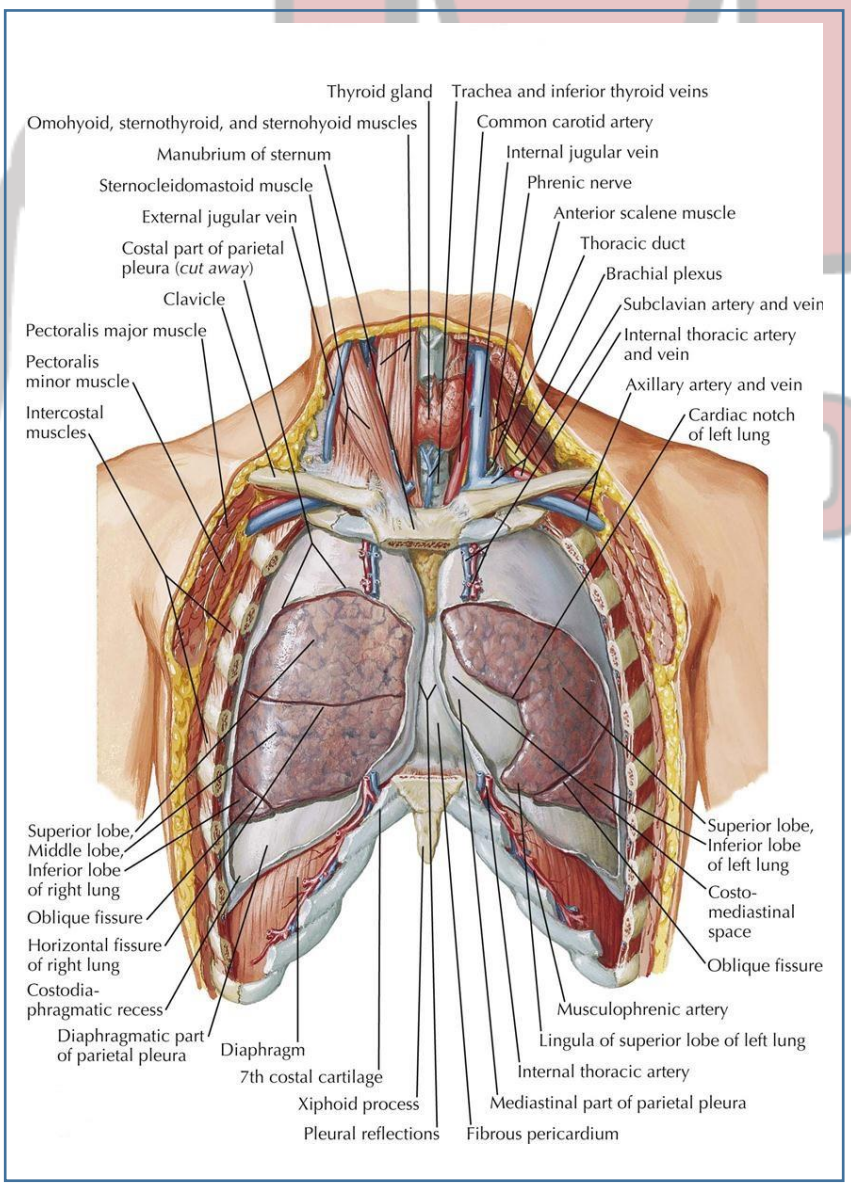
HUMAN ANATOMY



First Year MBBS

Note: Underlined and bold words are important and often asked by teachers in vivas. Some frequently asked questions are also mentioned here.

These are maximum clinicals of Thorax put together from different books and internet by **Umer Shehroz Khan** (Kemcolian)

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Thorax:

Bones and Joints:

- **Cervical rib:**

A cervical rib is an extra rib that forms above the first rib, growing from the base of the neck just above the collarbone. A cervical rib occurs in 0.5% people. It's not usually a problem, but if it presses on nearby nerves and blood vessels, it can cause neck pain, numbness in the arm and other symptoms. This is known as **thoracic outlet syndrome**.

➢ Rib fractures:

- The most common ribs fractured are the 7th to 10th ribs.
- The commonest site of fracture is just anterior to the angle of ribs.
- Fracture of the first rib may injure the brachial plexus and subclavian vessels.
- The middle ribs are most commonly fractured and usually result from direct blows or crushing injuries. The broken ends of ribs may cause pneumothorax and lung or spleen injury.
- Lower rib fractures may tear the diaphragm, resulting in a diaphragmatic hernia.

Sternum:

- ➢ The sternum is a common site for bone marrow biopsy because it possesses hematopoietic marrow throughout life. Needle pierce thin cortical bone, & enters spongy bone. It is done in its upper half to avoid the injury to the arch of aorta which lies behind its lower half.
- ➢ Fracture of sternum is usually comminuted fracture (a break resulting in several pieces).

➢ Pectus carinatum (pigeon chest):

Pectus carinatum is a condition in which the sternum (breastbone) protrudes, or sticks out, more than usual with flattening of the chest wall. It is believed to be a disorder of the cartilage that joins the ribs to the breastbone.

➢ Pectus excavatum (funnel chest):

Pectus excavatum is a condition in which a person's breastbone is depressed or sunken into his chest. This condition can interfere with the function of the heart and lungs.

Funnel chest

Pigeon chest

➢ Median sternotomy:

Sternum is split in the median plane & retracted (because of flexibility of ribs & cartilages) to allow the surgeon to gain easy access for coronary artery bypass grafting & removal of tumors from lungs.

➢ Ectopia cordis:

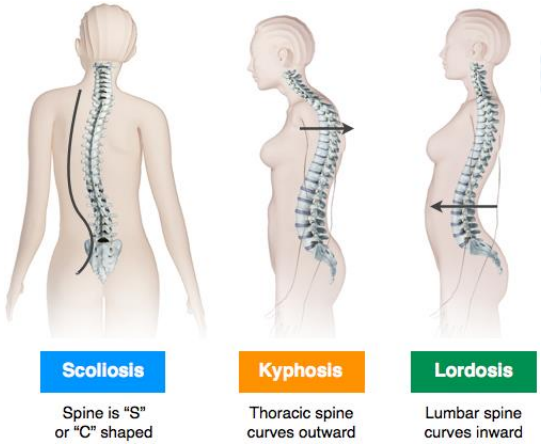
It is an extremely rare condition in which babies are born with their hearts partially or fully outside their chests. It is because halves of sternum may not fuse together which results in complete **sternal cleft** through which heart may protrude.

➢ Incomplete fusion of sternal halves leads to formation of sternal foramen (perforation) and bifid xiphoid process.

Vertebral column:

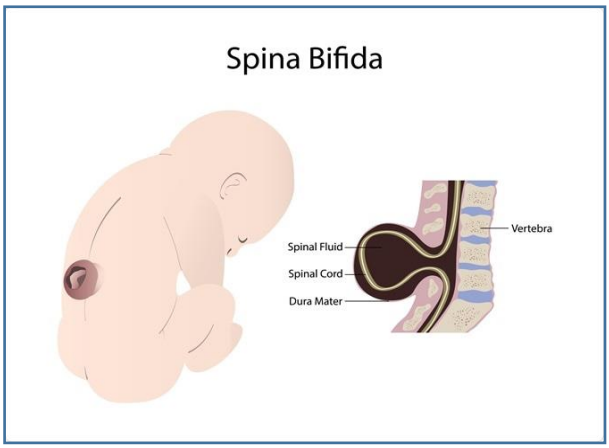
➢ **Scoliosis** is abnormal lateral curvature of vertebral column.

➢ **Kyphosis** is abnormal humped back appearance of vertebral column.



➢ Spina bifida:

It is a birth defect that occurs when the spine and spinal cord doesn't form properly. It's a type of neural tube defect. The two halves of neural arch may fail to fuse leaving a gap in the midline of the vertebral column. This is called spina bifida. Meninges and spinal cord may herniate out through the gap.



➢ Hemivertebra:

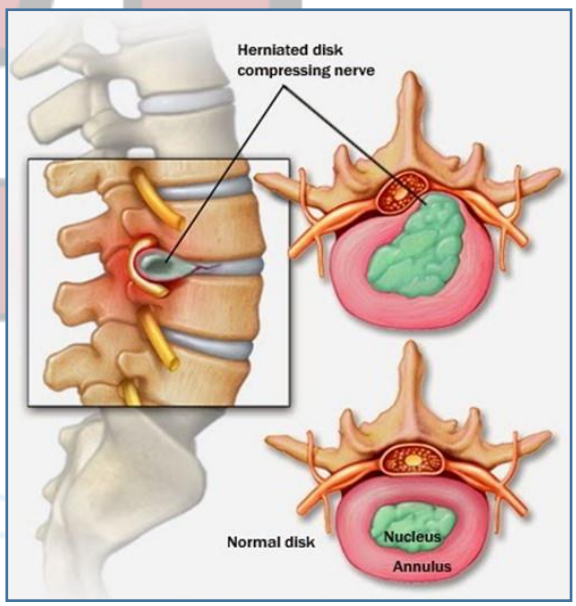
It is a rare congenital spinal malformation, where only one side of the vertebral body develops, resulting in deformation of the spine, such as scoliosis, lordosis, or kyphosis.

