

Mediastinum and Heart

Mediastinum

Mediastinum is a space in the thorax that contains a group of non-delineated organs and their surrounding connective tissue.

It lies in the midline of the chest between the pleural surfaces of each lung and extends from the sternum to the vertebral column.

The mediastinum contains all the thoracic viscera except the lungs: [heart and great vessels](#), [esophagus](#), [trachea](#), [phrenic nerve](#), [cardiac nerve](#), [thoracic duct](#), [thymus](#), and [mediastinal lymph nodes](#).

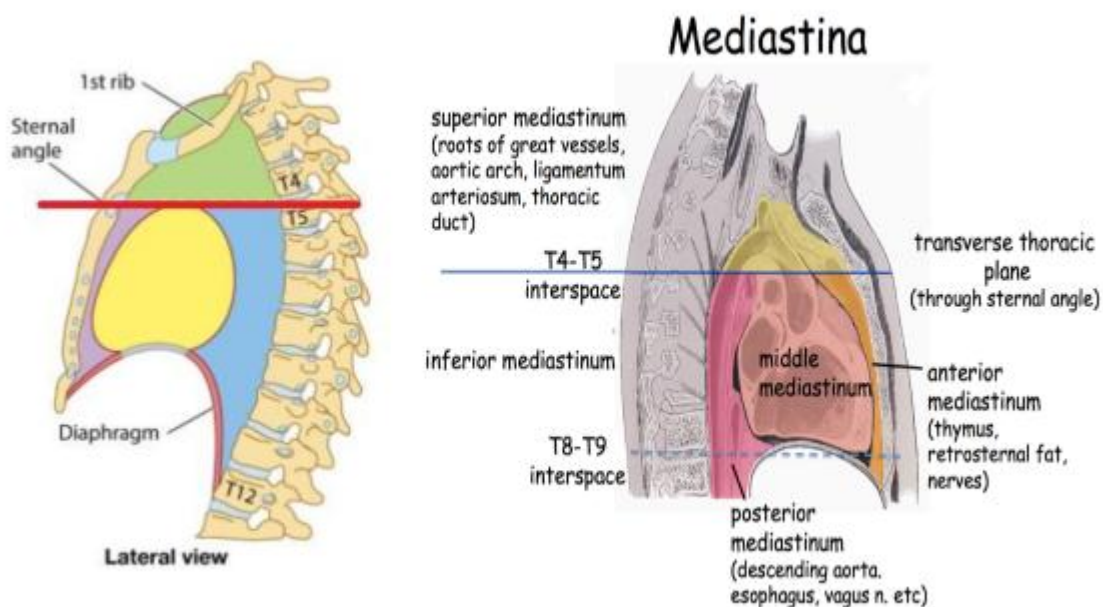
Anatomical division

The mediastinum can be divided into parts based on their relationship to the [pericardium](#):

1. [*superior mediastinum](#): is an artificially divided compartment of the [mediastinum](#) located between the [thoracic plane](#) inferiorly and the [thoracic inlet](#) superiorly
2. [*anterior mediastinum](#): anterior to the pericardium
3. [*middle mediastinum](#): within the pericardium
4. [*posterior mediastinum](#): posterior to the pericardium

Relations

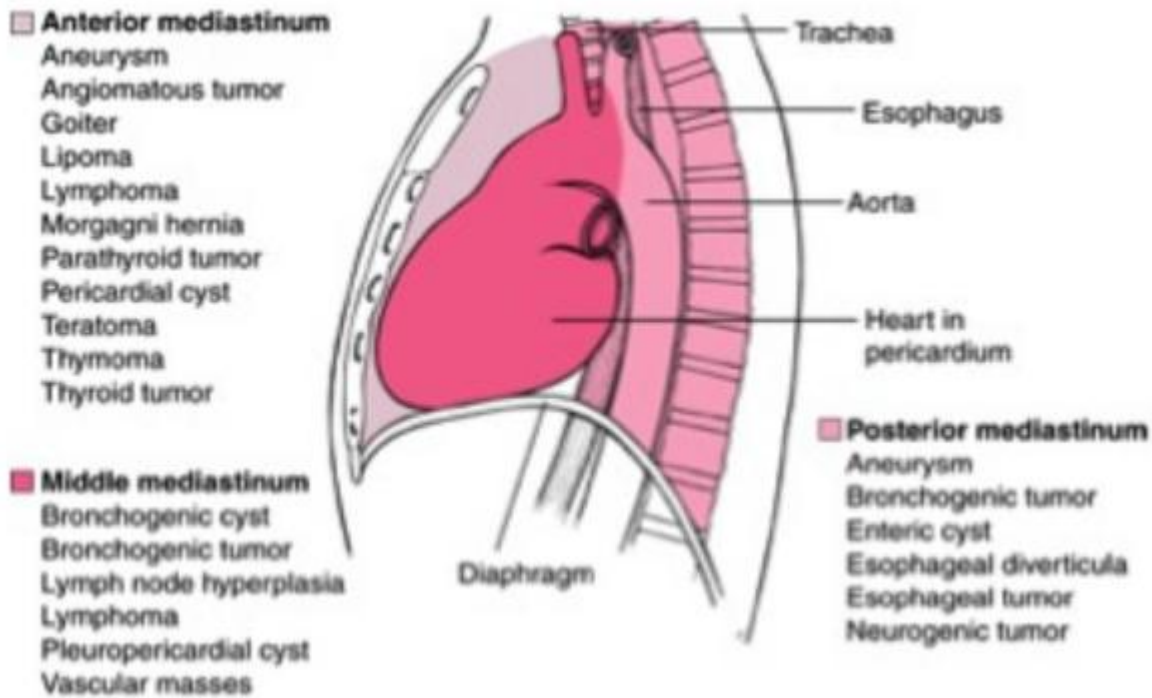
1. superiorly: continuous with the loose connective tissue of the neck
2. anteriorly: chest wall
3. laterally: lungs and pleura
4. posteriorly: thoracic spine
5. inferiorly: diaphragm



Mediastinal lesion

The differential diagnosis for an **anterior** mediastinal mass includes:

