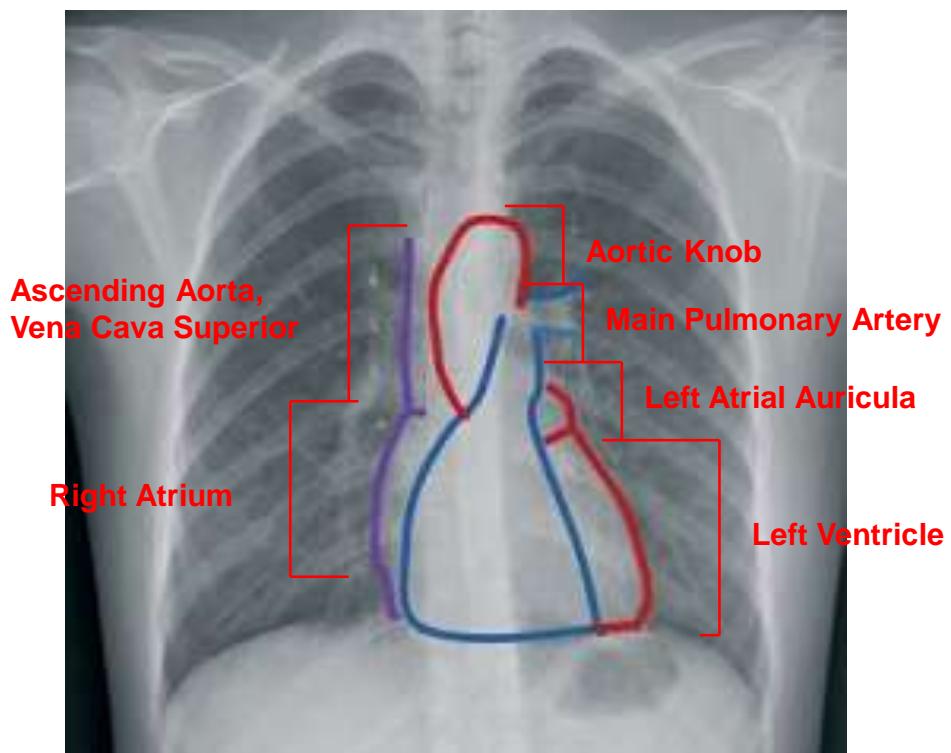
- I. Aortic Knob
 - II. Main Pulmonary Artery
 - III. Left Atrial Auricula
 - IV. Left Ventricle

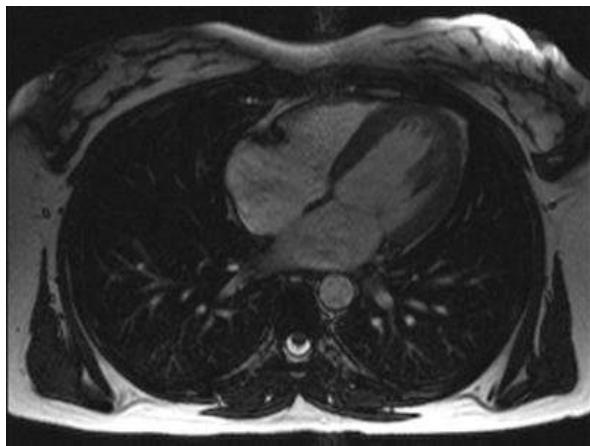
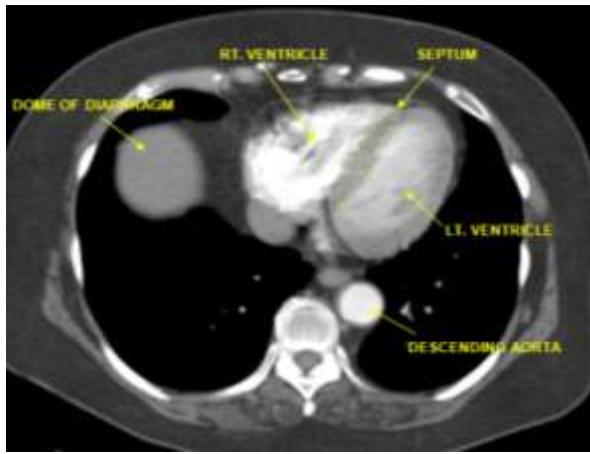
- **Right side:**

- **Convexities**

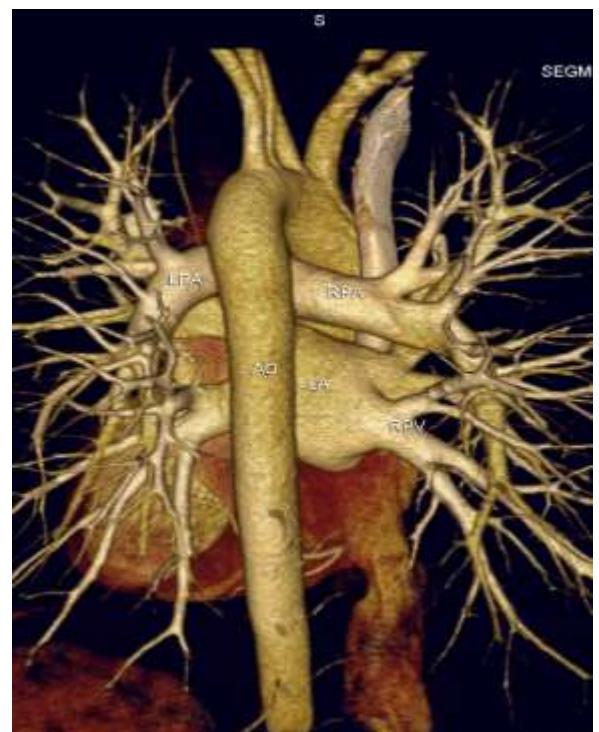
- I. Ascending Aorta, Vena Cava Superior
 - II. Right Atrium