➢ Disc prolapse:

When an intervertebral disc is subjected to strain, the annulus fibrosus may rupture leading to prolapse of the nucleus pulposus. This is commonly referred to as disc prolapse. It may occur even after a minor strain. In addition to prolapse of the nucleus pulposus, internal derangements of the disc may also take place.

Site: Disc prolapse is usually posterolateral. Disc prolapse occurs most frequently in the lower lumbar region. It is also common in the lower cervical region from fifth to seventh cervical vertebrae.

Effects: The prolapsed nucleus pulposus presses upon adjacent nerve roots and gives rise to pain that radiates along the distribution of the nerve. Such pain along the course of the sciatic nerve is called **sciatica**. Motor effects, with loss of power and reflexes, may follow.



Thoracic wall:

- The chest wall of the child is highly elastic, and fractures of the ribs are rare. In adults, the ribs may be fractured by direct or indirect violence. In indirect violence, like crush injury, the rib fractures at its weakest point located at the angle. The upper two ribs which are protected by the clavicle, and the lower two ribs which are free to swing are least commonly injured.
- Intercostal spaces are **11** on the back and only **9** in front of chest.
- Intercostal muscles are in 3 layers, external, internal and transversus. These correspond to the muscle layers of anterior abdominal wall.
- Neurovascular bundle lies in the upper part of the intercostal space in between internal and inner most intercostal muscles.
- Right posterior intercostal arteries are longer than the left ones.

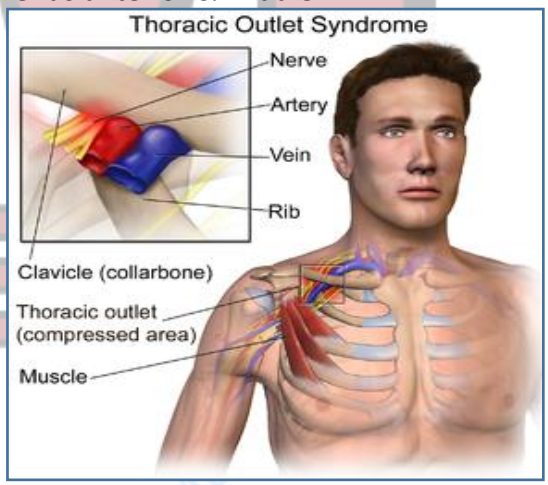
➢ Thoracic outlet Syndrome:

Two structures pass through thoracic outlet (space between clavicle & 1st rib): the subclavian artery and first thoracic nerve (lower trunk of brachial plexus i.e. C8 & T1). These structures may be pulled or pressed by

1) cervical rib which is abnormal rib.

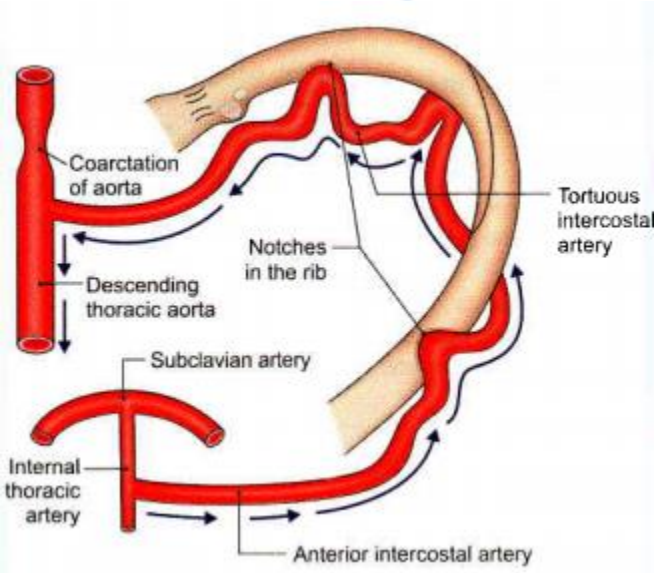
2) variations in the insertion of the scalenus anterior & middle.

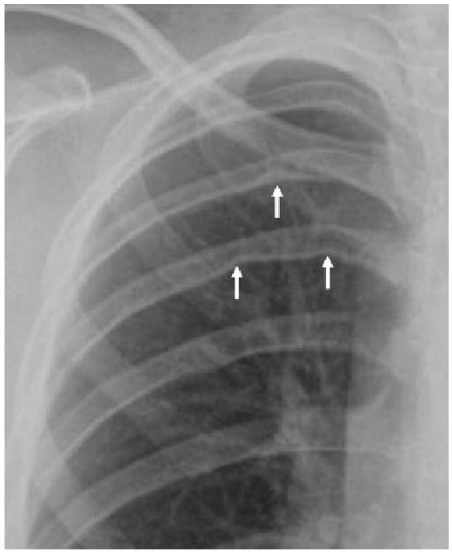
Compression of lower trunk causes **sensory loss** across medial border of forearm & wasting of intrinsic muscles of hand. Whereas, compression of subclavian artery causes ischemic muscle pain in upper limb.



➢ Notching of ribs:

In coarctation or narrowing of aorta, posterior intercostal arteries get enlarged greatly to provide a collateral circulation. Pressure of enlarged arteries produce characteristic notching on ribs especially in their posterior parts.





➢ Hiccups:

These are spasmodic involuntary sharp contraction of diaphragm accompanied by closed glottis. It is common in normal individuals and occurs after eating or drinking as a result of gastric irritation of the vagus nerve endings. Its causes are:

1. gastric irritation

2. phrenic nerve irritation

3. uraemia

4. peritonitis.

It can be stopped by sectioning phrenic nerve.

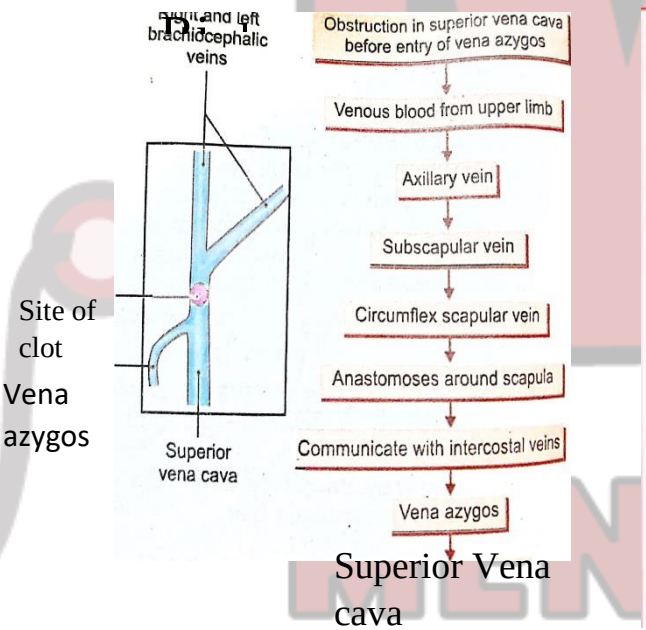
- 2nd costal cartilage at the manubriosternal angle is extremely important landmark. The 2nd intercostal space lies below this cartilage and is used for counting the intercostal spaces for the position of heart, lungs and liver.
- 1-7 ribs with costal cartilages reach the sternum, costal cartilages of 8-10 ribs form **the costal margin**, while 11th and 12th ribs do not reach the front at all.
- **Apex beat** lies below and to the normally placed left nipple
- Chest pain results from:

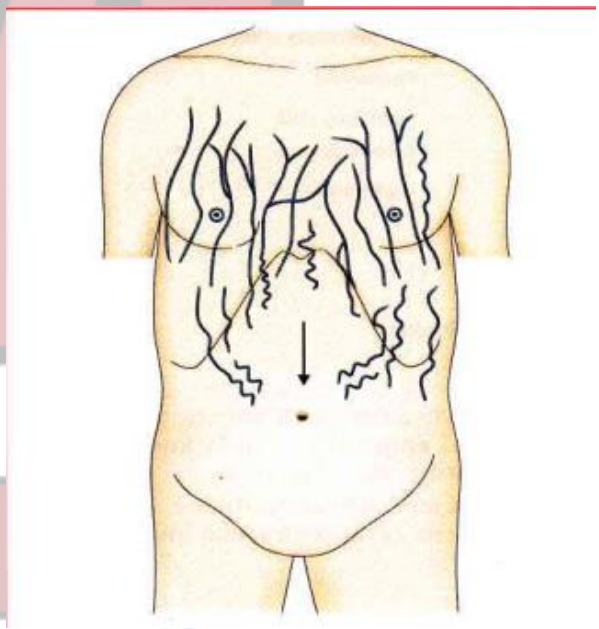
1)cardiac disease. 2)pulmonary disease. 3)intestinal, gallbladder & musculoskeletal disorders.