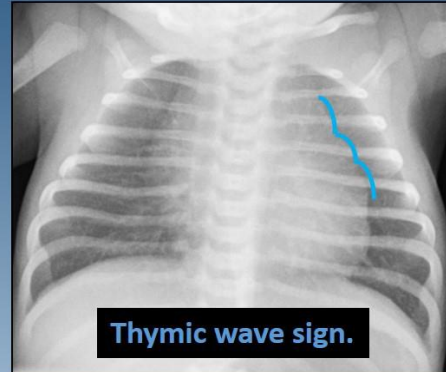
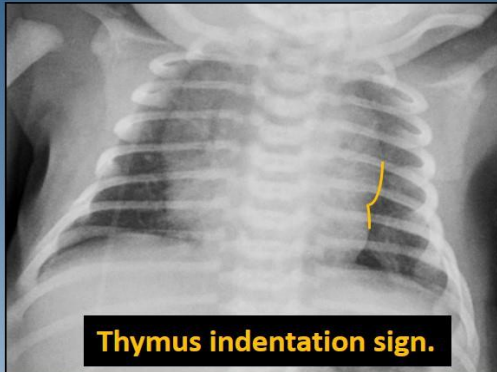
1. **thymus**
 - a. thymoma: most common primary neoplasm of the antero superior mediastinum
 - b. thymic cyst
2. **thyroid and parathyroid**
 - a. thyroid neoplasms
 - b. thyroid goitre
 - c. parathyroid neoplasms
3. **lymphoma**
 - a. Hodgkin lymphoma
 - b. non-Hodgkin lymphoma (NHL)
4. **germ cell tumours**
5. **mediastinal teratoma**
6. **teratocarcinoma (malignant teratoma)**



Normal thymus gland (sail shape sign)

1. NEONATAL CHEST X-RAY: NORMAL FINDINGS.

Thymus: normal appearance.



Retro sternal goiter

Radiographic features

Chest radiograph

It may show a superior mediastinal radio-opacity causing the deviation of trachea to opposite site. The superior margin of the radio-opacity/mass is untraceable ([cervicothoracic sign](#)).

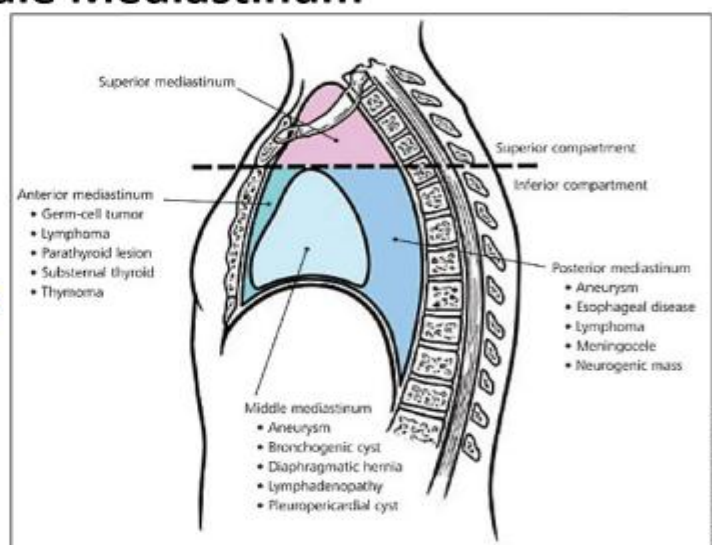


Retrosternal
goiter

Middle Mediastinum

Related Pathology

1. malignancy
2. lymphadenopathy
3. [hiatus hernia](#)
4. [thoracic aortic aneurysm](#)
5. thyroid mass
6. [bronchogenic cysts](#)



Lymph adeno pathy

The spectrum of conditions than can result in mediastinal lymph adenopathy is exhaustive and includes:

1. primary lung [lung cancer](#)
2. metastatic malignancies to the mediastinum from other sites common
 - a. [oesophageal cancers](#)
 - b. [breast cancers](#)
 - c. [thyroid cancers](#)
3. [mediastinal lymphoma](#)

primary mediastinal large B-cell lymphom

4. Sarcoidosis
5. infective (acute suppurative)
6. reactive
 - a. follicular hyperplasia
 - b. granulomatous TB , fungal infection
 - c. neoplastic
 - d. drugs: e.g. cyclosporin, phenytoin, methotrexate

- **Lymphoma**

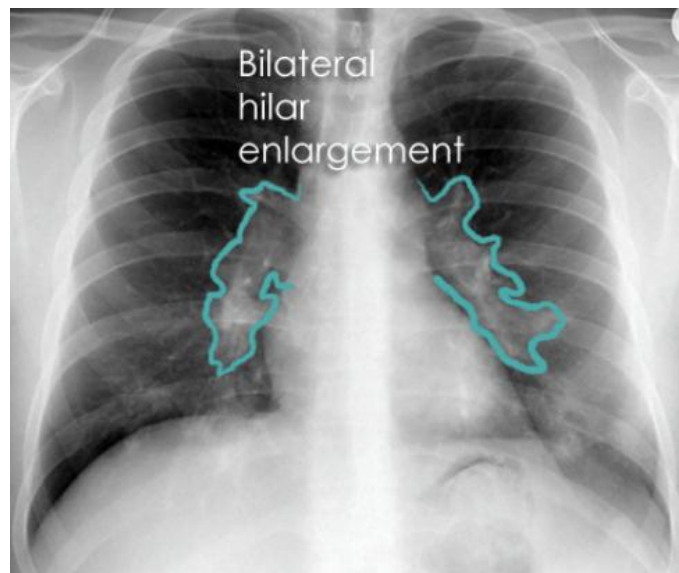
is a malignancy arising from lymphocytes or lymphoblasts. Lymphoma can be restricted to the lymphatic system or can arise as extra nodal disease. This, along with variable aggressiveness results in a diverse imaging appearance.

- **Nodal disease**

Hodgkin's disease is usually almost entirely confined to the lymph nodes.

