# Anatomy of the Thorax

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The anatomy of the thorax can be described under two headings:

(*a*) The Thoracic Wall
(*b*) The Thoracic Cavitv

**The Thoracic Wall**

The wall of the thoracic cavity is composed of the thoracic vertebral column, the sternum, the ribs, and the intervening masculature.

These parts are in turn largely covered by the masculature of the vertebral column and that of the upper limbs respectively.

**The framework of the Thorax**

*Inlet of the Thorax*

The superior thoracic aperture or thoracic inlet is formed by the body of the first thoracic vertebra, the first ribs and costal cartilages and the extremely thick upper part of the manubrium sterni.

The aperture is open because the structures entering or leaving the thorax through the inlet are surrounded by loose connective tissue, resulting in potential spaces through which cervical infections or tumors may descend into the mediastinum.

*Outlet of the Thorax*

In contrast to the inlet the outlet of the thorax is completely closed by the diaphragm, which closely invests those structures passing between the thorax and abdomen. It might, however, be pointed out here that in consequence of the curvature of the diaphragm the lower ribs actually afford much protection to the upper abdominal organs, and are also therefore functionally a part of the abdominal wall.

*Ribs and Costal Articulations*

The first seven ribs are attached to the sternum they are known as true or vertebro-sternal ribs. The remaining five pairs are classified as false ribs. The cartilages of the 8th, 9th and 10th ribs articulate with the cartilages of the ribs immediately above them and so form a sub group of vertebrochrondral ribs. The last two pairs end among the muscles of the abdominal wall and they form a sub group of floating or vertebral ribs.

The articulations with the bodies and transverse processes of the vertebrae belong to the synovial variety of joints. The mobility provided by this arrangement is diminished by the attachment of the upper ten ribs to the sternum or to each other. Slight movement is provided for by the elasticity of the costal cartilages.

*The Sternum*

The sternum consist of manubrium, body and xiphoid process. The very thick concave upper border is called the supra sternal notch, it forms an important landmark. The lower border of the manubrium articulates at an angle with the body—called the sternal angle. The sterno-manubrial joint so formed plays an important part in the mechanism of respiration, because it allows the body of the sternum to move forward.

Below the body lies the xiphoid process which extends downwards for a variable distance into the post-wall of the sheath of the rectus abdominis. The tip of the xiphoid process is never selected as a landmark because it is variable in length.

*The Intercostal Spaces*

The intercostal muscles occupy the spaces between the ribs; the external intercostal runs downward and forward from one rib to the next, in the same direction as the external oblique of the abdomen. The external intercostal muscle fails to reach the sternum anteriorly, being replaced here by a membrane through which the internal intercostal may be seen. Similarly, the internal intercostal muscle which runs upward and forward from one rib to the next, reaches posteriorly only about to the angles of the ribs, behind which it is replaced by a posterior intercostal membrane.

The internal intercostal muscle is divided by the intercostal nerves and vessels into two parts an inner and outer part. The innermost part is sometimes called the innermost intercostal.

*The Nerve and Blood Supply of the Thoracic Wall*

The upper nine posterior intercostal arteries from the supreme intercostal and thoracic aorta end by anastomosing with the anterior intercostal branches from the internal mammary and the musculo-phrenic. While the lower two and the sub costal artery, continue into the musculature of the abdominal wall.

The anterior intercostal veins end in the musculo phrenic and the venae comitantes of the internal mammary artery. The posterior intercostal veins differ in their arrangement on the two sides of the body, and are drained by the Azygos and Heniazygos systems.

*The Diaphragm*

Is the dome shaped musculo-aponeurotic partition between the thorax and abdomen. It has a rounded cupola on each side below the lungs; and a depressed median portion on which the heart lies.

The median portion rises to the level of the xiphisternal joint, which corresponds to the body of the ninth thoracic vertebra. The right cupola rises to the 5th rib ½″ below the right nipple and the left cupola rises to the 5th interspace 1″ below the nipple.

*Structure and Attachment*

The muscular fibres are arranged peripherally about a central tendon. They arise from the posterior surface of the xiphoid process from the inner surfaces of the cartilages and the adjacent bony parts of the lower six ribs, from the upper lumbar vertebrae by means of the crura of the diaphragm and the median, lateral and medial arcuate ligaments.

Between the sternal and costal origin of the diaphragm lies a small gap, occupied by connective tissue and transmitting the superior epigastric vessels. The potential gap is known as the sterno costal triangle.

A similar gap is sometimes found between the lumbar origin and the last rib which is called the vertebro-costal triangle. These gaps are important because they may result into hernias (*Fig. 1*).

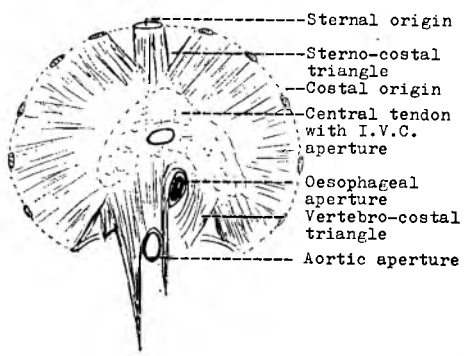


Fig. 1

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*Apertures*

In addition to small apertures for the transmission of the splanchnic nerves and parts of the azygos system of veins, the diaphragm presents three larger apertures.