- Irritation of the intercostal nerves causes severe pain which is referred to the front of the chest or abdomen, i.e. at the peripheral termination of the nerve. This is known as **root pain or girdle pain**.
- Herpes virus may cause infection of intercostal nerves. If herpes infection is in 2nd thoracic nerve, there is referred pain via intercostobrachial nerve to the medial side of arm.
- Pus from the vertebral column tends to track around the thorax along the course of the neurovascular bundle, and may point at any of the three sites of exit of the branches of a thoracic nerve; one dorsal primary ramus and two cutaneous branches.

➢ superior vena caval obstruction

- When the superior vena cava is obstructed before the opening of the azygos vein, the venous blood of the upper half of the body is returned through the azygos vein; and the superficial veins are dilated on the chest up to the costal margin. The pathway of blood is shown below

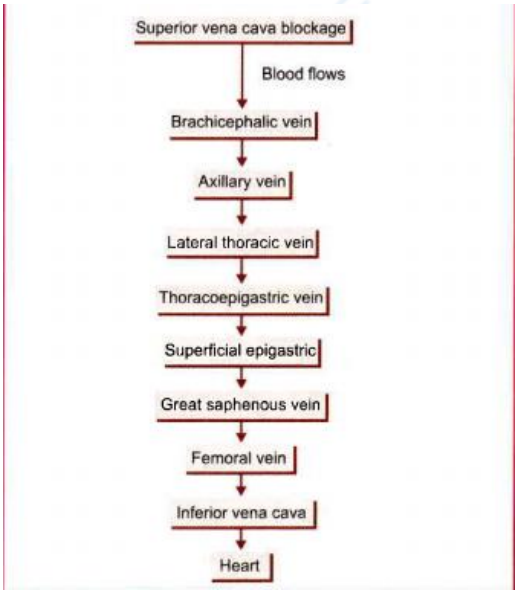


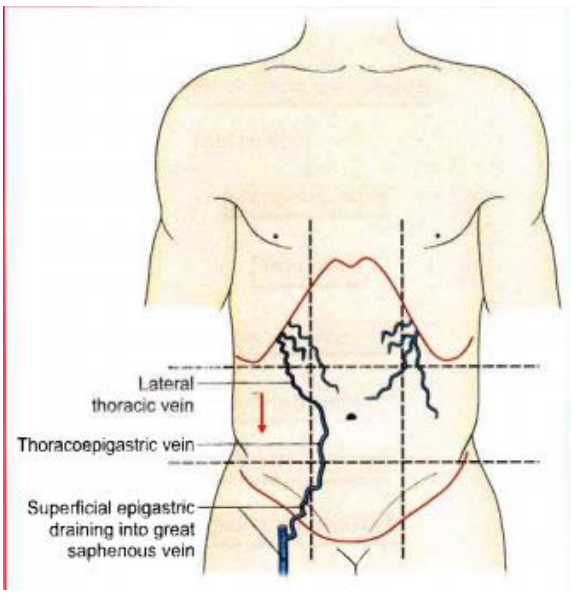


Superior vena cava blockage before the opening of azygos vein

- When the superior vena cava is obstructed <u>after the opening of the azygos veins</u>, the blood is returned through the <u>inferior vena cava via the femoral vein</u>; The superficial vein connecting the lateral thoracic vein with the superficial epigastric vein is known as the <u>thoracoepigastric vein.</u>

Superior vena cava blockage after the opening of vena azygos





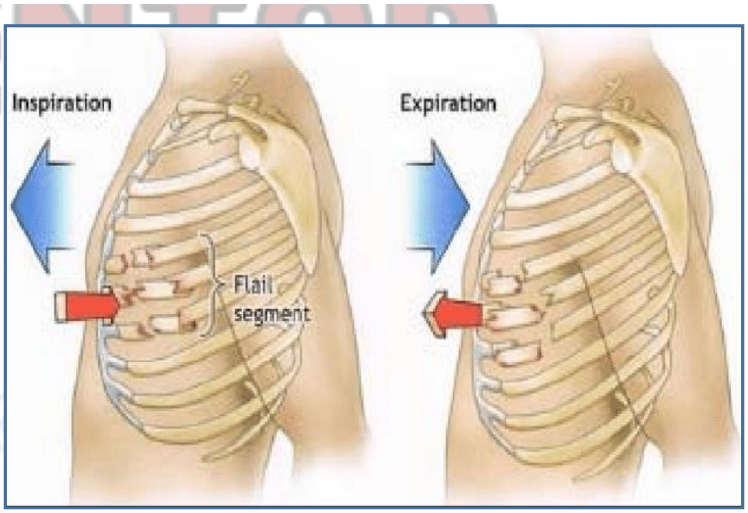
Q. To which area cardiac pain is referred and why?

A. Cardiac pain is an ischemic pain caused by incomplete obstruction of a coronary artery. Axons of pain fibers conveyed by the sensory sympathetic cardiac nerves reach thoracic one to thoracic five segments of spinal cord mostly through the dorsal root ganglia of the left side. Since these dorsal root ganglia also receive sensory impulses from the medial side of arm, forearm and upper part of front of chest, the pain gets referred to these areas. Though the pain is usually referred to the left side, it may even be referred to right arm, jaw, epigastrium or back.

➢ Paradoxical respiration:

In paradoxical breathing, the diaphragm moves upward rather than downward when you inhale, and the lungs can't expand as much. This prevents you from inhaling enough oxygen, which is important for many bodily functions. It also makes it difficult to exhale carbon dioxide. It results from 2 cases.

1. Flail chest is a loss of stability of the thoracic cage that occurs because of multiple rib fractures which allows segment of anterior & lateral thoracic wall to move freely, allowing the loose segment to move inward on inspiration and outward on expiration. Flail chest is an extremely painful injury and impairs ventilation, thereby affecting oxygenation of the blood and causing respiratory failure.



2. Injury of the phrenic nerve produce complete paralysis of the corresponding half of the diaphragm. It results in paradoxical movements i.e. paralyzed half ascends during inspiration & descends during expiration.

➢ Intercostal Nerve Block:

Anesthesia of intercostal space is produced by injecting anaesthetic agent around intercostal nerve between paravertebral line & area of required anaesthesia (anterior and lateral thoracic and abdominal walls,). The intercostal nerve should be blocked before the lateral cutaneous branch arises at the midaxillary line. Intercostal nerve block is indicated for repair of lacerations of the thoracic and abdominal walls, for relief of pain in rib fractures, and to allow pain-free respiratory movements. Nerve endings & impulses carrying information of pain from required area are blocked. Pneumothorax & hemorrhage are complications after this procedure.

➢ Thoracotomy:

Surgical creation of opening in thoracic cavity to enter pleural cavity is called Thoracotomy. 5th-7th intercostal spaces are important sites for posterior thoracotomy. A lateral approach is made with patient lying on contralateral side, upper limb is abducted placing forearm beside patient's head. The following tissues will be incised:

(a) skin, (b) subcutaneous tissue, (c) serratus anterior and pectoral muscles, (d) external intercostal muscle and anterior intercostal membrane, (e) internal intercostal muscle, (f) innermost intercostal muscle, (g) endothoracic fascia, and (h) parietal pleura.

Diaphragm:

Large openings in thoracoabdominal diaphragm

Opening	*Situation*	*Shape*	*Structures passing*	*Effect on contraction*
Vena cava	T8, junction of right and median leaflet of central tendon	Quadrilateral	IVC Right phrenic nerve Lymphatic of liver	Dilation
Oesophageal	T10, splitting of right crus	Elliptical	Oesophagus Both vagal trunks Left gastric vessels	Constriction
Aortic	T12, behind median arcuate ligament	Rounded	Aorta Thoracic duct Azygos vein	No change

- In **dyspnoea** or difficulty in breathing, the patients are most comfortable on sitting up, leaning forwards and fixing the arms. In the sitting posture, the position of diaphragm is lowest allowing maximum ventilation. Fixation of the arms fixes the scapulae, so that the serratus anterior and pectoralis minor may act on the ribs to good advantage.
- The **height of the diaphragm** in the thorax is variable according to the position of the body and tone of the abdominal muscles. It is highest on lying supine, so the patient is extremely uncomfortable, as he/she needs to exert immensely for inspiration. The diaphragm is lowest while sitting. The patient is quite comfortable as the effort required for inspiration is the least.
- The diaphragm is midway in position while standing, but the patient is too ill or exhausted to stand. So dyspnoeic patients feel comfortable while sitting
- Most prominent role in respiration is played by diaphragm.