Cardiac silhouette

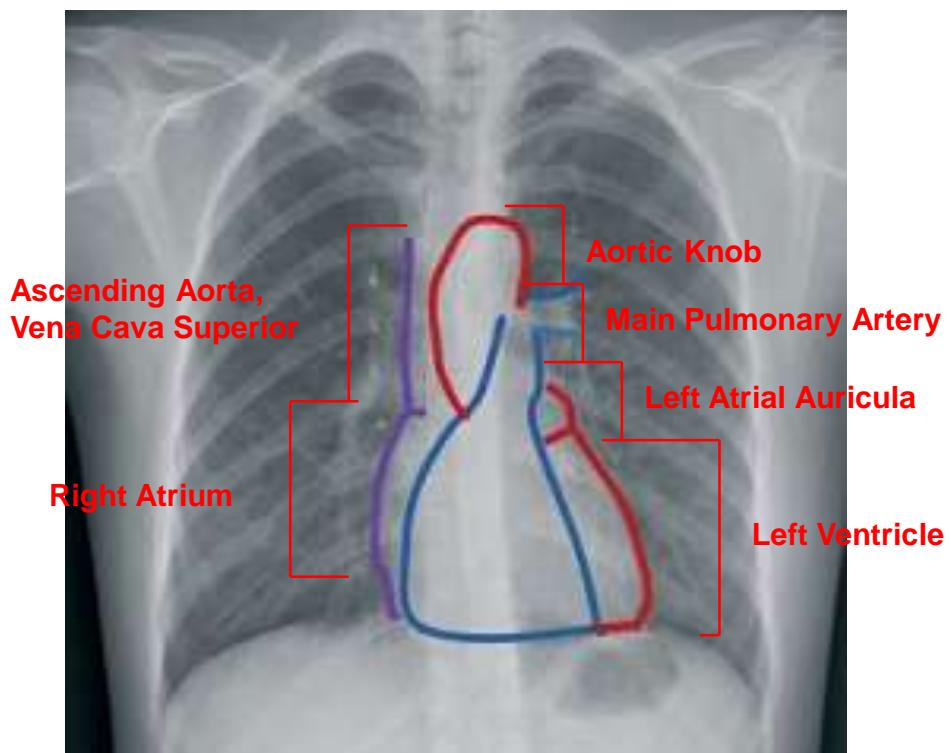




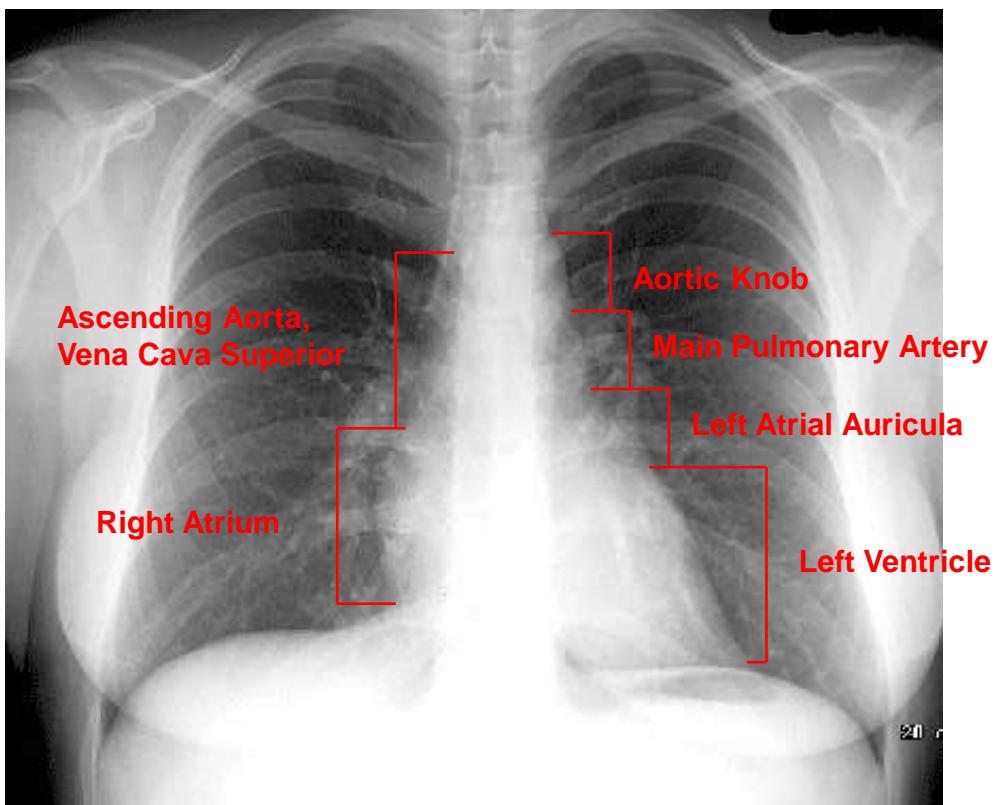
CT-3D



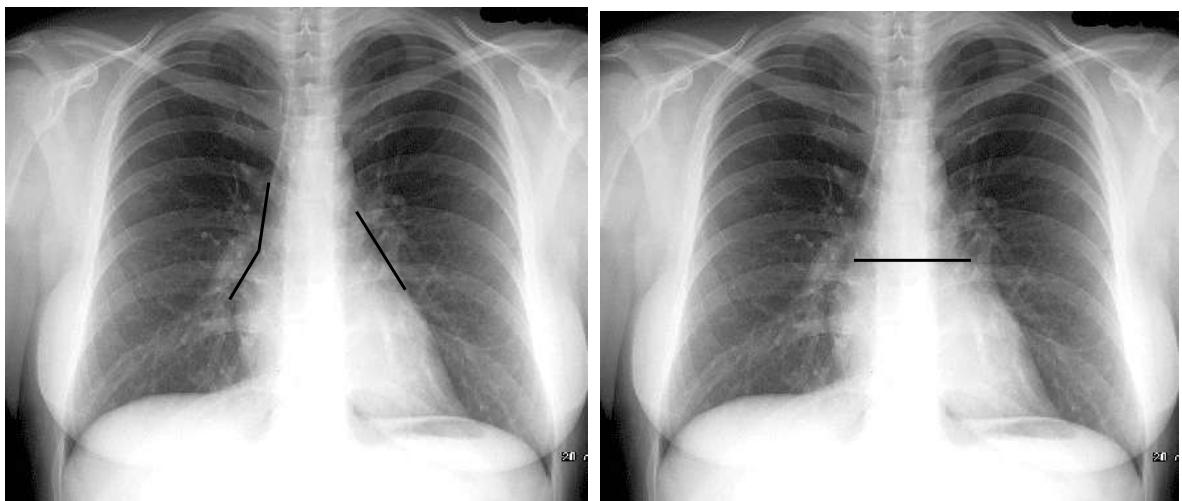
Cardiac silhouette



Cardiac silhouette



- The angle between the two convexities of the right contour of the heart is called the right atriovasal angle and is normally located in the middle of the height of the heart shadow.
- On the left the atriovascular region (pulmonary artery and atrium of the left atrium) is called the cardiac gulf,
- The middle segment of the cardiac silhouette in a chest radiograph is called the waist of heart.

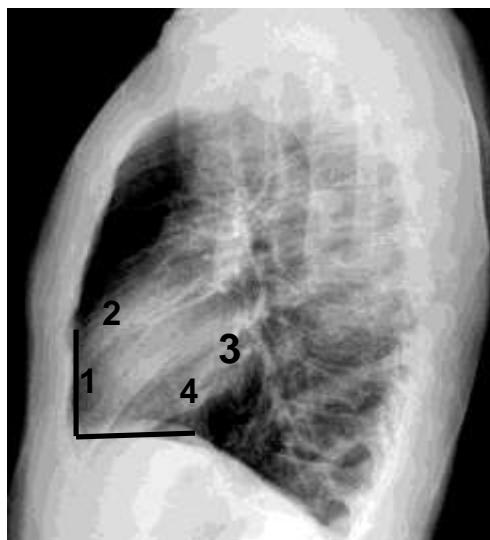


Cardiac configuration

- These aspects, together with the normal position and the indicated dimensions of the heart, characterize ***the normal cardiac configuration.***



Left lateral view



Cardiac convexities.

- 1) Right ventricle
- 2) Ascending aorta
- 3) Left atrium
- 4) Left ventricle

The length of the RV contour (1) = the length of the LV contour (4), ≤ 7 cm each

Cardiovascular Imaging

Abnormal Radiological Findings

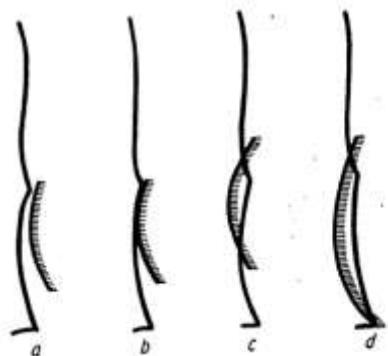
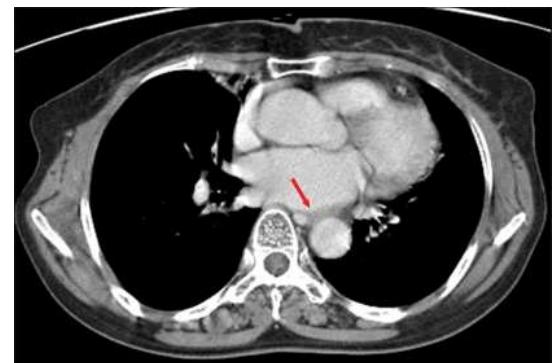
Cardiomegaly Left Ventricle enlargement