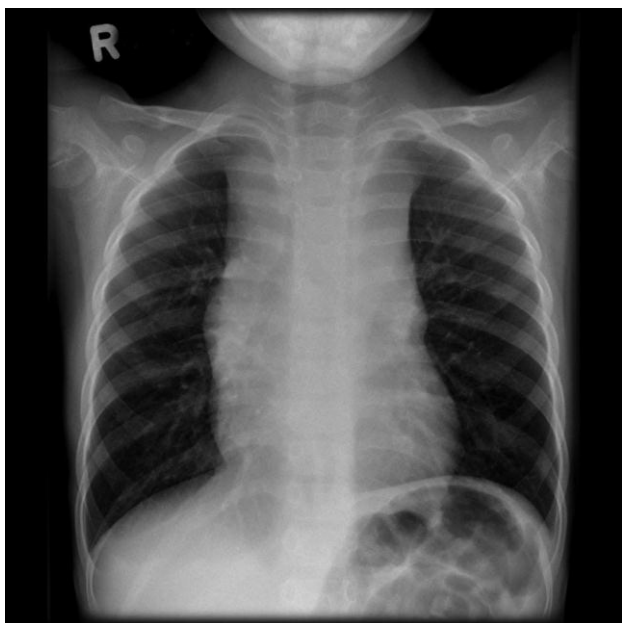
- **Extra nodal disease**

Extra nodal HD although uncommon may be found in any organ system, either as a primary manifestation or as dissemination of systemic disease.





Hodgkin lymphoma of the middle mediastinum



The differential diagnosis for **a posterior** mediastinal mass includes:

1. **neoplasm**

- a) neurogenic tumours most common nerve sheath tumours
- b) non-neurogenic tumours
- c) schwannoma
- d) neurofibromaa
- e) oesophageal neoplasm
- f) lymphoma ¹
- g) metastasis

2. **infection** : paraspinal abscess

3. **inflammation**

- a) mediastinitis
- b) sarcoidosis
- c) lymphoid hyperplasia
- d) pancreas pseudocyst

4. **vascular** : descending aortic aneurysm

5. **hernias**

- a) hiatus hernia
- b) Bochdalek hernia

6. **trauma**

7. **paraspinal hematoma**

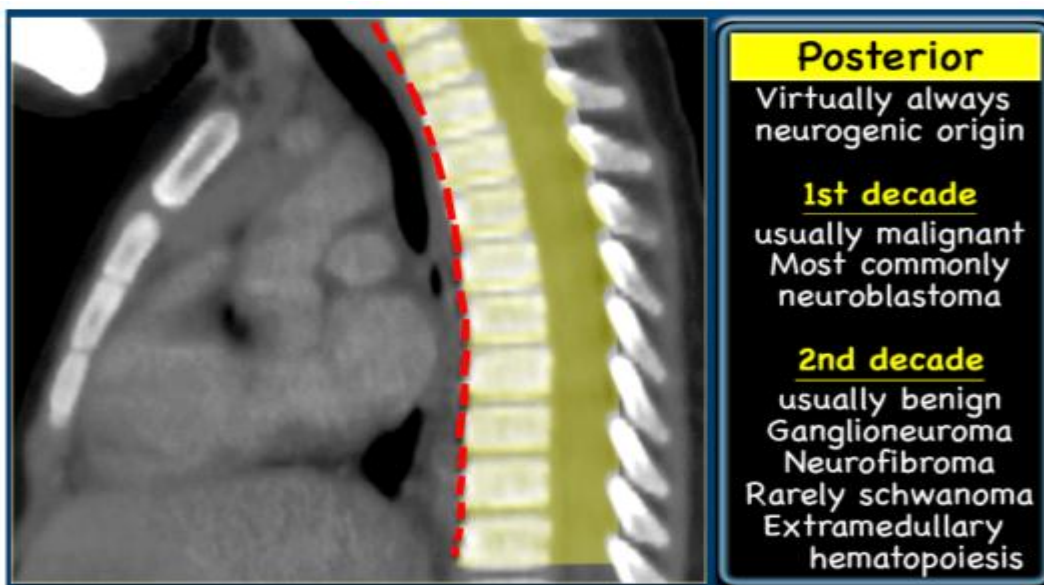
8. **lymphadenopathy**

9. **extramedullary haematopoiesis**

10. **foregut duplication cysts**

11. **neurenteric cyst**

12. **oesophageal duplication cyst**



Heart

Assessment & measurement

The heart has a somewhat conical form and is enclosed by pericardium. It is positioned posteriorly to the body of the sternum with one-third of it is situated on the right and two-thirds on the left of the midline .