Thoracic Cavity, Pleura and Lungs:

	Visceral	*Parietal*
Development position	Splanchopleuric mesoderm Lines surface of lung including the fissures	Somatopleuric mesoderm Lines thoracic wall, mediastinum and diaphragm
Nerve supply	Sympathetic nerves from T2–T5 ganglia Parasympathetic from vagus nerve	Thoracic nerves and phrenic nerves
Sensitivity	Insensitive to pain	Sensitive to pain which may be referred.
Blood supply	Bronchial vessels	Intercostal and pericardiacophrenic vessels
Lymph drainage	Tracheobronchial lymph nodes	Intercostal lymph nodes

- Pleura is most commonly injured at following places due to unprotected location

1. Cervical pleura & apex which causes pneumothorax.
2. Right part of infrasternal angle.
3. Right & left costovertebral angles.

➢ Pleurisy:

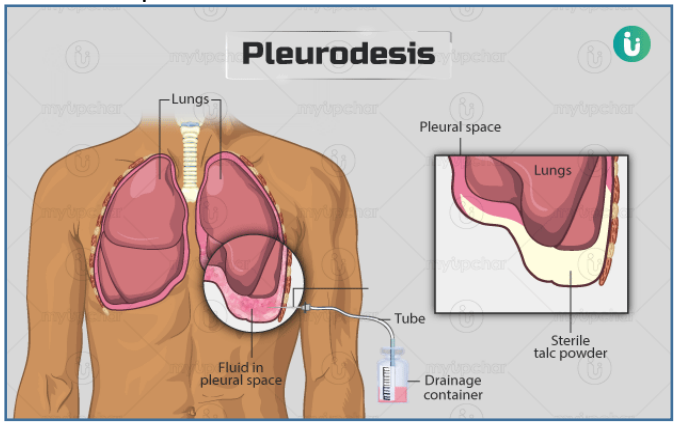
It is a condition in which the pleura gets inflamed. It is also called pleuritis, it causes sharp chest pain (pleuritic pain) that worsens during breathing. Symptoms of pleurisy might include: Chest pain, cough or sneeze, Shortness of breath and fever. It may be dry, but often it is accompanied by collection of fluid in the pleural cavity. The condition is called the pleural effusion. Dry pleurisy is more painful because during inspiration both layers come in contact and there is friction.

➢ Pleurectomy:

It is a type of surgery in which part of the pleura is removed. This procedure helps to prevent fluid from collecting in the affected area and is used for the treatment of mesothelioma, a pleural mesothelial cancer.

➢ Pleurodesis:

Pleurodesis is a procedure which involves putting a mildly irritant drug into the space between lung and chest wall (the pleural space), on one side of your chest. This is done to try to 'stick' lung to the wall of your chest and prevent a further collection of fluid or air in this space.



➢ Thoracoscopy:

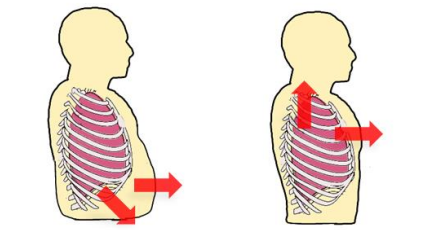
It is a diagnostic & therapeutic procedure in which pleural cavity is examined with a thoracoscope.

➢ Hemoptysis:

It is the spitting of blood that originated in the lungs or bronchial tubes. Its causes include: Blood clot in the lung, Pulmonary aspiration (breathing blood into the lungs), Lung cancer, Excessive, Pneumonia, Tuberculosis, Pulmonary embolism (blockage of an artery in your lungs).

- Respiration occurs in two phases
  Inspiration-active phase of 1 second.

  Expiration-passive phase of 3 second.
- In young children (up to 2yr of age), the thoracic cavity is almost circular in cross-section so the scope for anteroposterior or side to side expansion is limited. The type of respiration in children is **abdominal**.
- In women of advanced stage of pregnancy, descent of diaphragm is limited, so the type of respiration in them is mainly **thoracic**.



Abdominal breathing Thoracic breathing

➢ Pleural effusion:

It is an abnormal accumulation of excess fluid in the pleural space.

There are two types of pleural effusion:

1. Transudate (clear watery fluid):

A transudate is caused by congestive heart failure or, less commonly, liver or kidney disease.

2. Exudate (cloudy viscous fluid):

An exudate is caused by inflammation, pneumonia, lung cancer, TB, asbestosis, or pulmonary embolism. Symptoms include shortness of breath, chest pain, and cough. It can be treated by removing fluid by thoracentesis.

- **Paracentesis thoracis:**

Aspiration of any fluid from the pleural cavity is called paracentesis thoracis. It is usually done in the eighth intercostal space in the midaxillary line. The needle is passed through the lower part of the space to avoid injury to the principal neurovascular bundle, i.e. vein, artery and nerve (VAN).

- **Pneumothorax:** Presence of air in the pleural cavity. Its causes are

1) wound of parietal pleura from bullet. 2)Rupture of pulmonary lesion into pleural cavity.

3) Fractured ribs.

- **Haemothorax:** Presence of blood in the pleural cavity. It results from

1) injury to intercostal or internal thoracic vessel. 2)lung laceration.

- **Hydrothorax:** Fluid accumulation in pleural cavity resulting from pleural effusion.
- **Hydropneumothorax:** Presence of both fluid and air in the pleural cavity.
- **Empyema:** Presence of pus in pleural cavity.

- **Referred pain:**

Costal and peripheral parts of diaphragmatic pleurae are innervated by intercostal nerves. Hence irritation of these regions cause referred pain along intercostal nerves to thoracic or abdominal wall. Mediastinal and central part of diaphragmatic pleurae are innervated by phrenic nerve (C4). Hence irritation here causes referred pain on tip of shoulders.

- Pain on right shoulder occurs due to inflammation of gallbladder, while on left shoulder is due to splenic rupture.
- Bronchopulmonary segments are independent functional units of lung.

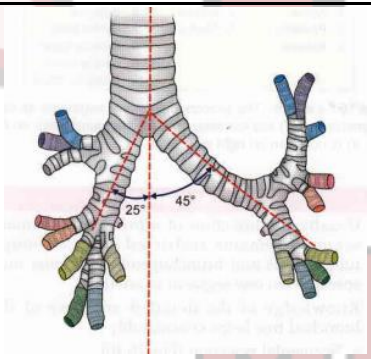
Differences between the right and left lungs

Right lung	*Left lung*
1. It has 2 fissures and 3 lobes	1. It has only one fissure and 2 lobes
2. Anterior border is straight	2. Anterior border is interrupted by the cardiac notch
3. Larger and heavier, weighs about 700 g	3. Smaller and lighter, weighs about 600 g
4. Shorter and broader	4. Longer and narrower

➢ Bronchoscopy:

Visualizing the interior of the bronchi through an instrument passed through the mouth and trachea. The instrument is called a bronchoscope and the procedure is called bronchoscopy.

➢ **Carina** is the area where trachea divides into two primary bronchi. Right bronchus makes an angle of **25'**, while left one makes an angle of **45'**. Foreign bodies mostly descend into right bronchus as it is wider and more vertical than the left bronchus.



➢ Postural drainage:

Carina (Latin keel) of the trachea is a sensitive area. When patient is made to lie on her/his left side, secretions from right bronchial tree flow towards the carina due to effect of gravity. This stimulates the cough reflex and sputum is brought out. This is called postural drainage.

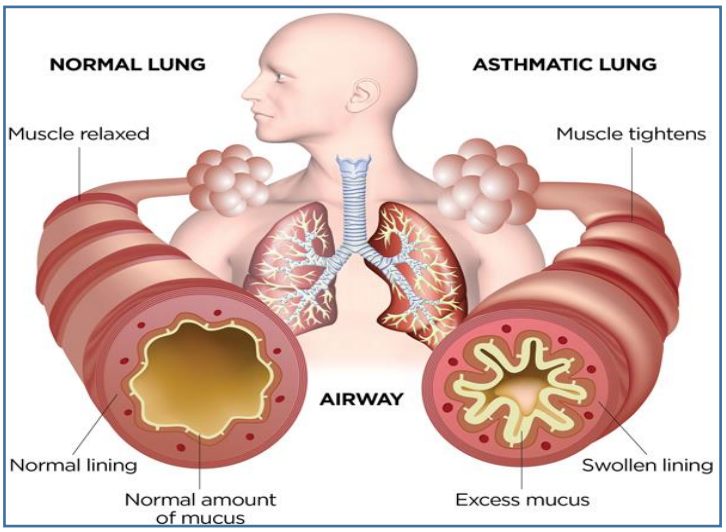
➢ Atelectasis:

It is the term for a collapse of one or more areas in the lung. It may be caused by surgery, chest pressure, blocked airways, and other lung conditions like lung cancer, pneumonia, pleural effusions and respiratory distress syndrome (RDS).