Enlarged cardiac silhouette



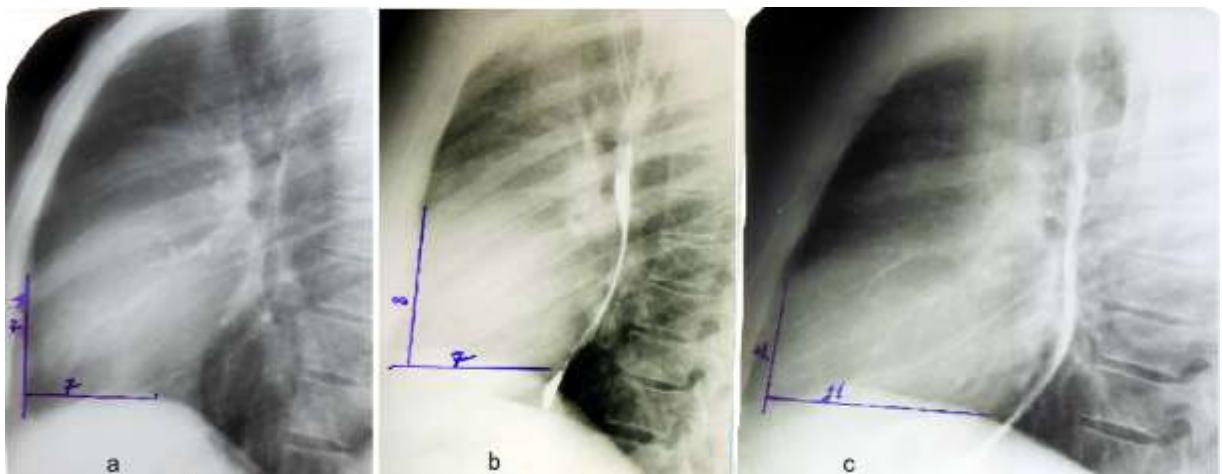
Enlargement of left atrium



Enlargement of right atrium



Left lateral view

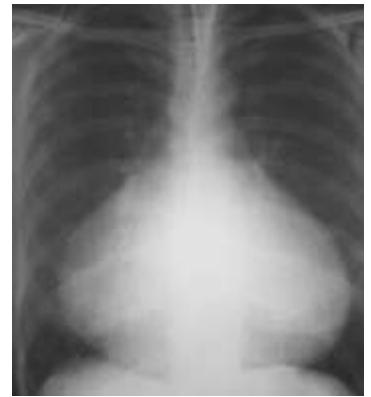


Contact of the right ventricle with the anterior thoracic wall and of the left ventricle with the diaphragm:

- a – normally equal,
- b – enlargement of the right ventricle,
- c – enlargement of the left ventricle.

Pathological cardiac configuration

Cardiac configuration Feature \	Mitral	Aortic	Tricuspid (trapezoid, cardiomyopathic)
Right atriovasal angle	Cranial displacement	Caudal displacement	Cranial displacement
Cardiac gulf	Leveled, the pulmonary artery arch protrusion	Pronounced, deep	Blurred heart convexities, poorly pronounced
Arch of aorta	Decreased or disappeared	Prominent	
Enlargement of the cardiac shadow	Enlarged arch of the LV, more or less pronounced. Enlarged right inferior arch (LA enlargement)	Enlarged LV, ascending aorta, arch of aorta	The heart is enlarged bilaterally, "lying" on the diaphragm
Pathologies	-Mitral valvulopathies -Interatrial septal defect -Patent ductus arteriosus	-Aortic valvulopathies -Aortic coarctation -Systemic arterial hypertension -Fallot tetralogy	-Exudative pericarditis -Polyvalvular valvulopathies -Dilated Cardiomyopathy



Mitral configuration

- ✓ Disappearance of the waist of heart
- ✓ Atriovascular angle is displaced upwards (enlarged right inferior arch)
- ✓ Aortic knob is indistinct or absent
- ✓ There may be cardiac enlargement to the left

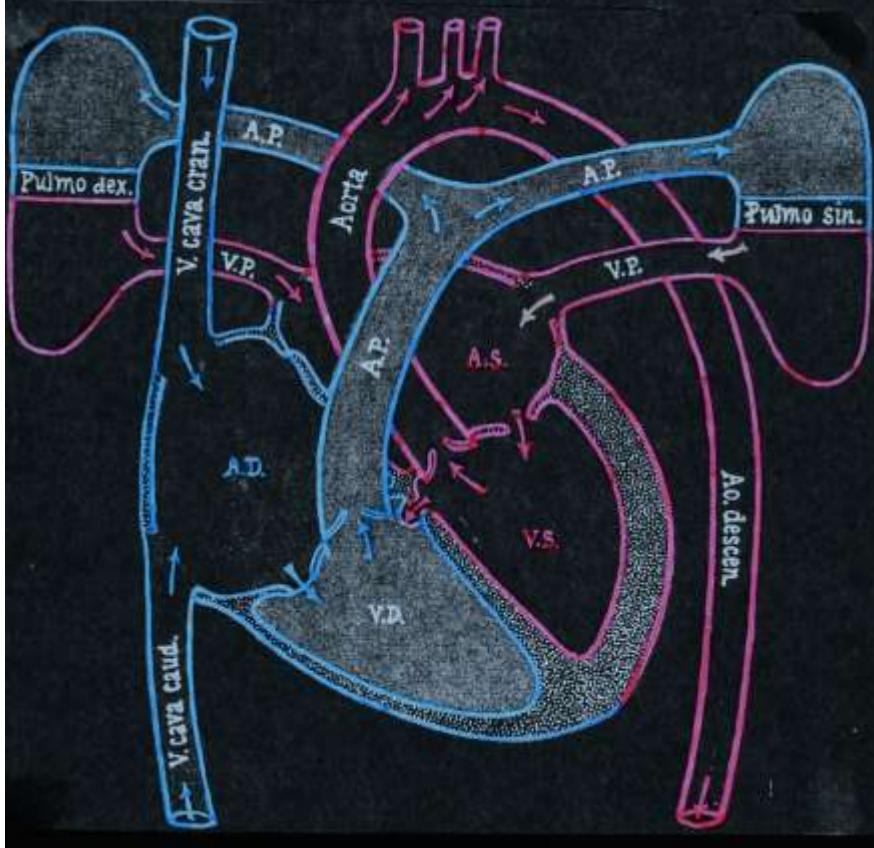


Mitral configuration

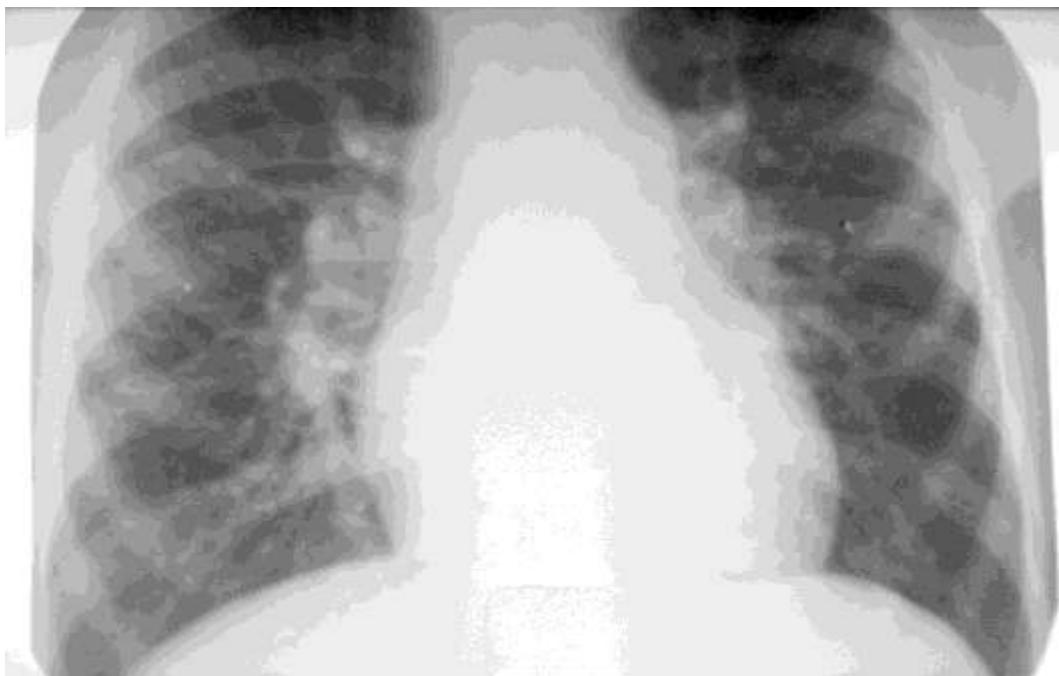
- Mitral Stenosis
- Mitral Regurgitation
- Interventricular septal defect
- Arterial canal persistence
- Pulmonary artery stenosis
- Pulmonary heart