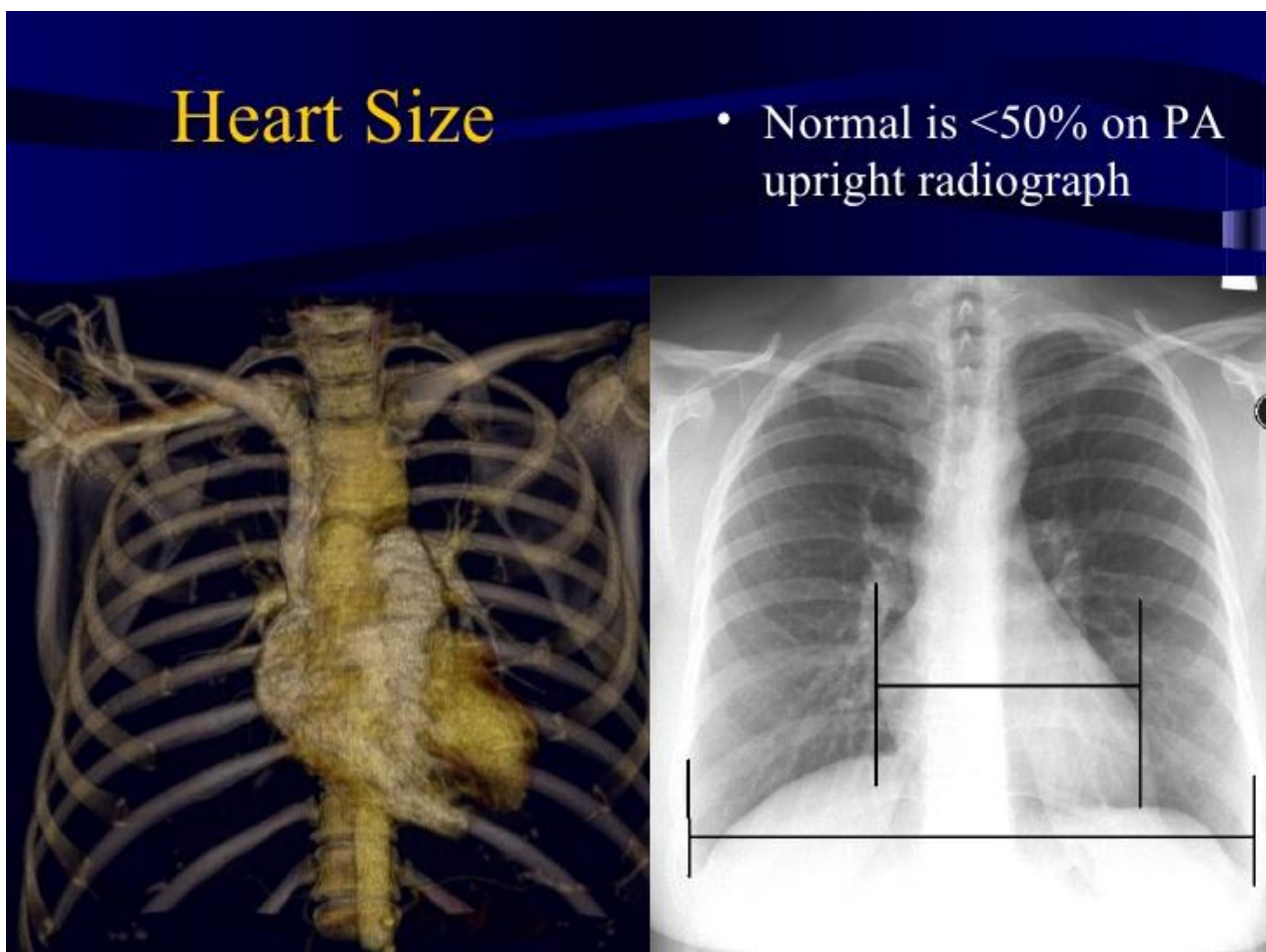
The heart has four borders:

- 1) right border: IVC, right atrium, SVC
- 2) left border: left ventricle, left atrium, pulmonary trunk and arch of aorta
- 3) inferior border: right ventricle
- 4) superior border: right and left atria, SVC, ascending aorta and pulmonary trunk

Cardiothoracic ratio (CTR) = Cardiac Width : Thoracic Width

A CTR of greater than 1:2 (50%) is considered abnormal. This however, assumes the projection is Posterior-Anterior (PA), and that cardiac size is not exaggerated by factors such as patient rotation or an incomplete breath in .

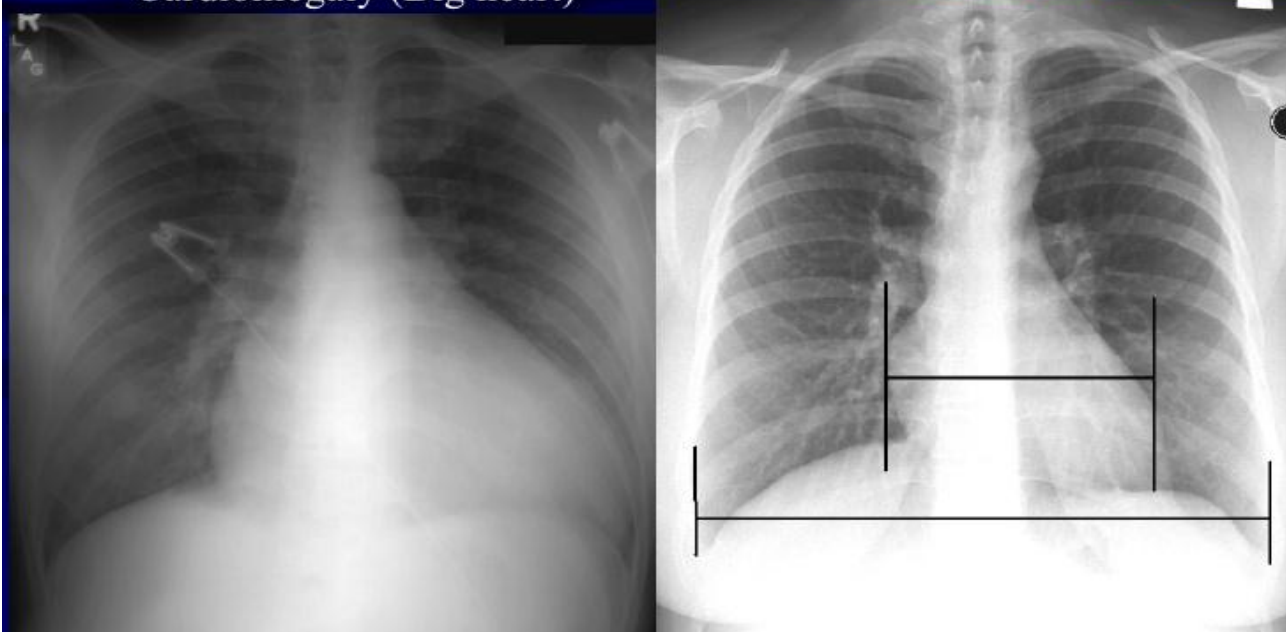
The **cardiothoracic ratio** aids in the detection of **cardiomegaly**, or more broadly, enlargement of the **cardiac silhouette**.