➢ Tuberculosis:

Tuberculosis (TB) is caused by a bacterium called *Mycobacterium tuberculosis* and is characterized by the formation of tubercles that can undergo caseous necrosis.

➢ **Bronchial asthma** is a common disease of respiratory system. It occurs due to bronchospasm of smooth muscles in the wall of bronchioles. Patient has difficulty especially during expiration. It is accompanied by wheezing. Epinephrine, a sympathomimetic drug, relieves the symptoms.



➢ Chronic bronchitis:

It is a long-term inflammation of the bronchi. It is common among smokers. People with chronic bronchitis tend to get lung infections more easily. It results in excessive mucus production that plugs up the airways, causing a cough and breathing difficulty.

➢ Emphysema:

It is a condition that involves damage to the walls of the air sacs (alveoli) of the lung as a result of which the total surface area of lungs for gaseous exchange decreases.

➢ Pneumonia (pneumonitis):

It is an inflammation of the lungs, which is of bacterial and viral origin. Symptoms are usually cough, fever, sputum production, chest pain, and dyspnea.

➢ Pulmonary embolism (pulmonary thromboembolism):

It is an obstruction of the pulmonary artery by an embolus, which arises in the deep veins of the lower limbs or in the pelvic veins. Symptoms may be sudden onset of dyspnea, anxiety, and substernal chest pain

➢ Auscultation of lung:

- Upper lobe is auscultated above 4th rib on both sides
- lower lobes are best heard on the back.
- Middle lobe is auscultated between 4th and 6th ribs on right side.

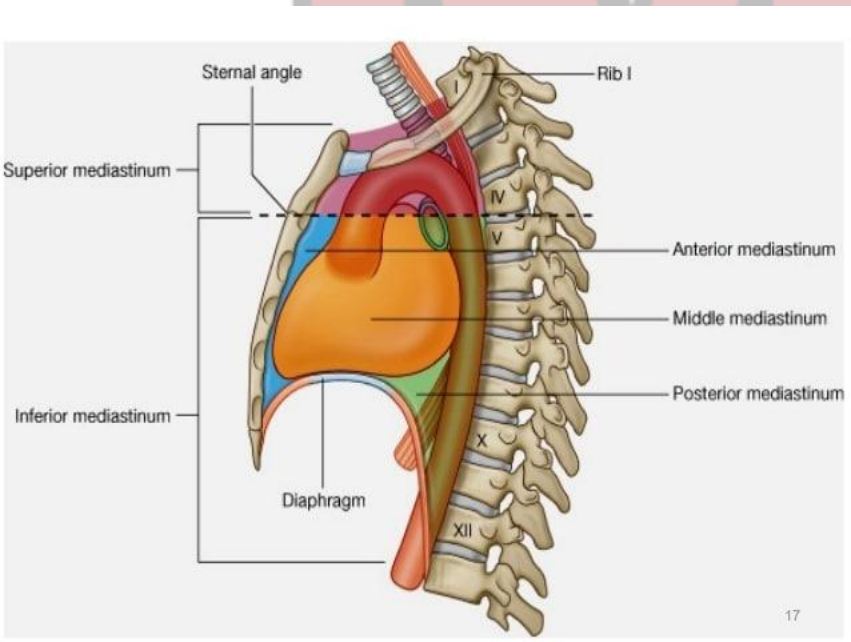
➢ Percussion:

It is tapping on fingers pressed firmly on thoracic wall over lungs to detect sounds in lungs which establishes whether underlying fissures are air filled (resonant sound), fluid filled (dull sound) or solid (flat sound).

Q. Which bronchopulmonary segment of lungs is most dependent one?

A. Apical segment of lower lobe is the most dependent bronchopulmonary segment in supine position. Foreign bodies are likely to be lodged here.

Mediastinum:



➢ Mediastinitis:

Mediastinitis is swelling and irritation (inflammation) of the mediastinum i.e. chest area between the lungs. This area contains the heart, large blood vessels, windpipe (trachea), food tube (esophagus), thymus gland, lymph nodes, and connective tissue. Due to mediastinitis, these structures get compressed.

- The prevertebral layer of the deep cervical fascia extends to the superior mediastinum, and is attached to the fourth thoracic vertebra. An infection present in the neck behind this fascia can pass down into the superior mediastinum but not lower down.
- The pretracheal fascia of the neck also extends to the superior mediastinum, where it blends with the arch of the aorta. Neck infections between the pretracheal and prevertebral fasciae can spread into the superior mediastinum, and through it into the posterior mediastinum. Thus mediastinitis can result from infections in the neck.
- In the superior mediastinum, all large veins are on the right side and the arteries on the left side. During increased blood flow veins expand enormously, while the large arteries do not expand at all. Thus there is much **'dead space'** on the right side and it is into this space that tumor or fluids of the mediastinum tend to project.
- Mediastinum is widened in

1)hemorrhage. 2)malignant lymphoma. 3) Heart hypertrophy due to heart failure.

➢ Mediastinal syndrome:

Compression of mediastinal structures by any tumor gives rise to a group of symptoms known as mediastinal syndrome. The common causes of mediastinal syndrome are bronchogenic carcinoma, Hodgkin's disease causing enlarg5ement of the mediastinal lymph nodes, aneurysm or dilatation of the aorta, etc.

The common symptoms are as follows.

a. Obstruction of superior vena cava gives rise to engorgement of veins in the upper half of the body.

b. Pressure over the trachea causes **dyspnoea**, and cough.

c. Pressure on esophagus causes **dysphagia**.

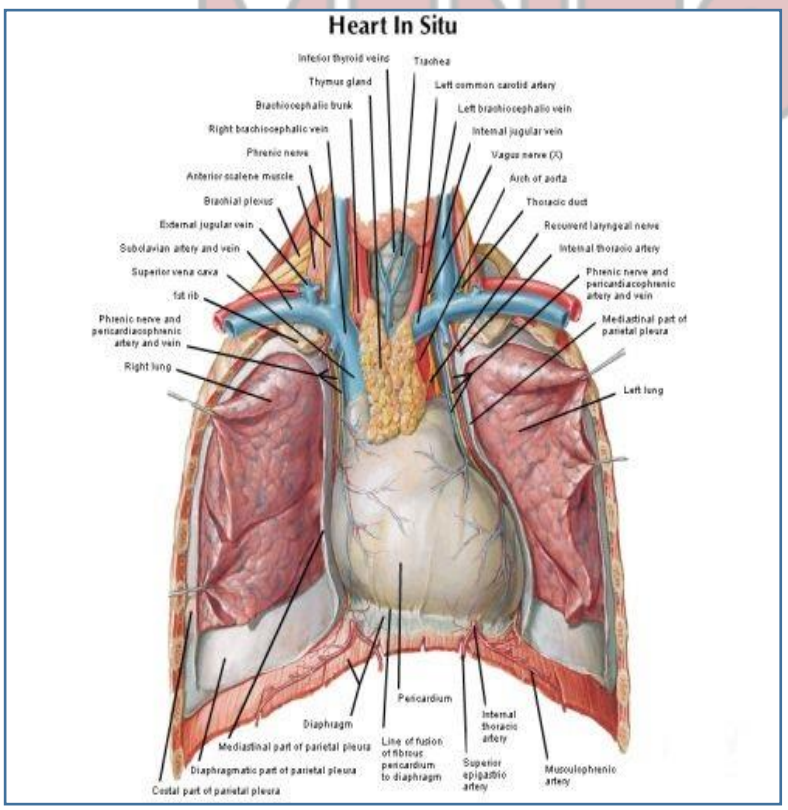
d. Pressure or the left recurrent laryngeal nerve gives rise to hoarseness of voice (**dysphonia**).

e. Pressure on the phrenic nerve causes paralysis of the diaphragm on that side.

f. Pressure on the intercostal nerves gives rise to pain in the area supplied by them. It is called **intercostal neuralgia**.

g. Pressure on the vertebral column may cause erosion of the vertebral bodies.

Pericardium and Heart:



➢ Pericarditis:

It is an inflammation of the pericardium, which may result in cardiac tamponade, pericardial effusion, and precordial, epigastric pain and pericardial murmur. It has symptoms of dysphagia, dyspnea and cough, inspiratory chest pain, and paradoxic pulse.

➢ Pericardial effusion:

Collection of fluid in the pericardial cavity is referred to as pericardial effusion or **cardiac tamponade**. The fluid compresses the heart and restricts venous filling during diastole. It also reduces cardiac output.