DEFECTUL SEPTAL VENTRICULAR



Interventricular septal defect



Aortic configuration

- ✓ The waist of heart is evident
- ✓ Atriovascular angle is displaced downwards
- ✓ Modifications of the thoracic aorta
- ✓ Cardiac enlargement to the left



Aortic configuration

- Aortic Stenosis
- Aortic Regurgitation
- Aortic Coarctation
- Tetralogy of Fallot
- Arterial Hypertension



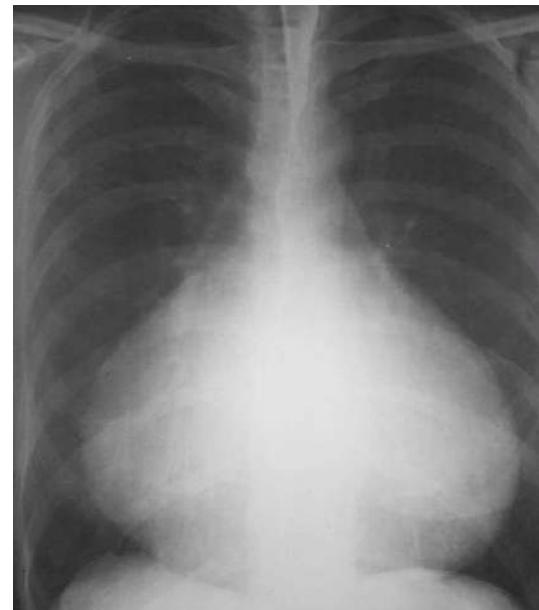
Aortic configuration

- Aortic Stenosis
- Aortic Regurgitation
- Aortic Coarctation
- Tetralogy of Fallot
- Arterial Hypertension



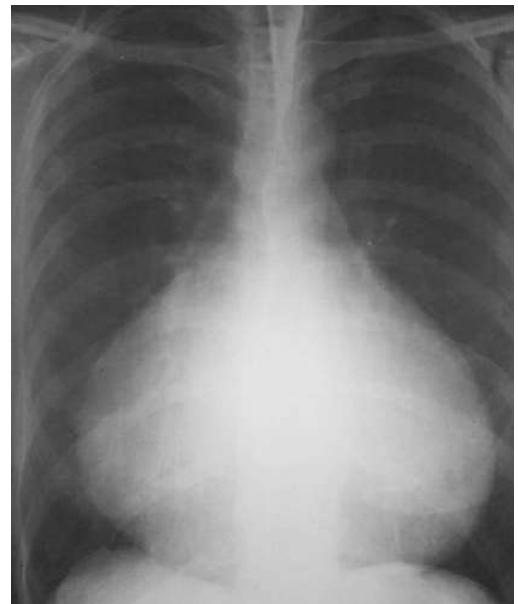
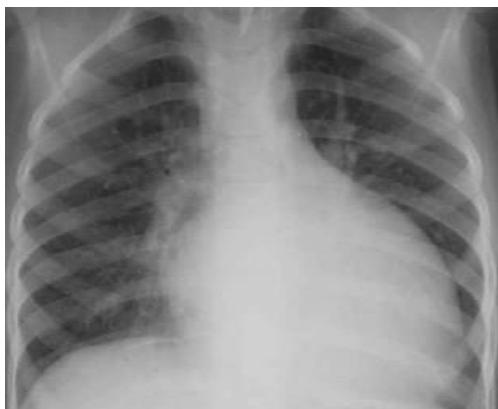
Trapezoid (tricuspid) configuration

- ✓ Bilateral enlargement of the heart (in transverse diameter)
- ✓ Cardiovascular angles moved cranially
- ✓ Cardiac convexities cannot be distinguished



Trapezoid configuration

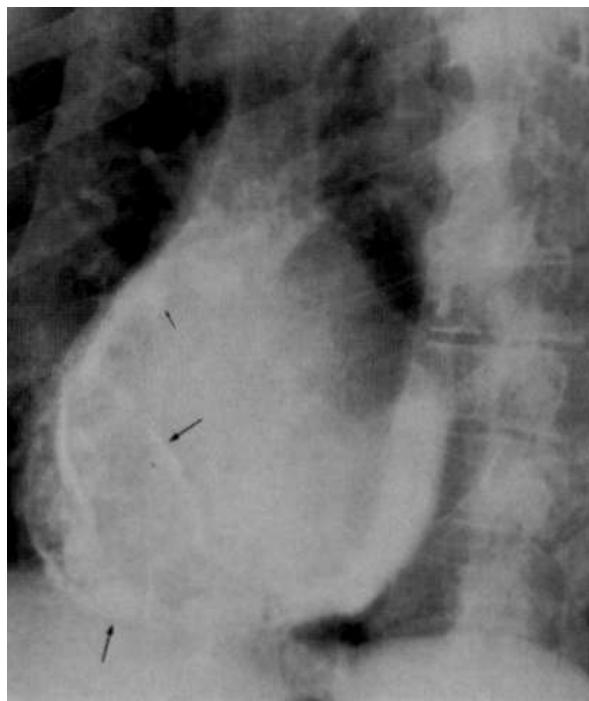
- Tricuspidal Stenosis
- Tricuspidal Regurgitation
- Interatrial septal defect
- Diffuse myocardial pathology
- Pericardial effusion



Pericardial effusion



Calcified pericarditis (constrictive pericarditis)



Pneumohydropericardium



Horizontal line - hydroaeric level

Cardiovascular Imaging

- **Congenital Heart Disease (CHD)**
 - Dextrocardia (situs inversus)
 - Acyanotic (left to right shunt)
 - Atrial septal defect
 - Ventricular septal defect
 - Cyanotic (right to left shunt)
 - Ebstein's anomaly (Tricuspidian defect, Small right ventricle, Septal atrial defect)
 - Tetralogy of Fallot
 - Trilogy of Fallot
 - Coarctation of the aorta