Increased Cardiac Size

Cardiomegaly (Big heart)

Normal for comparison



Enlargement of the cardiac silhouette on chest x-ray can be due to a number of causes :

1. cardiomegaly (most common cause by far)
2. pericardial effusion
3. anterior mediastinal mass
4. prominent epicardial fat pad

Causes of cardiomegaly

There are many aetiologies for cardiomegaly. The list includes:

1. Mitral valve disease
2. Congestive heart failure
3. Congenital heart disease
 - a. -tetralogy of Fallot
 - b. -Ebstein anomaly

Mitral valve disease

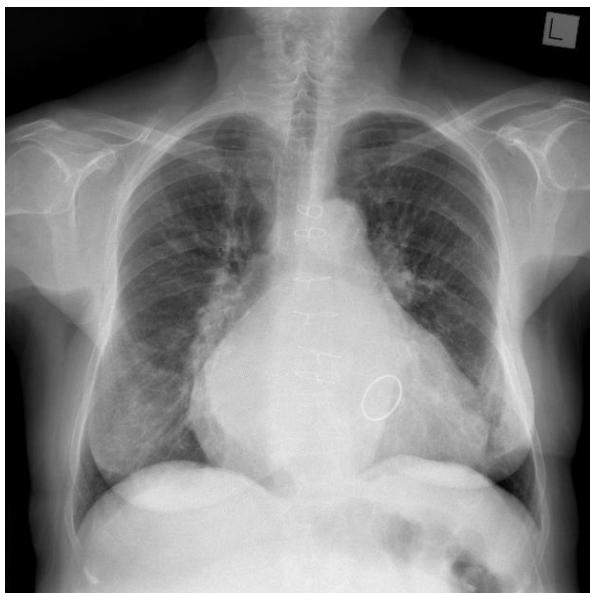
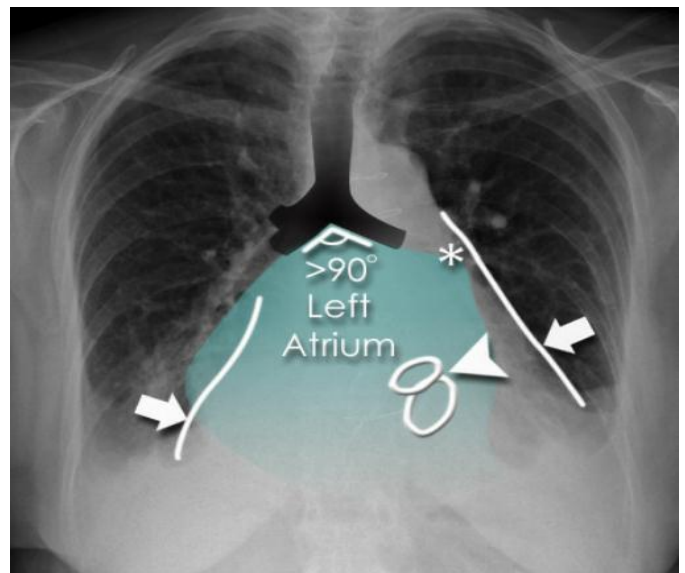
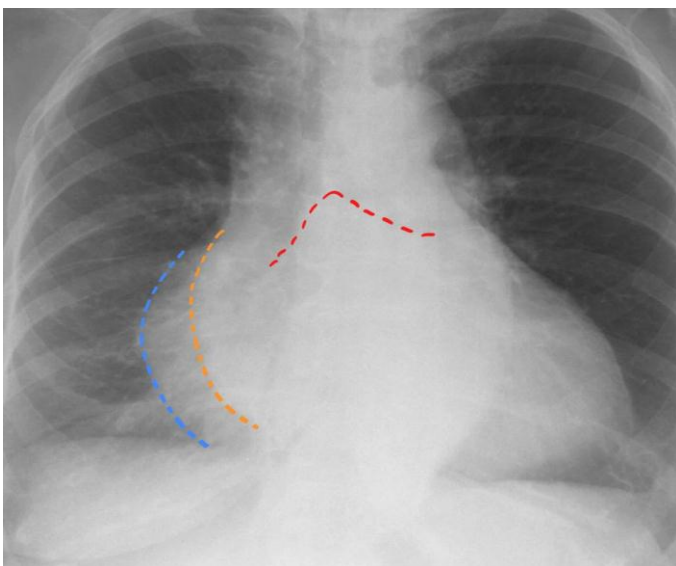
Radiographic features

Plain film

Typical radiographic features of mitral regurgitation include :

frontal projection

1. **left atrial enlargement**
convexity or straightening of the left atrial appendage just below the main pulmonary artery (along left heart border)
2. **double density sign**: the right side of the enlarged left atrium pushes into the adjacent lung and creates an additional contour superimposed over the right heart
3. **elevation of the left main bronchus and splaying of the carina**
4. **upper zone venous enlargement due to pulmonary venous hypertension**
5. **left ventricular enlargement is also eventually present due to volume overload**
6. **Features of pulmonary oedema may also be present.**



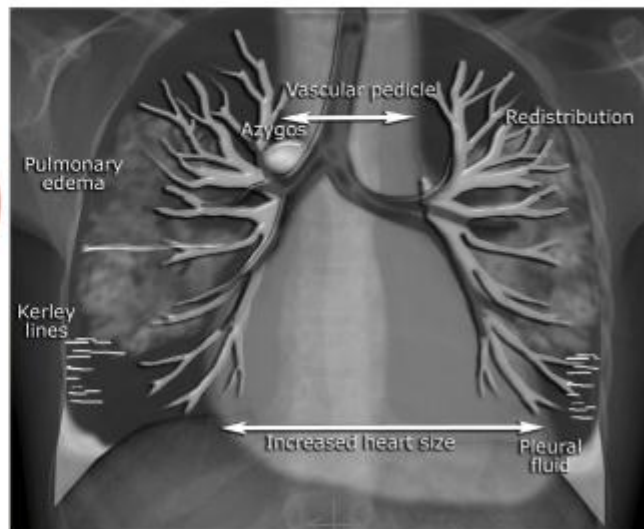
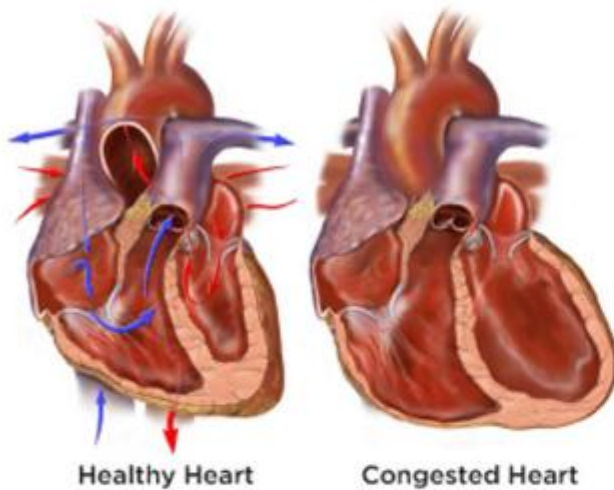
Congestive cardiac failure (CCF) is a form of cardiac failure which is primarily manifested by the heart inability to pump the volume of blood. It can affect the left (common) or right cardiac chambers or both.