➢ Pericardiocentesis:

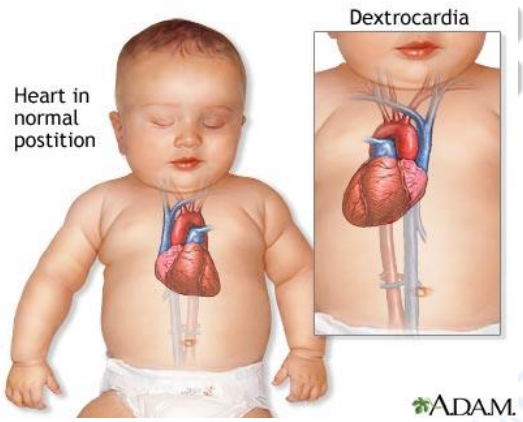
Drainage of fluid from pericardial cavity is called pericardiocentesis. A needle is inserted in the left fifth or sixth intercostal space just lateral to the sternum (bare area of pericardium is present here) or in the angle between the xiphoid process and left costal margin, with the needle directed upwards, backwards and to the left.

➢ Dextrocardia:

It is a condition in which the heart is pointed toward the right side of the chest. Normally, the heart points toward the left. The condition is present at birth (congenital).

➢ Situs inversus:

It is a condition in which the arrangement of the internal organs is a mirror image of normal anatomy. Dextrocardia may be a part of situs inversus. It can occur alone (isolated, with no other abnormalities or conditions) or it can occur as part of a syndrome with various other defects.



- The area of the chest wall overlying the heart is called as **precordium**
- Rapid pulse or increased heart rate is called **tachycardia**.
- Slow pulse or decreased heart rate is called **bradycardia**.
- Irregular pulse or irregular heart rate is called **arrhythmia**.
- Consciousness of one's heartbeat is called **palpitation**.
- Inflammation of the heart can involve more than one layer of the heart. Inflammation of the pericardium is called **pericarditis**, of the myocardium is **myocarditis**; and of the endocardium is **endocarditis**.
- Coronary arteries are functional end arteries.
- Pain of heart due to myocardial infarction is referred to left side of chest between 3rd and 6th intercostal spaces. It also gets extended to medial side of left upper limb in the area of distribution of C8 and T1 spinal segments.

Comparing the systemic circulation and pulmonary circulation

Systemic circulation	*Pulmonary circulation*
Left ventricle	Right ventricle
↓ Aortic valve	↓ Pulmonary valve
↓ Aorta	↓ Pulmonary trunk and pulmonary arteries
↓ Oxygenated blood to all tissues except lungs	↓ Only to lungs
↓ Venous blood collected	↓ Deoxygenated blood gets oxygenated
↓ Superior vena cava and inferior vena cava	↓ 4 pulmonary veins
↓ Right atrium	↓ left atrium

Comparison of right atrium and left atrium

Right atrium	*Left atrium*
Receives venous blood of the body	Receives oxygenated blood from lungs
Pushes blood to right ventricle through tricuspid valve	Pushes blood to left ventricle through bicuspid valve
Forms right border, part of sternocostal and small part of base of the heart	Forms major part of base of the heart
Enlarged in tricuspid stenosis	Enlarged in mitral stenosis

Comparison of right ventricle and left ventricle

Right ventricle	*Left ventricle*
Thinner than left, 1/3 thickness of left ventricle	Much thicker than right, 3 times thicker than right ventricle
Pushes blood only to the lungs	Pushes blood to top of the body and down to the toes
Contains three small papillary muscles	Contains two strong papillary muscles
Cavity is crescentic	Cavity is circular
Contains deoxygenated blood	Contains oxygenated blood
Forms 2/3rd sternocostal and 1/3rd diaphragmatic surfaces	Forms 1/3rd sternocostal and 2/3rd diaphragmatic surfaces

➢ Cardiac failure:

Normally the diastolic pressure in ventricles is zero. A positive diastolic pressure in the ventricle is evidence of its failure. Any one of the four chambers of the heart can fail separately, but ultimately the rising back pressure causes right sided failure (congestive cardiac failure or CCF) which is associated with increased venous pressure, edema on feet, and breathlessness on exertion. Heart failure (right sided) due to lung disease is known as **cor pulmonale**.

Q. To which area cardiac pain is referred and why?

A. Cardiac pain is an ischemic pain caused by incomplete obstruction of a coronary artery. Axons of pain fibers conveyed by the sensory sympathetic cardiac nerves reach thoracic one to five segments of spinal cord mostly through the dorsal root ganglia of the left side. Since these dorsal root ganglia also receive sensory impulses from the medial side of arm, forearm and upper part of front of chest, the pain gets referred to these areas. Though the pain is usually referred to the left side, it may even be referred to right arm, jaw, epigastrium or back.

➢ Auscultation of heart:

1) The tricuspid valve is best heard over the right half of the lower end of the body of the sternum.

2)The mitral valve is best heard over the apex beat, that is, at the level of the fifth left intercostal space, 3.5 in. (9 cm) from the midline.

3) The pulmonary valve is heard with least interference over the medial end of the second left intercostal space.

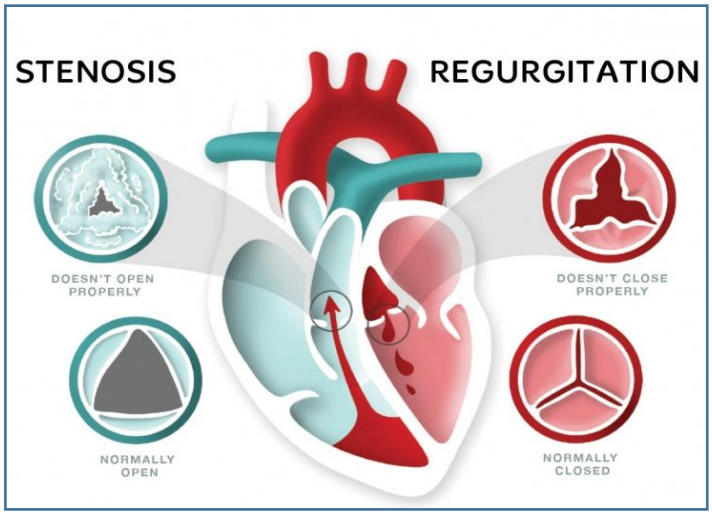
4) The aortic valve is best heard over the medial end of the second right intercostal space

- **Percussion** defines density & size of heart. Cardiac percussion is performed at 3rd,4th and 5th intercostal space from left to right anterior axillary line.

- The first heart sound is produced by closure of the atrioventricular valves. The second heart sound is produced by closure of the semilunar valves.

- Narrowing of the valve orifice due to fusion of the cusps is known as **'stenosis'**, e.g. mitral stenosis, aortic stenosis, etc.

- Dilatation of the valve orifice, or stiffening of the cusps causes imperfect closure of the valve leading to back flow of blood. This is known as **incompetence or regurgitation**, e.g. aortic incompetence or aortic regurgitation.



Q. What is blood supply of conducting system of heart?

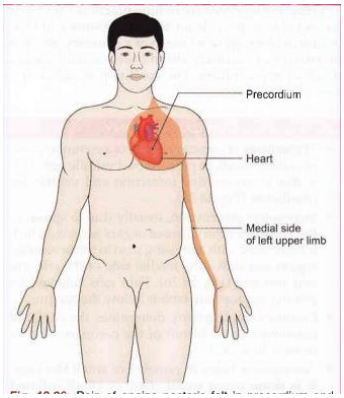
A. Except for a part of the left branch of the AV bundle supplied by the left coronary artery, the whole of the conducting system is usually supplied by the right coronary artery. Vascular lesions of the heart can cause a variety of arrhythmias.

Q. What is cardiac dominance?

A. In about 10% of hearts, the right coronary is rather small and is not able to give the posterior interventricular branch. In these cases, the circumflex artery, the continuation of left coronary provides the posterior interventricular branch as well as to the AV node. Such cases are called left dominant. Mostly the right coronary gives interventricular artery. Such hearts are right dominant. Thus the artery giving the posterior interventricular branch is the dominant artery.

➢ Angina pectoris:

Incomplete obstruction, usually due to spasm of the coronary artery causes angina pectoris, which is associated with agonizing pain in the precordial region and down the medial side of the left arm and forearm. Pain gets relieved by putting appropriate tablets below the tongue.



Pain of angina pectoris felt In precordium along medial Border of left arm

➢ Three most common sites of coronary artery occlusion are

1) Anterior IV branch of Left coronary artery (40-50%).

2) Right coronary artery (30-40%).

3) Circumflex branch of Left coronary artery (15-20%).