The aortic hiatus lies at about the level of the twelfth thoracic vertebra between the two crura of the diaphragm. The aorta, thoracic duct and often contributions to the azygos and hemi-azygos veins pass through the aortic hiatus.

The oesophageal hiatus lies in the muscular part of the diaphragm opposite the 10th thoracic vertebra. The muscular fibres appear to act as a sphincter which prevents regurgitation of the stomach contents when the diaphragm contracts. In addition to the oesophagus this hiatus transmits the vagus nerve and the oesophageal blood vessels connecting the vessels of the stomach with those of the thorax.

The foramen for the inferior vena cava is situated opposite the 8th thoracic vertebra, slightly to the right in the central tendon. It ensures that the inferior vena cava is stretched when the diaphragm contracts—facilitating the flow of venous blood into the thorax with inspiration.

*Innervation and Blood Supply*

The motor nerve supply is entirely through the phrenic nerve which also supplies most of the diaphragm with sensory fibres. The margins of the diaphragm are supplied with sensory fibres through the lower 5th or 6th intercostal nerves.

The blood supply is from several sources: The largest vessels are the inferior phrenic arteries which arise from the first part of the abdominal aorta, the superior phrenic, the pericardiaco phrenic, twigs from the lower intercostal vessels and the musculophrenic running laterally along the attachment of the diaphragm to the cartilages of the false ribs.

The inferior phrenic veins are the chief drainage of the diaphragm.

*Function*

The action of the diaphragm is responsible for the greatest part of the movement of the lungs in respiration.

*The Thoracic Cavity*

Deep to the ribs and the intercostal muscles the endothoracic fascia forms a rather indistinct layer which essentially serves only to unite the pleura to the thoracic wall.

Over the apices of the lungs, where they protrude into the neck through the thoracic aperture the fascia is thickened and known as the supra pleural membrane or Sibsons fascia.

The thoracic cavity is divided into right and left pleural cavities separated completely by a middle partition the mediastinum.

The pleural cavities are lined with pleura which is subdivided into three parts; parietal, visceral and connecting. (*Fig. 2. 3.*)

THE PARIETAL PLEURA: The parietal pleura lines the inner surface of the walls of the pleural cavities. It is subdivided according to the area it covers:

(*a*) Costal pleura,
(*b*) Mediastinal pleura,
(*c*) Diaphragmatic pleura,
(*d*) Cervical pleura.

The Visceral pleura or the pulmonary pleura invests the lungs.

The connecting pleura covers the root of the lung and its lower portions forms the pulmonary ligament.

PLEURAL RECESSES: The parietal pleura is in contact with the visceral pleura over the surface of the lung, but anteriorly it extends between the chest wall and the pericardial sac it also extends farther inferiorly, between the thoracic wall and the highly curved lateral and posterior parts of the diaphragm. These potential spaces not occupied by lung constitute the so-called pleural recesses and are named accordingly the costomediastinal and costo diaphragmatic recesses. (*Fig. 2 and 3.*)

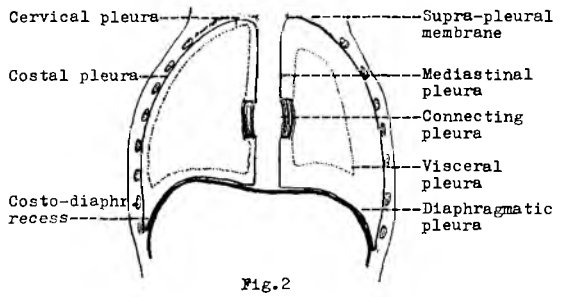


Fig.2

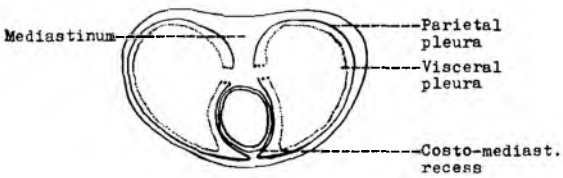


Fig.3

*Mediastinum*

The pleural sacs with their contained lungs occupy a large portion of the thoracic cavity. The right and left pleural cavities are separated from each other by a middle partition which is called the mediastinum.

*Sub-divisions of the Mediastinum*

The mediastinal septum is made up of a large number of structures embedded in connective tissue. It extends from the sternum to the vertebral column behind and from the inlet of the thorax to the diaphragm below.

The principal structures in the mediastinum are the heart in the pericardium, the aorta and other great vessels, the oesophagus and trachea, several important nerves, remains of the thymus gland and numerous lymph glands.

The mediastinum is divided into four parts. The superior mediastinum is the part above an imaginary plane that passes from the lower border of the manubrium sterni to the lower surface of the body of the fourth thoracic vertebra.