Radiographic features

Chest radiograph

With left sided congestive cardiac failure, the features are that of pulmonary edema which includes:

1. central pulmonary venous congestion (prominent hilum)
2. cephalisation of pulmonary veins (upper lobe pulmonary venous diversion)
3. pulmonary interstitial oedema
4. pulmonary alveolar oedema
5. Cardiomegaly
6. Pleural effusion



Pulmonary edema is a broad descriptive term and is usually defined as an abnormal accumulation of fluid in the extra-vascular compartments of the lung .

Radiographic features

Septal lines, also known as **Kerley lines**, are seen when the **interlobular septa** in the **pulmonary interstitium** become prominent. This may be because of lymphatic engorgement or edema of the connective tissues of the interlobular septa. They usually occur when pulmonary capillary wedge pressures reach 20-25 mmHg ,

Classification

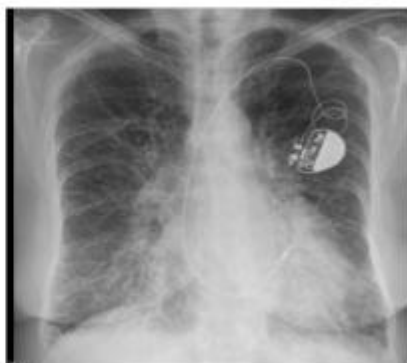
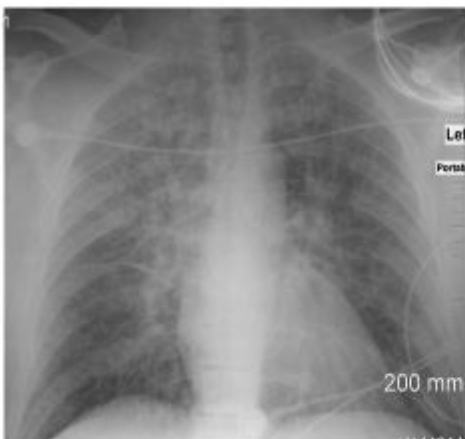
1. Kerley A lines

These are 2-6 cm long oblique lines that are <1 mm thick and course towards the hila. They represent thickening of the interlobular septa

2. Kerley B lines

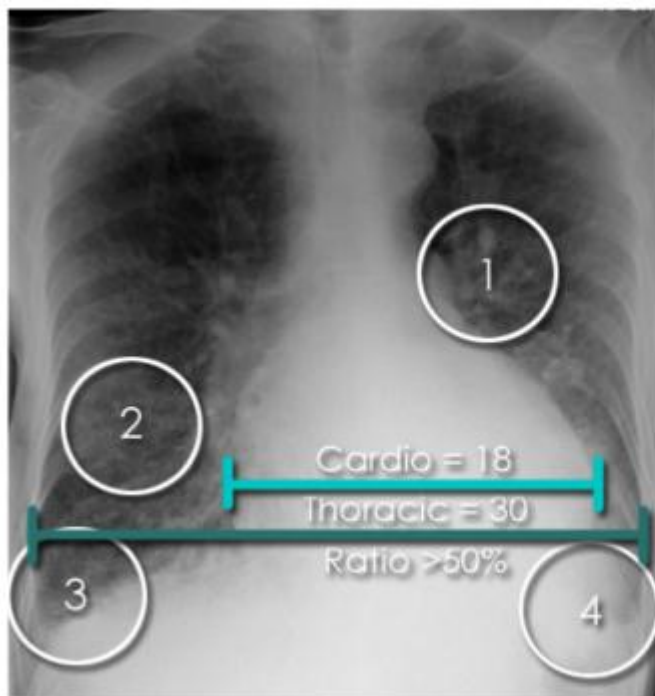
These are 1-2 cm thin lines in the peripheries of the lung. They are perpendicular to and extend out to the pleural surface . They represent thickened sub pleural interlobular septa and are usually seen at the lung bases.

Interstitial pulmonary edema



radiograph include if pressure > 25 mmHg the findings of :

1. cardiac size/**cardio-thoracic ratio**: useful for assessing for an underlying cardiogenic cause or association
2. **bat wing pulmonary opacities**
3. **presence of peri-bronchial cuffing**
4. **septal lines: Kerley lines become more prominent**
5. **pleural effusions**
6. **pulmonary venous engorgement**/pulmonary blood flow distributionupper lobe pulmonary venous diversion



Signs of heart failure

- ◆ Cardiomegaly CTR = 18/30
- ◆ Upper zone vessel enlargement (1) pulmonary venous hypertension
- ◆ Pulmonary oedema (2) - bilateral in markings (classically peri-hilar and wings - more widespread in this case)
- ◆ Septal (Kerley B) lines (3) - See next
- ◆ Pleural effusions (4)