Dextrocardia



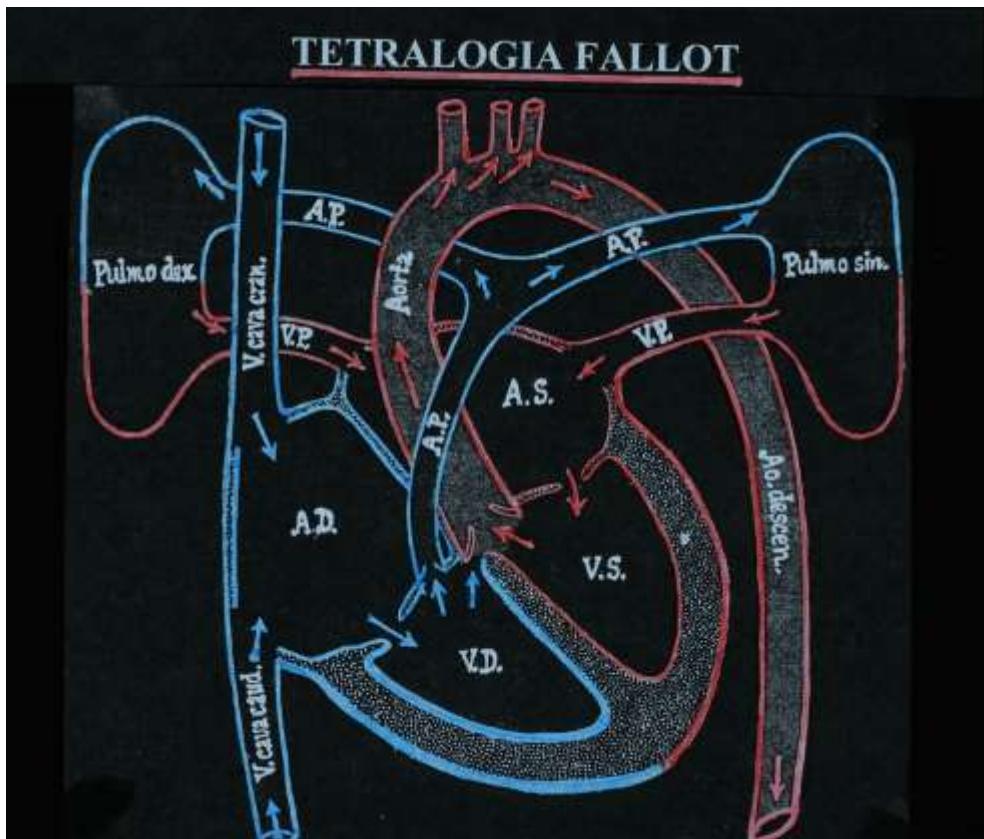
Cardiovascular Imaging

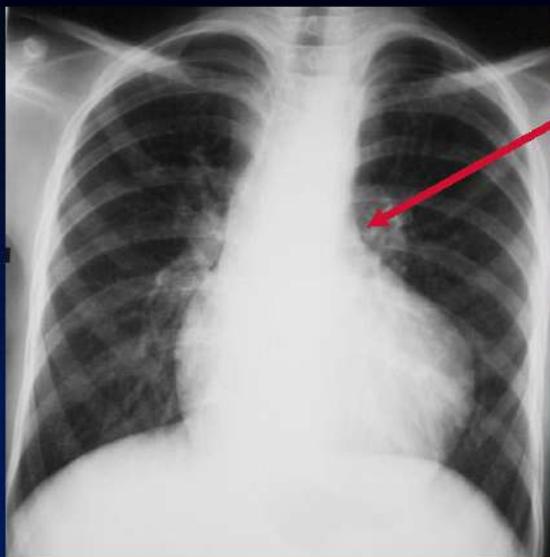
– **Tetralogy of Fallot**

- **Interventricular septal defect**
- **Infundibular pulmonary artery stenosis**
- **Right aortic arch (over-riding of the aorta)**
- **Right ventricular hypertrophy**

– **Trilogy of Fallot**

- **Interatrial communication**
- **Pulmonary artery stenosis**
- **Right ventricular hypertrophy**



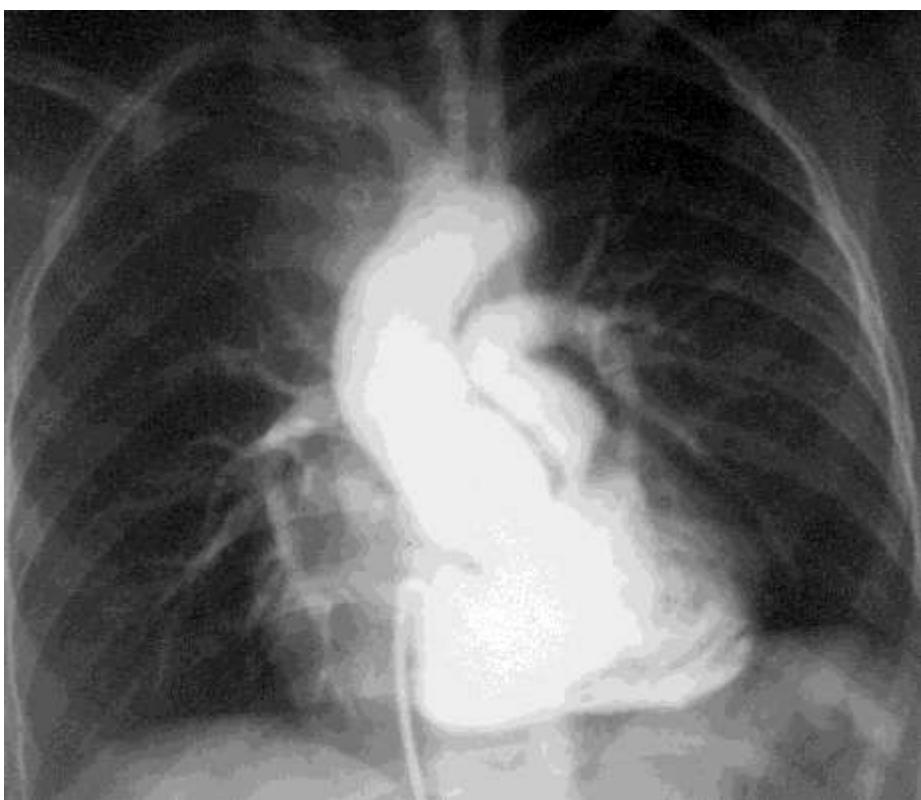


Concave
pulmonary
artery
segment

malformation complex with the presence of three signs :

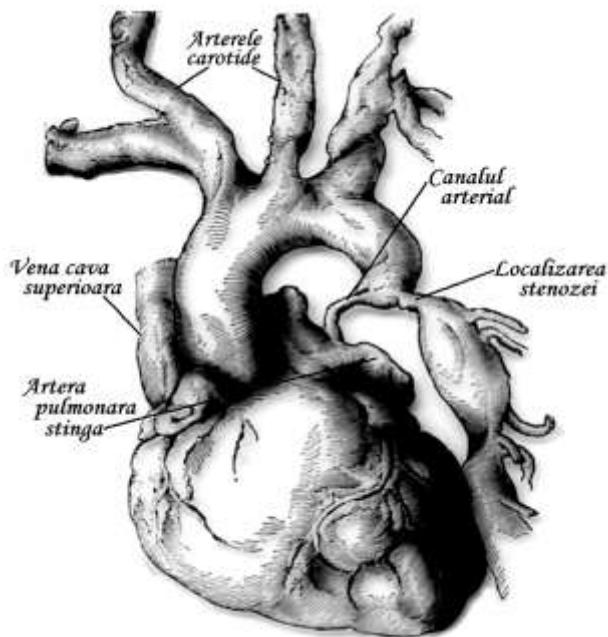
1. narrowing the opening of the pulmonary artery
2. cleft of atrial sept
3. right ventricular hypertrophy