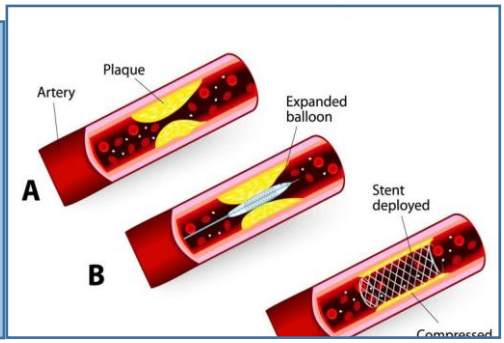
➢ Coronary angiography:

It is a procedure that uses X-ray imaging to see your heart's blood vessels. It determines the site of narrowing or occlusion of the coronary arteries or their branches.

➢ Angioplasty:

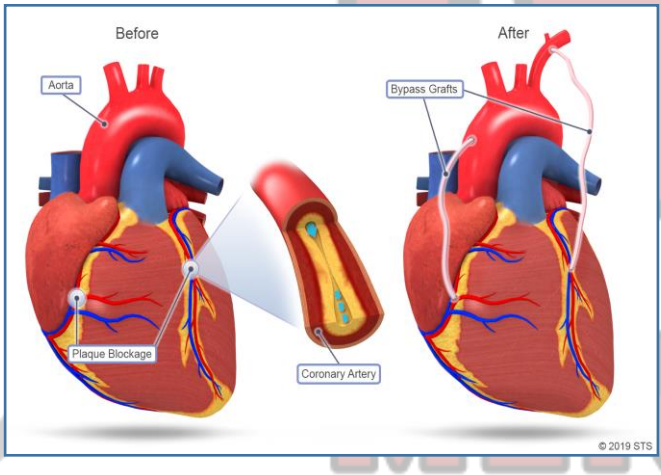
Angioplasty is a procedure used to open blocked coronary arteries caused by coronary artery disease. It restores blood flow to the heart muscle without open-heart surgery. Angioplasty can be done in an emergency setting such as a heart attack. It is done using small stent or small inflated balloon through a catheter passed upwards through femoral artery, aorta, into the coronary artery.

➢ If there are large segments or multiple sites of blockage, coronary bypass is done using either great saphenous vein or internal thoracic artery as grafts.



➢ Coronary bypass:

I t involves a connection of a section of vessel (the saphenous vein or of the internal thoracic artery or radial artery) between the aorta and a coronary artery distal to an obstruction in the coronary artery, shunting blood from the aorta to the coronary arteries.



Q. Why great saphenous vein is preferred for coronary bypass?

A. Great saphenous vein is preferred because it has

1) It has diameter almost equal to that of coronary artery.

2) It can be easily dissected.

3) It offers lengthy portion with minimum walls.

➢ Atrial septal defect:

It is a birth defect of the heart in which there is a hole in atrial septum. It results from incomplete closure of **oval foramen**. It causes hypertrophy of right atrium, ventricle &pulmonary arteries. It causes **cyanosis** (blueness of skin) in new born babies (blue babies)

➢ Ventricle septal defect:

It is a birth defect of the heart in which there is a hole in ventricular septum. It occurs when membranous part of interventricular septum develops separately from muscular part or defects in muscular part.

➢ Patent ductus arteriosus / ligamentum arteriosum:

It results from failure of the ductus arteriosus (which connects aorta to pulmonary artery bypassing pulmonary circulation during fetal life) to close after birth, and it is common in premature infants. A persistent patent ductus arteriosus results in high-pressure aortic blood passing into the pulmonary artery, which raises the pressure in the pulmonary circulation. A patent ductus arteriosus is life threatening and should be ligated and divided surgically.

➢ Myocardial infarction:

It is a necrosis of the myocardium because of local ischemia resulting from vasospasm or obstruction of the blood supply, most commonly by a thrombus or embolus in the coronary arteries. Symptoms are severe chest pain, pressure for a prolonged period, congestive heart failure, and murmur of mitral regurgitation.

➢ Atrial or ventricular fibrillation:

It is a cardiac arrhythmia that causes an irregular and often abnormally fast heart rate, resulting from rapid irregular uncoordinated contractions of the atrial or ventricular muscle due to fast repetitive excitation of myocardial fibers, causing palpitations, shortness of breath, angina, fatigue, congestive heart failure, and sudden cardiac death.

- Damage to one of the bundle branches results in **bundle branch block** in which systole occurs normally but impulse spreads to other ventricle via myogenic conduction producing asynchronous contraction.

➢ Heart block:

Heart block, also called **AV block**, occurs when the electrical signal that controls heartbeat is partially or completely blocked and is unable to reach the ventricles from atria. This makes heart beat slow or skip beats and heart can't pump blood effectively.

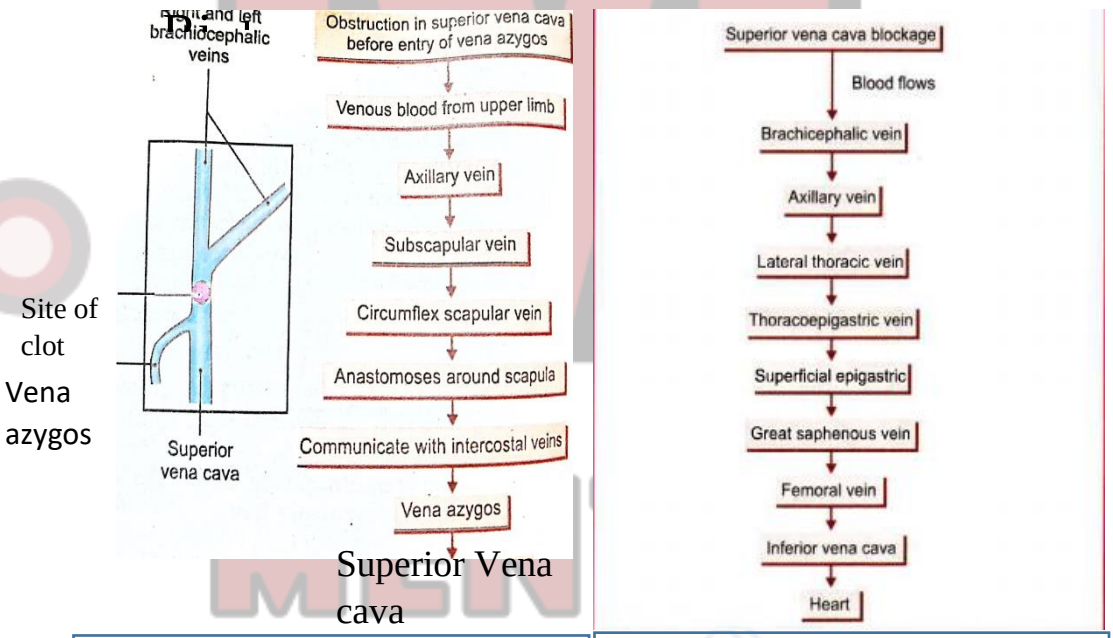
Symptoms include dizziness, fainting, tiredness and shortness of breath. Pacemaker implantation is a common treatment.

Superior vena cava, Aorta and Pulmonary trunk:

- Superior vena cava is the second largest vein of the body.
- Pulmonary trunk and ascending aorta develop from a common source, the **truncus arteriosus**.

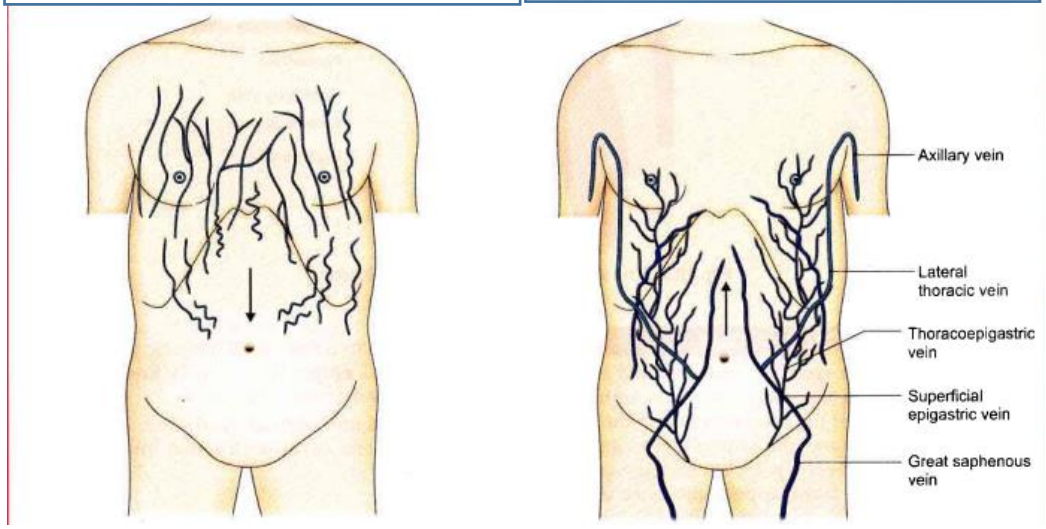
➢ Obstruction of superior vena cava:

- When the superior vena cava is obstructed above the opening of the azygos vein, the venous blood of the upper half of the body is returned through the azygos vein; and the superficial veins are dilated on the chest up to the costal margin. Blood from upper limb is returned through the communicating veins joining the veins around the scapula with the intercostal veins. The latter veins of both sides drain into vena azygos.
- When the superior vena cava is obstructed below the opening of the azygos veins, the blood is returned through the inferior vena cava via the femoral vein; and the superior veins are dilated on both the chest and abdomen up to the saphenous opening in the thigh. The superficial vein connecting the lateral thoracic vein with the superficial epigastric vein is known as the thoracoepigastric vein.