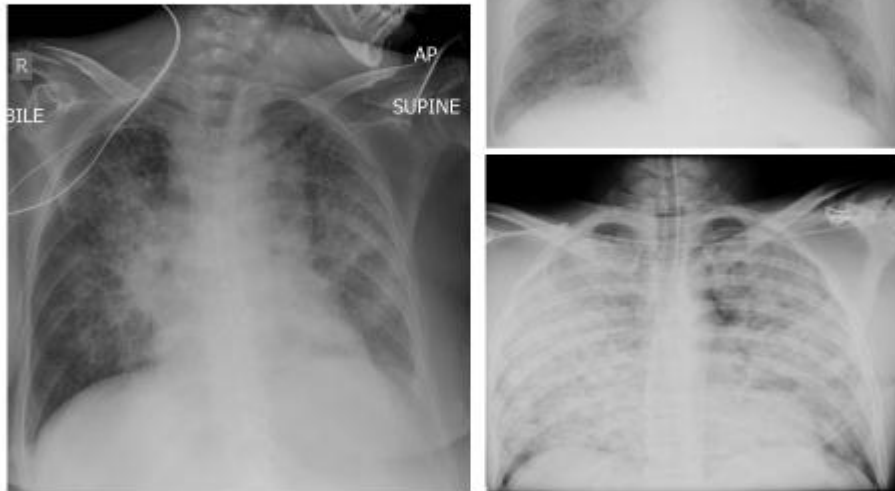
Clinical information

- ◆ Worsening exercise tolerance
- ◆ Chronic uncontrolled hypertension
- ◆ Rapid onset of shortness of breath
- ◆ Atrial fibrillation

Diagnosis

- ◆ Left ventricular failure with pulmonary

Alveolar pulmonary edema

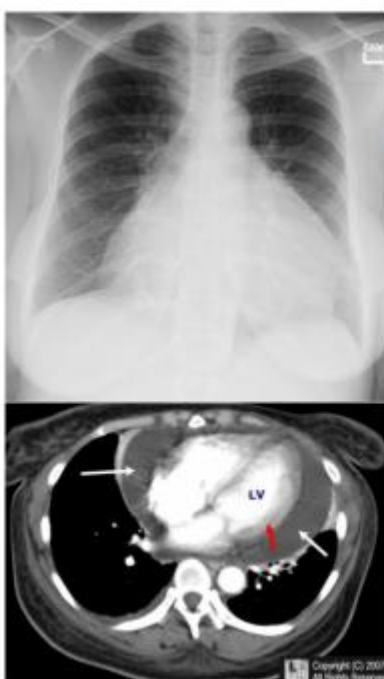


Pericardial effusions occur when fluid collects in the pericardial space (a normal pericardial sac contains approximately 30-50 mL of fluid).

Radiographic features

Plain radiograph

a very small pericardial effusion can be occult on plain film there can be globular enlargement of the cardiac shadow giving a **water bottle configuration** known as Globe shape heart or pumpkin shape heart



Pericardial effusion



Congenital heart disease

A . CCHD

A number of entities can present as cyanotic congenital heart disease. These can be divided into those with increased or decreased pulmonary vascularity. They include:

1) increased pulmonary vascularity

- a) total anomalous pulmonary venous return (TAPVR) (types I and II)
- b) transposition of the great arteries (TGA)
- c) truncus arteriosus (types I, II and III)
- d) large AVSD
- e) single ventricle without pulmonary stenosis

2) decreased pulmonary vascularity

- a) tetralogy of Fallot
- b) pentalogy of Cantrell
- c) many other combined and infrequent anomalies such as
- d) Ebstein anomaly with atrial septal defect

B . ACCHD

There are numerous causes of **acyanotic congenital heart disease** and can be divided into those that have increased pulmonary vascularity and those that do not. They include:

1) increased pulmonary vascularity

- a) ventricular septal defect (VSD)
- b) atrial septal defect (ASD)
- c) atrioventricular septal defect (AVSD)
- d) patent ductus arteriosus (PDA)

2) normal pulmonary vascularity

- a) small shunts (see above)
- b) aortic valve stenosis
- c) aortic coarctation
- d) pulmonary stenosis

Tetralogy of Fallot (TOF) is one of the most common cyanotic congenital heart conditions and continues to be a major source of morbidity .

Tetralogy of Fallot is classically characterised by four features which are:

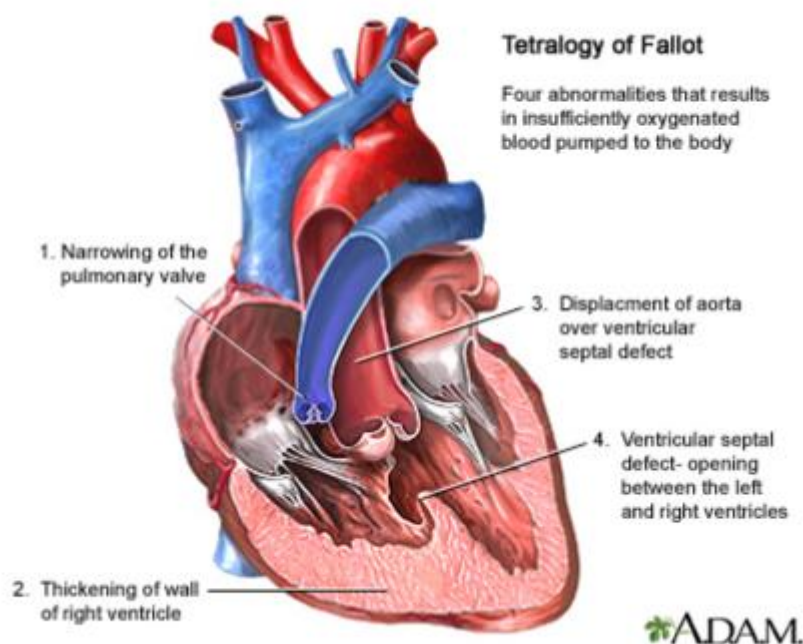
- 1) ventricular septal defect (VSD) ⁶
- 2) right ventricular outflow tract obstruction (RVOTO) due to: pulmonary artery stenosis
- 3) overriding aorta
- 4) right ventricular hypertrophy

Radiographic features

Plain film

Plain films may classically show :

- 1) "boot shaped" heart with an upturned cardiac apex due to right ventricular hypertrophy and concave pulmonary arterial segment.
- 2) Pulmonary oligoemia due to decreased pulmonary arterial flow.
- 3) Right sided aortic arch is seen in 25%.