Tetralogy of Fallot with subvalvular pulmonic stenosis



Cardiovascular Imaging

– Coarctation of the aorta



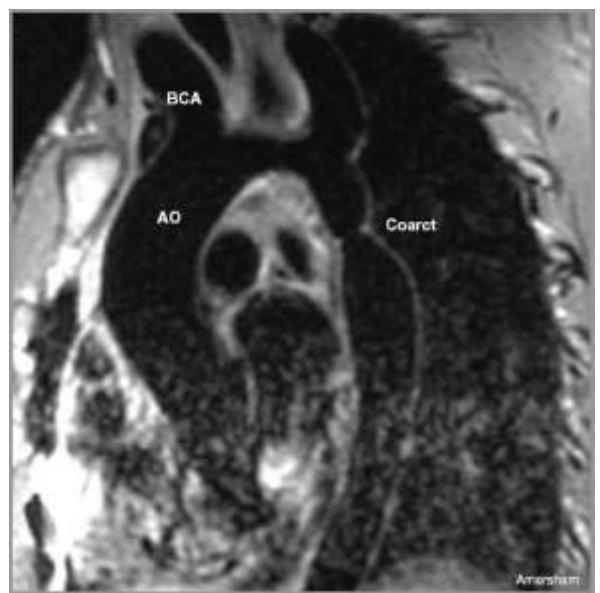
Coarctation of the aorta

Aortography

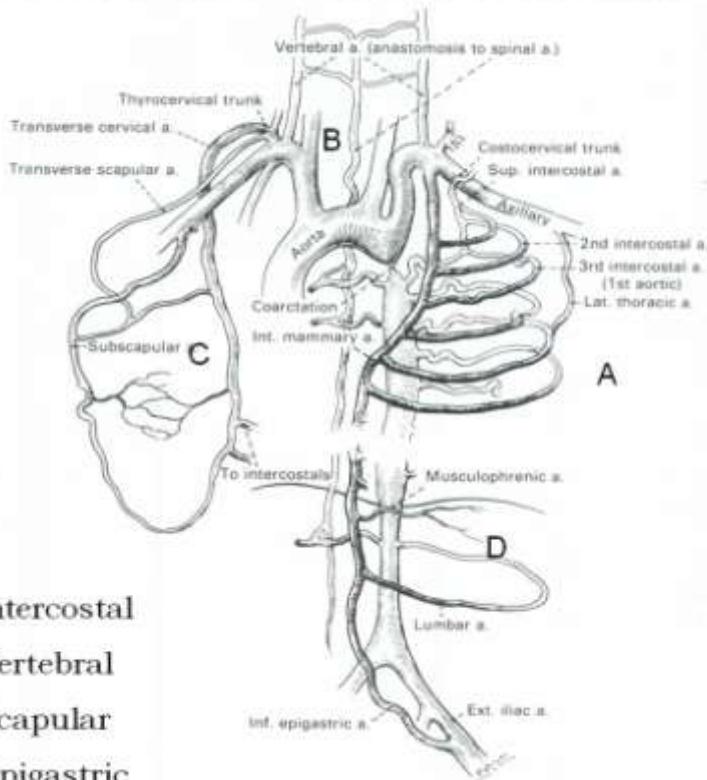


Coarctation of the aorta

MR-Angiography

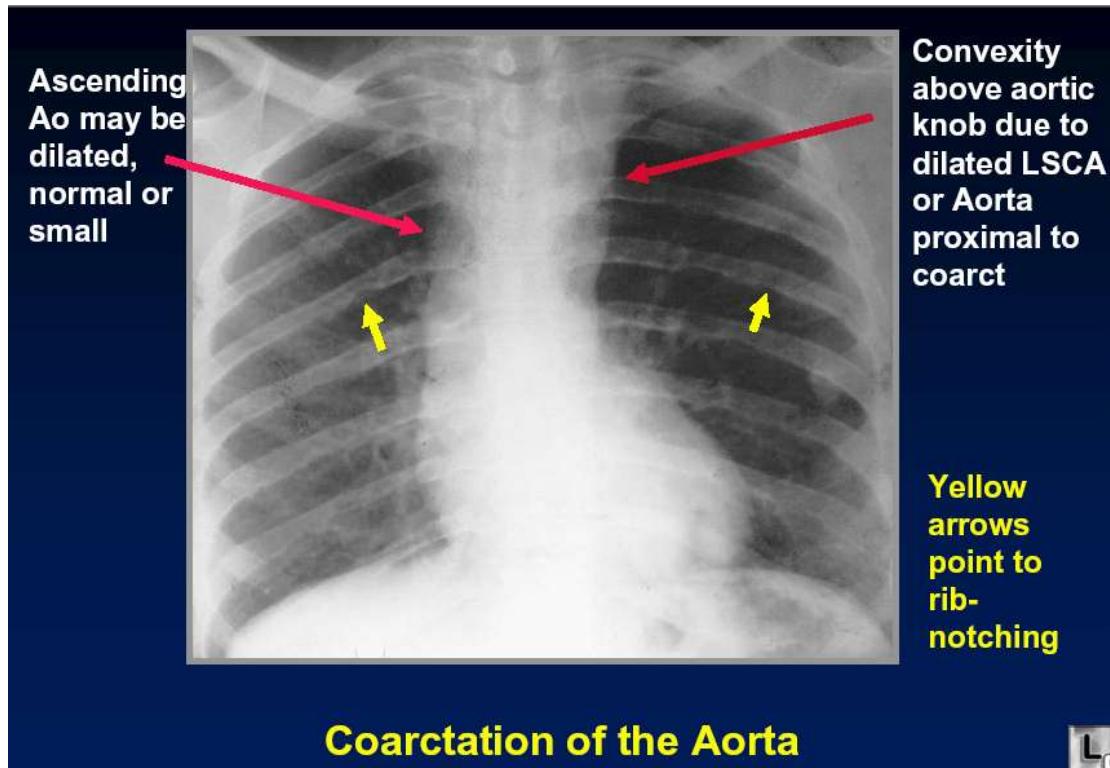


Collaterals in coarctation of Aorta

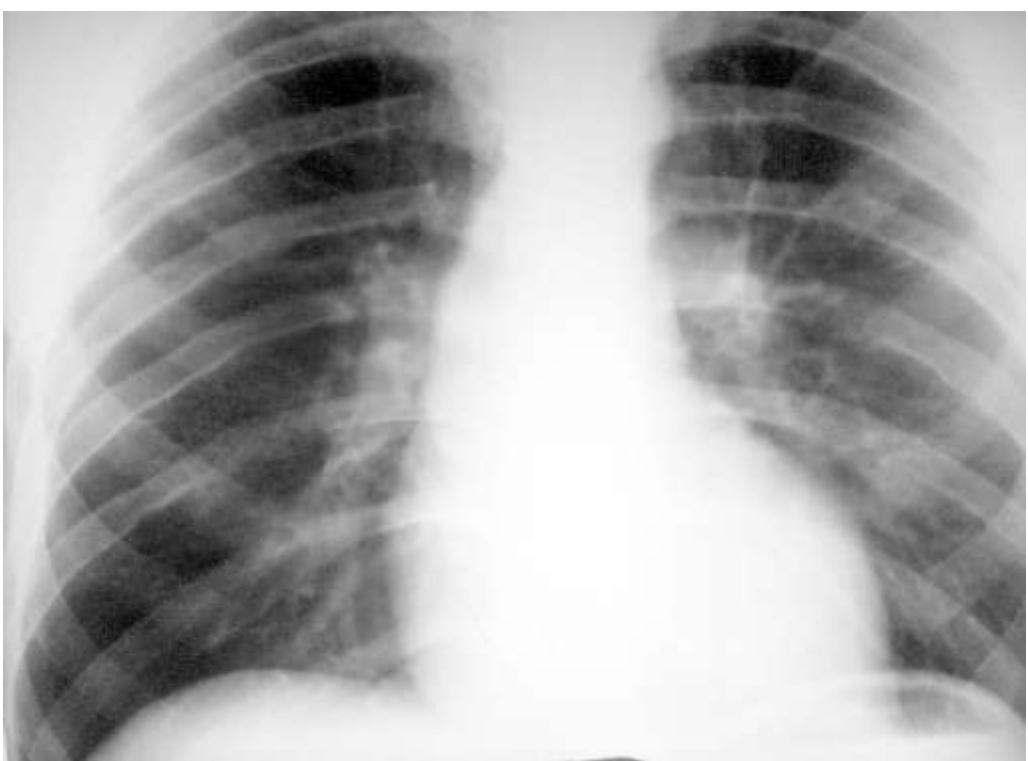


Modified from Dr.Jesse Edwards

www.drsvenkatesan.com

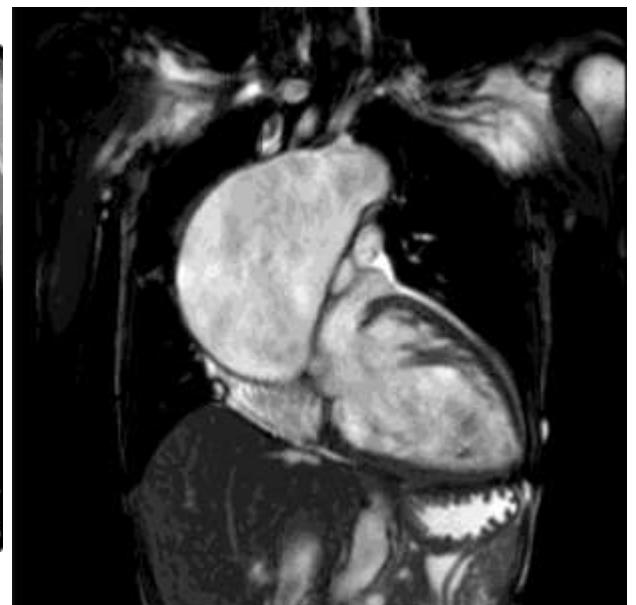


Ao – aorta, LSCA - left subclavicular artery



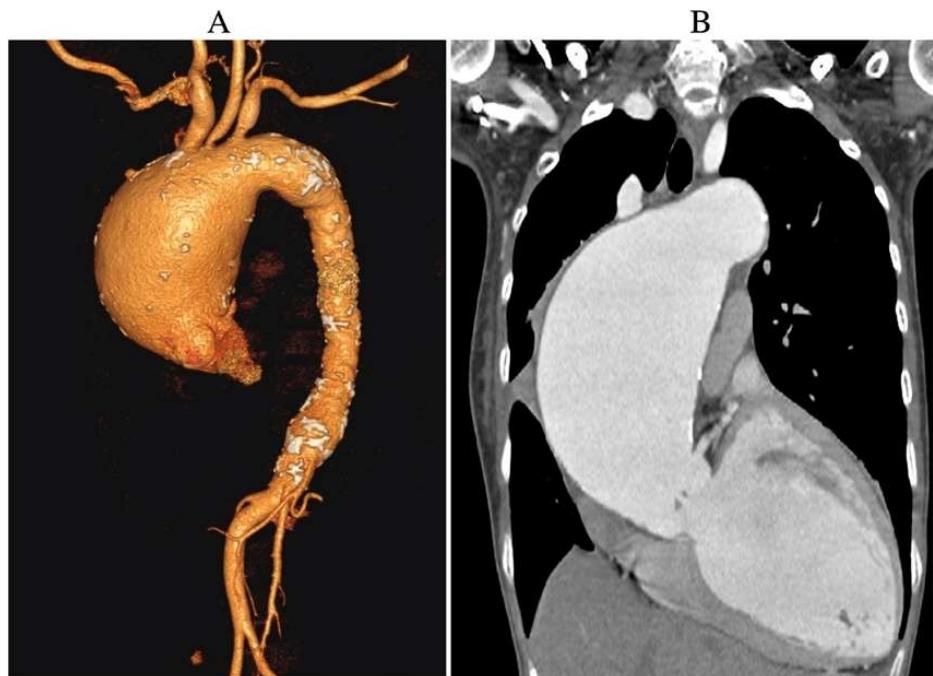


Ascending aortic aneurysm

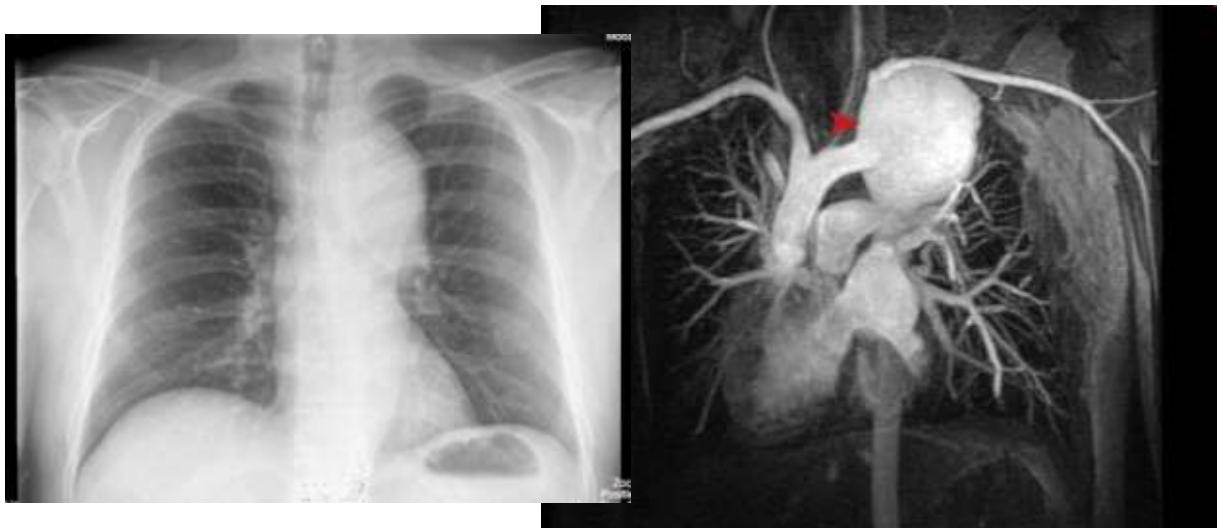


Dilatation of the ascending aorta and dilated left ventricle

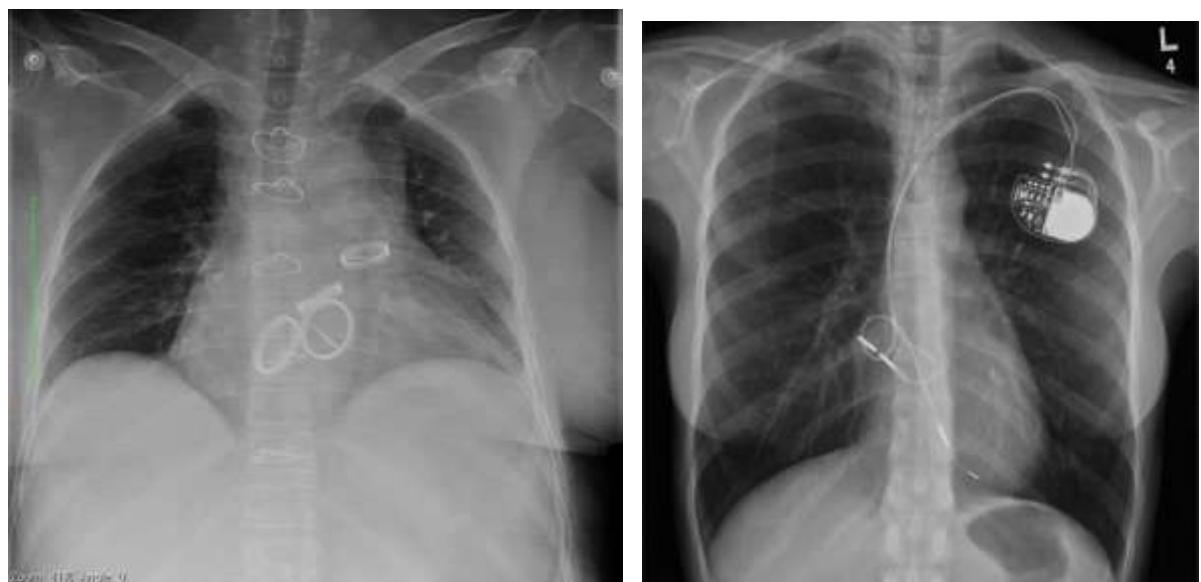
Ascending aortic aneurysm



Aortic Aneurysm



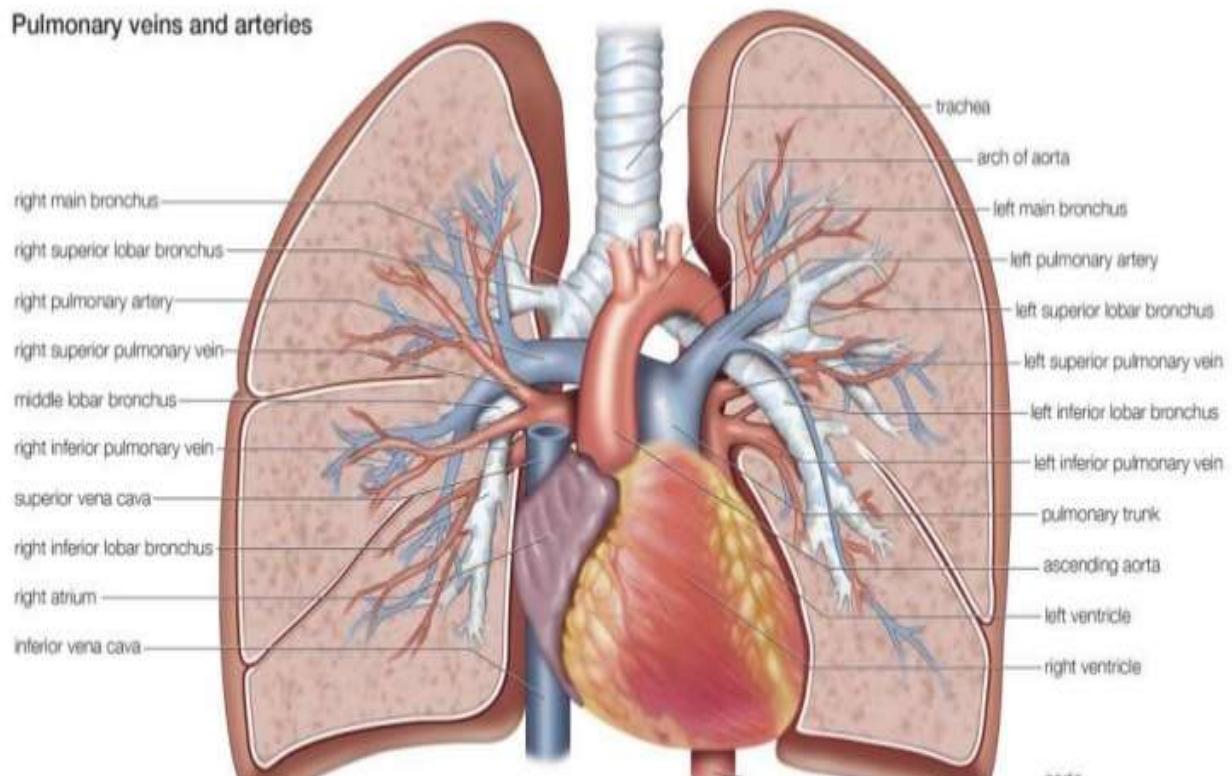
- MR-Angiography



Normal pulmonary vascular pattern (pulmonary vasculature, pulmonary picture)