Obstruction of superior vena cava above the opening of vena azygos.

Obstruction of superior vena cava below the opening of vena azygos.



Obstruction of superior vena cava above the opening of vena azygos.

Obstruction of superior vena cava below the opening of vena azygos.

➢ Aortic knuckle:

In posteroanterior view of radiographs of the chest, the arch of the aorta is seen as a projection beyond the left margin of the mediastinal shadow. The projection is called the aortic knuckle. It becomes prominent in old age.

➢ Aneurysm of arch of aorta may exert pressure on trachea, esophagus & recurrent laryngeal nerve causing dyspnea, dysphagia & dysphonia.

➢ Coarctation of the aorta:

It is a localized narrowing of the aorta opposite to or just beyond the attachment of the ductus arteriosus. An extensive collateral circulation develops between the branches of the subclavian arteries and those of the descending aorta. These include the anastomoses between the anterior and posterior intercostal arteries. These arteries enlarge greatly and produce a characteristic notching on the ribs. It causes

(a) a characteristic **rib notching** and a high risk of cerebral hemorrhage

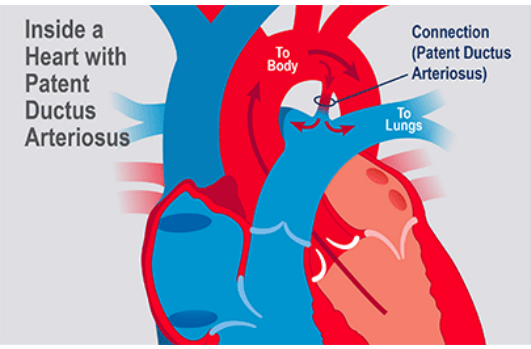
(b) tortuous and enlarged blood vessels, especially the internal thoracic, intercostal, epigastric, and scapular arteries

(c) an elevated blood pressure in the radial artery and decreased pressure in the femoral artery

(d) the femoral pulse to occur after the radial pulse (normally, the femoral pulse occurs slightly before the radial pulse).

➢ Ductus arteriosus, ligamentum arteriosum and patent ductus arteriosus:

During fetal life, the **ductus arteriosus** is a short wide channel connecting the beginning of the left pulmonary artery with the arch of the aorta immediately distal to the origin of the left subclavian artery. It conducts most of the blood from the right ventricle into the aorta, thus short circuiting the lungs. After birth it is closed functionally within about a week and anatomically within about eight weeks. The remnants of the ductus form a fibrous band called the **ligamentum arteriosum**. The left recurrent laryngeal nerve hooks around the ligamentum arteriosum. The ductus may remain patent after birth. The condition is called patent ductus arteriosus and may cause serious problems.



➢ Aortic arch aneurysm:

It is a localized dilatation of the aorta which may press upon the left recurrent laryngeal nerve leading to paralysis of left vocal cord and hoarseness. It may also press upon the surrounding structures and cause the mediastinal syndrome, i.e. dyspnoea, dysphagia, dysphonia, etc.

Trachea, Oesophagus and thoracic duct:

- **Dyspnoea** is the medical term used for breathing difficulties
- **Dysphagia** is the medical term used for swallowing difficulties.
- Trachea contains C-shaped hyaline cartilaginous rings which are deficient posteriorly, so that the oesophagus situated behind the trachea is not compressed by trachea.
- Trachea begins at 6th cervical vertebra and ends at thoracic 4 (in expiration) by dividing into two principal bronchi. Trachea is always patent.
- Clinically the trachea is palpated in the suprasternal notch. Normally it is median in position. Shift of the trachea to any side indicates a mediastinal shift.
- Oesophagus is 25 cm long, like duodenum and ureter. Its maximum part about 20 cm/8" lie in thoracic cavity.
- Lower part of oesophagus is a site of **portocaval anastomoses**.
- Thoracic duct drains lymph from both lower limbs, abdominal cavity, left side of thorax, left upper limb and left side of head and neck.

Tracheostomy:

It is a surgical procedure which allows air to enter directly into trachea. It is done in cases of blockage of air pathway in nose or larynx.

Tracheal tug:

During swallowing when the larynx is elevated, the trachea elongates by stretching because the tracheal bifurcation is not permitted to move by the aortic arch. Any downward pull due to sudden and forced inspiration, or aortic aneurysm will produce the physical sign known as 'tracheal tug'.

Q. What is the function of trachealis muscle?

A. As the tracheal rings are incomplete posteriorly the oesophagus can dilate during swallowing. This also allows the diameter of the trachea to be controlled by the trachealis muscle. This muscle narrows the caliber of the tube, compressing the contained air if the vocal cords are closed. This increases the explosive force of the blast of compressed air, as occurs in coughing and sneezing.

- Injury to the **recurrent laryngeal nerve** may be caused by:

1) a bronchogenic or esophageal carcinoma (because recurrent laryngeal nerve winds around arch of aorta & ascends between trachea & esophagus).

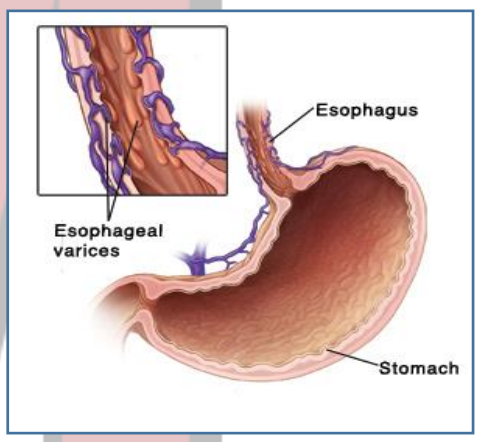
2) enlargement of mediastinal lymph nodes.

3) an aneurysm of the aortic arch.

4) thyroid and parathyroid surgeries, causing respiratory obstruction, hoarseness, and an inability to speak because of paralysis of the vocal cord.

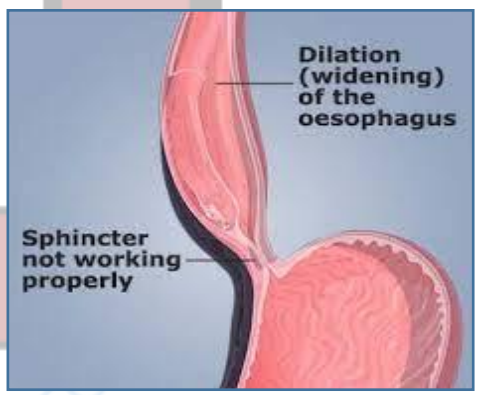
➢ Oesophageal varices:

In portal hypertension, the communications between the portal and systemic veins draining the lower end of the oesophagus dilate. These dilatations are called oesophageal varices. Rupture of these varices can cause serious haematemesis or vomiting of blood. The oesophageal varices can be visualized radiographically by barium swallow; they produce worm-like shadows.



➢ Achalasia cardia:

The lower end of the oesophagus is normally kept closed. It is opened by the stimulus of a food bolus. In case of neuromuscular incoordination, the lower end of the oesophagus fails to dilate with the arrival of food which, therefore, accumulates in the oesophagus. This condition of neuromuscular incoordination (caused by degeneration of myenteric (Auerbach's) plexus) characterized by inability of the oesophagus to dilate is known as 'achalasia cardia'. It may be due to congenital absence of nerve cells in wall of oesophagus.



Q. How many constrictions are present in oesophagus?

A. Normally the oesophagus shows 4 constrictions at the following levels.

1. At its beginning, 15 cm./5 inch from the incisor teeth, where it is crossed by cricopharyngeus muscle.
2. Where it is crossed by the aortic arch, 22.5 cm/9-inch from the incisor teeth.
3. Where it is crossed by the left bronchus, 27 .5 cm / 17- inch from the incisor teeth.
4. Where it pierces the diaphragm 37 .5 cml 15-inch from the incisor teeth.

- Improper separation of the trachea from the oesophagus during development gives rise to **tracheo-oesophageal fistula**.
- Atresia means absence or abnormal narrowing of an opening or passage in the body.