TOF

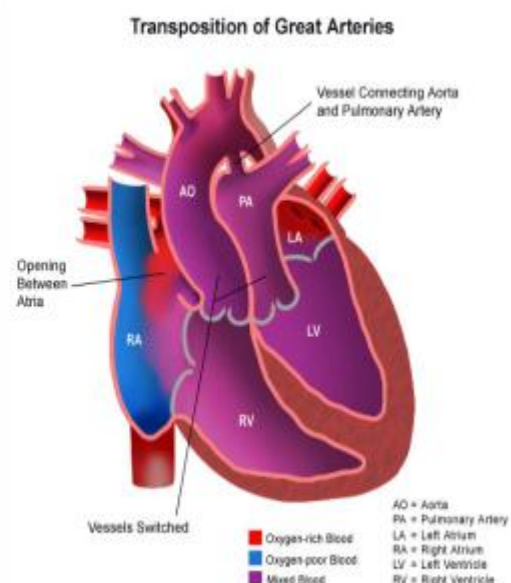
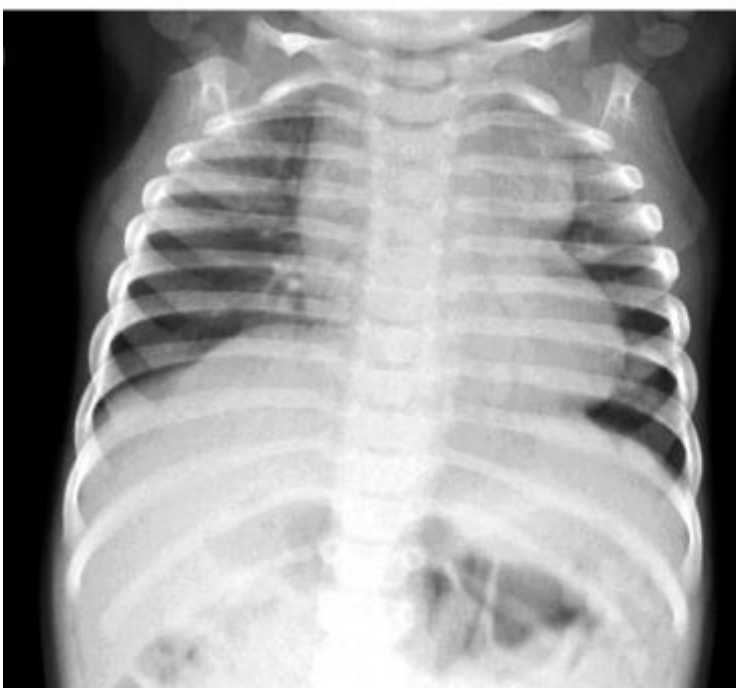


Transposition of the great arteries (TGA) is the most common cyanotic congenital cardiac anomaly with cyanosis in first 24 hours of life. It accounts for up to 7% of all congenital cardiac anomalies

Chest radiograph

A frontal chest radiograph classically shows cardiomegaly with a cardiac contours classically described as appearing like an **egg on a string**. There is often an apparent narrowing of the superior mediastinum as result of the aortic and pulmonary arterial configuration.

Egg-on-a-string sign (TGA)



Ventricular septal defects (VSD) They represent one of the most common congenital cardiac anomalies and up to 40% associated with such anomalies . They are considered the most common congenital cardiac abnormality diagnosed in children and the second most common diagnosed in adults

Ventricular septal defects (VSD) represent defects in the inter ventricular septum that allow a hemodynamic communication between the right and left ventricles. It typically results in a left to right shunt.

Radiographic features

Plain film

The chest radiograph can be normal with a small VSD.

Larger VSDs may show

- 1) cardiomegaly (particularly left atrial enlargement although the right and left ventricle can also be enlarged).
- 2) A large VSD may also show features of pulmonary arterial hypertension.
- 3) pulmonary oedema
- 4) pleural effusion and/or increased pulmonary vascular markings.

Pulmonary arterial hypertension

results from elevation of the resistance in the pulmonary arterial bed, usually at the arteriolar level. It is characterized radiographically by enlargement of the pulmonary trunk and right and left main pulmonary arteries with disproportionately small peripheral vessels This has been referred to as "pruning" of the pulmonary arteries

So the Plain radiograph

- 1) elevated cardiac apex due to right ventricular hypertrophy
- 2) enlarged right atrium
- 3) prominent pulmonary outflow tract
- 4) enlarged pulmonary arteries
- 5) pruning of peripheral pulmonary vessels

Pulmonary venous hyper tension

Pulmonary venous hypertension (PVH) results from an increase in pressure in the pulmonary veins, usually as a result of left atrial hypertension. This is measured clinically as an increase in the pulmonary capillary wedge pressure (PCWP) over the normal 12 to 14 mmHg.

Mild elevation of the PCWP results in redistribution of the pulmonary blood flow to the non-dependent lung zones

As the pressure approaches 20 mmHg, interstitial edema develops

Common **causes** of PVH:

- 1.obstruction to LV inflow,
- 2.LV systolic dysfunction,
- 3.severe mitral regurgitation,
- 4.acute pulmonary and systemic volume overload.



Eisenmenger syndrome is a complication of an uncorrected high-flow, high-pressure congenital heart anomaly leading chronic pulmonary arterial hypertension and shunt reversal .

Important Complications of VSD

Eisenmenger phenomenon with shunt reversal (i.e. L to R becomes R to L)

Very important to consider

- 1) **figure of 3 sign**: contour abnormality of the aorta with inferior rib notching : Roesler sign in Coarctation of the aorta
- 2) **"box shape"** heart in Ebstein anomaly
- 3) boot shaped heart (**TOF**)
- 4) Egg-on-a-string sign (**TGA**)
- 5) figure of 8 heart or cottage loaf heart in Total anomalous pulmonary venous return (**TAPVR**)

"box shape" heart in **Ebstein anomaly**