- Is formed by pulmonary arteries and veins
- Dichotomic division of vessels
- The diameter of each vessel is 2 times less than the diameter of the previous
- Pulmonary pattern is more evident in the inferior regions
- Pulmonary pattern is no more seen at the distance of 1,5-2 cm from the chest wall

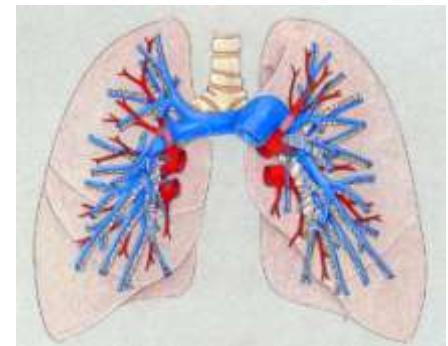
Pulmonary veins and arteries



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Changes of the pulmonary vascular pattern in cardiovascular pathology

- Hypovolemia
- Hypervolemia (pulmonary plethora)
- Venous congestion
- Pulmonary hypertension:
 - Arterial
 - Venous
 - Mixt





Hipovolemia

1. A poor pulmonary pattern
2. Major pulmonary transparency
3. Lung hila are structured and slim
4. The second border on left – pulmonary artery is normal or decreased or dilated (poststenotic dilation)

Pulmonary vasculature: Hypovolemia

- ✓ Pulmonary hyperlucency
- ✓ Narrow peripheric pulmonary arteries