The part below that plane is sub-divided into the middle mediastinum occupied by the pericardium and its contents. The phrenic nerve passes over the sides of it.

The anterior mediastinum lies in front of the pericardium and the posterior mediastinum lies behind the pericardium.

The mediastinum as a whole contains all the important structures of the thorax with the exception of the lungs themselves. (*Fig. 4, 5* and *6.*)

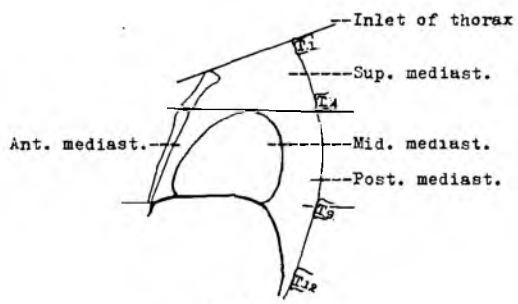


Fig.4

Subdivisions of the mediastinum.

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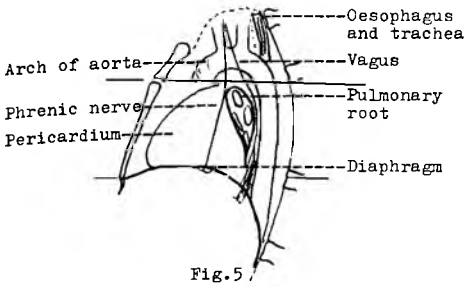


Fig.5

Structures seen through the left mediastinum.

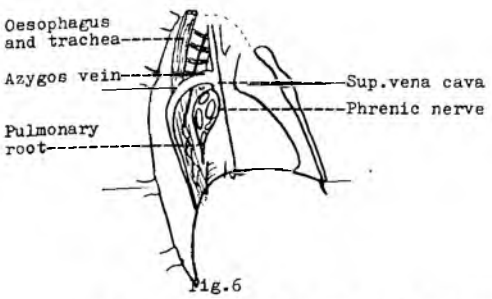


Fig.6

Structures seen through the right mediastinum.

*The Trachea and Lungs*

The trachea begins in the neck at the lower end of the larynx. It enters the thorax opposite the upper border of the manubrium sterni and terminates at the lower border of the manubrium opposite the 4th thoracic vertebra by dividing into a right and left bronchus. Its thoracic part therefore lies in the superior mediastinum.

The trachea, being an elastic structure, elongates during inspiration and its bifurcation may thus descend to the level of the body of the fifth or even the sixth thoracic vertebra.

*Bronchi*

Each bronchus passes downwards and sidewards to the hilum of the corresponding lung and thence downwards in the substance of the lung towards its base. The primary bronchi can therefore be divided into extra pulmonary and intra pulmonary portions, kept patent by rings—and plates of cartilage, respectively.

The right bronchus is shorter than the left bronchus, it is more vertical than the left and is slightly wider. It gives off one branch, which arises close to the hilum of the lung and is called the eparterial bronchus because it originates immediately above the point where the right pulmonary artery crosses in front of the bronchus.

The left bronchus gives off no branches in the hilum.

*The Lungs*

The lungs are a pair of comparatively light organs. The elasticity of the healthy lung substance is remarkable.

The lungs, when healthy, lie free in the cavity of the chest and are attached only by their roots.

Each lung presents for examination an apex, a base, a costal surface and a medial surface separated by anterior, posterior and inferior borders.

The apex rises into the root of the neck for an inch and a half above the level of the anterior part of the first rib.

The base of each lung has a semi lunar outline and is adapted to the upper surface of the diaphragm.

*Lobes of the Lungs*

The left lung is divided into two lobes by a long deep fissure which penetrates its substance to within a short distance of the hilum.

An oblique fissure and a horizontal fissure divides the right lung into three lobes.

Just as the lobes constitute major segments of the lung with their own bronchial, arterial and venous supply, so do the bronchi within a lobe branch and rebranch to supply smaller and smaller segments of lung tissue. In practice only the major broncho pulmonary segments supplied by tertiary bronchi are named or numbered.

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(*Continued from page 6*)

atrial septal defects, aortic stenosis and regurgitation, mitral regurgitation and other complicated congenital heart lesions. Owing to the marked drawback of having to work on an actively beating but empty heart, the technique of injecting a 2½% solution of potassium citrate in arterialised blood into the ascending aorta of a patient on the heart-lung machine was introduced by Melrose about five years ago, as this procedure brings about cardiac standstill which markedly facilitates the performance of the intra-cardiac operation. More recently it has been shown that be merely clamping off the ascending aorta and so depriving the heart of oxygen spontaneous cardiac standstill will be produced which will recover again spontaneously after removal of the clamp.

We shall now show you a film, very kindly lent to us by Winthrop Products, of an operation performed by Dr. Jerome Kay in the U.S.A., employing the principle described above of anoxic cardiac arrest with incision of the left ventricle to remove a tumour from the cavity of this ventricle, extending into both the left atrium and aorta via the mitral and aortic valves.

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