- ✓ Narrow hilum
- ✓ Changes of the PA convexity



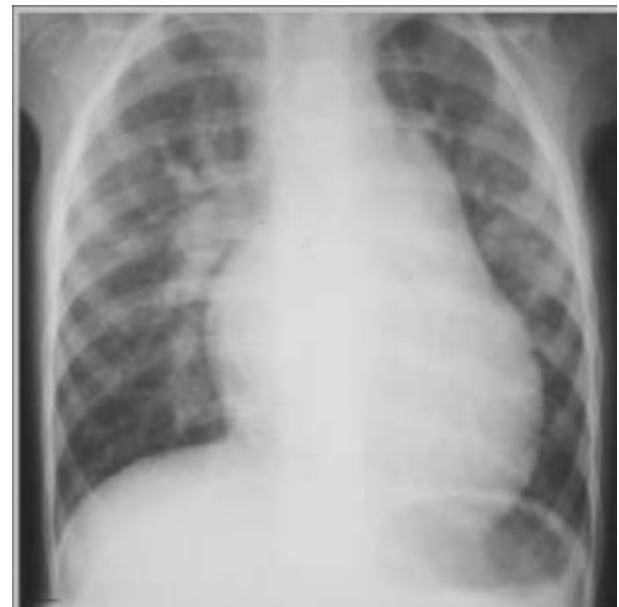


Hipervolemia

1. An enhanced pulmonary pattern
2. Lung hila are dilated
3. Cardiac gulf leveled

Pulmonary vasculature: Arterial hypervolemia

- ✓ Dilated pulmonary arteries
- ✓ Dilated hilum
- ✓ Evident PA convexity



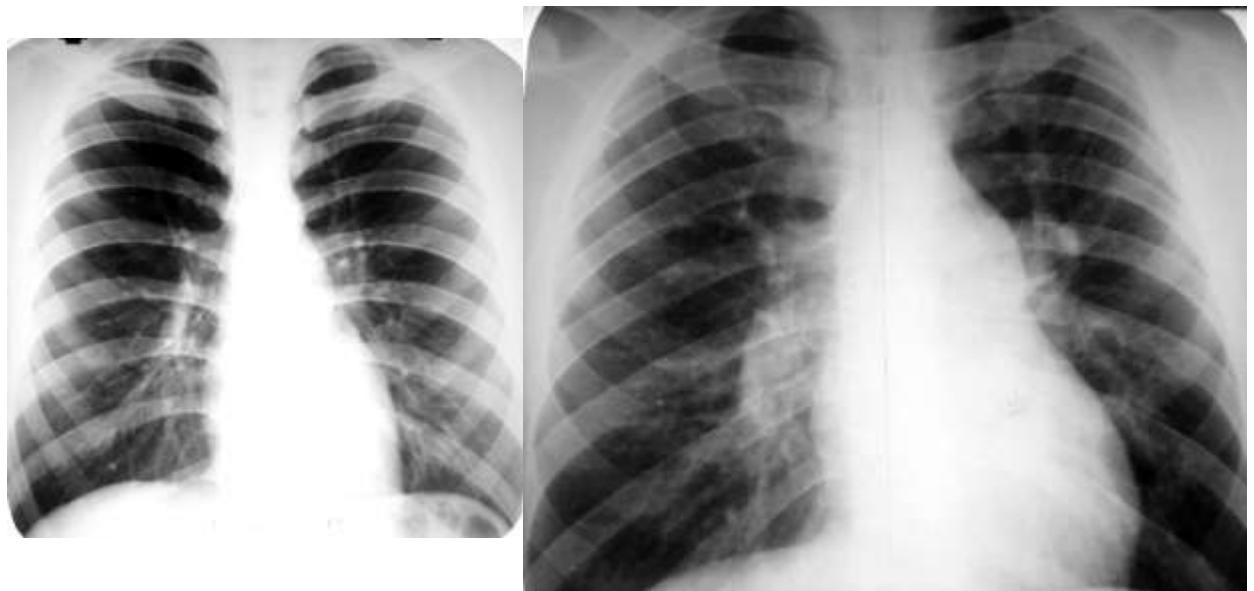
Pulmonary interstitial edema

Pulmonary vasculature: Venous congestion. Pulmonary edema

- ✓ Homogenized hilum
- ✓ Diminution of the pulmonary transparency
- ✓ Lines of Kerley



Pulmonary arterial hypertension



1. The pulmonary pattern is decreased at lateral regions of the lungs
2. Major or normal pulmonary transparency
3. Lung hila are dilated
4. The second convexity on left – pulmonary artery is dilated

Pulmonary vasculature: Pulmonary arterial hypertension

- ✓ Dilated hilum
- ✓ Narrowed peripheral arteries
- ✓ Evident PA convexity
- ✓ Narrowed pulmonary veins

