

The Diaphragm

The diaphragm is a dome-shaped partition between the thoracic and abdominal cavities (see page 75). It is formed of radially arranged muscle fibres which take origin from the sternum, the ribs, the costal cartilages, the arcuate ligaments and the lumbar vertebrae and which are inserted on to a central tendon. The sternal and costal parts of the diaphragm and the fibres from the arcuate ligaments are spread out into flat sheets, but the parts originating from the vertebrae form two pillars called the **crura**. The left crus is the shorter and arises from the second lumbar vertebra, while the right crus arises from the third.

Simultaneous contraction of all these muscles pulls down the central tendon and reduces the concavity of the diaphragm thus increasing the capacity of the thorax. This produces suction in the thoracic cavity which draws air into the lungs during inspiration. Contraction of the diaphragm also precedes all expulsive actions, e.g. coughing, vomiting, micturition, defaecation and parturition.

The upper surface of the diaphragm is covered by parts of the parietal pleura and pericardium, while the lower surface is covered with peritoneum and has the liver suspended from it by the falciform ligament—see page 75.

The Muscles of Respiration

A great many muscles are involved in the production of the respiratory movements. They not only produce the movements but also steady the adjacent parts. Only the most important are quoted below. (See also page 88.)

(a) **Quiet inspiration** involves the **diaphragm**, the **external** and **internal intercostals** and **levatores costarum**, and the **quadratus lumborum** and **serratus posterior inferior** muscles.

The whole dome of the diaphragm is pulled down till it presses on the viscera. Further downward movement is resisted by the tone of the abdominal muscles and continued contraction then causes the sternum to be moved forwards as the dome flattens. This movement is assisted by the intercostals and levatores costarum which raise and slightly rotate the ribs. The quadratus lumborum and serratus posterior inferior muscles fix the lower ribs and therefore hold the lower edge of the diaphragm in place.

(b) **Deep inspiration** involves, in addition to the above, the **scaleni**, **sternomastoid** and **serratus posterior superior** muscles which assist the raising of the ribs and sternum, and the **sacro-spinalis** which flattens the back.

(c) **Forced inspiration** involves, in addition to the above, the **serratus anterior** and **pectoralis minor** muscles which assist the raising of the ribs while the scapulae are fixed by the **trapezius**, **levator scapulae** and **rhomboideus** muscles. When the arms are fixed in the raised position the **pectoralis major** also helps inspiration.

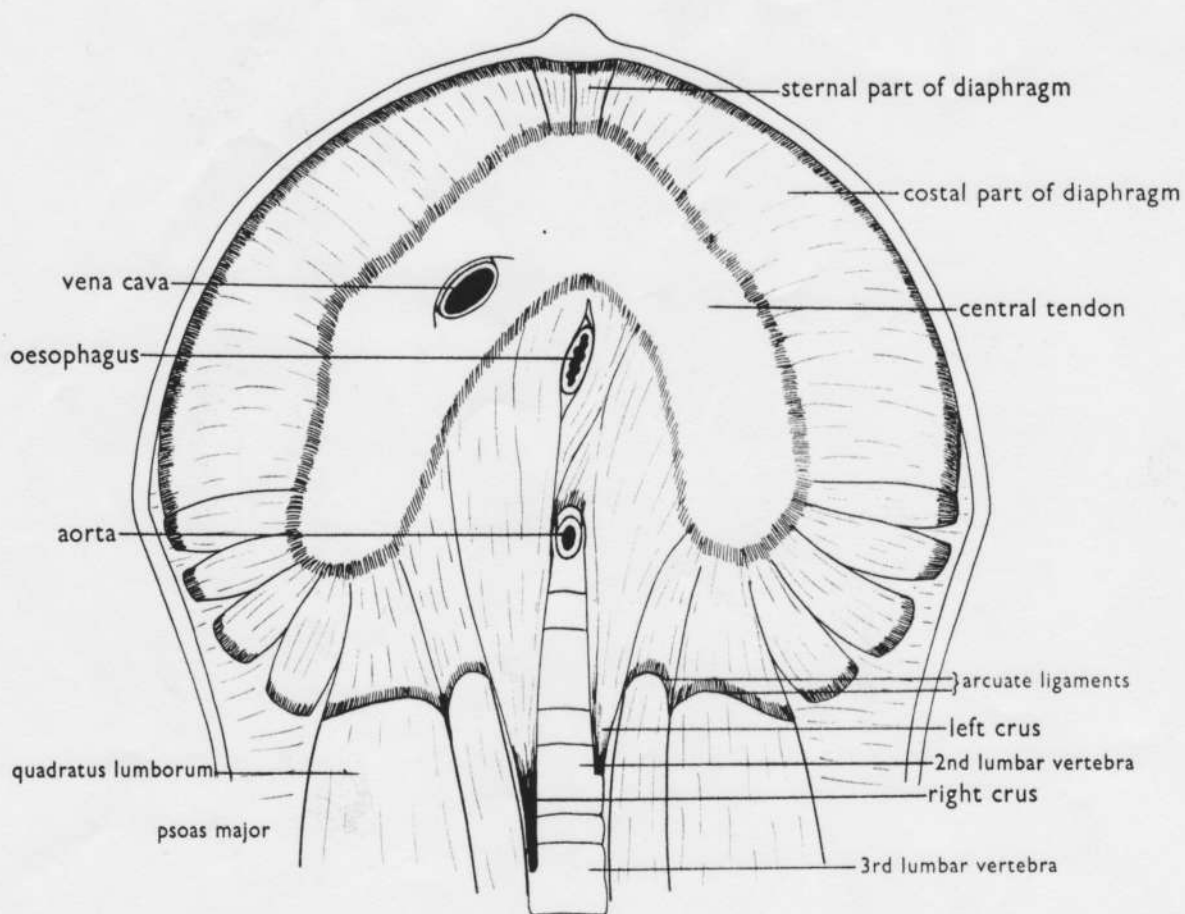
(d) **Quiet expiration** is caused mainly by elastic recoil assisted by the normal tone of the **abdominal wall** pressing the viscera against the under side of the diaphragm and by the **sternocostalis** muscles depressing the ribs.

(e) **Forced expiration** involves the strong contraction of all the muscles of the **abdominal wall** which force the viscera against the diaphragm and thus increase the concavity of the dome. In addition the **latissimus dorsi** and **serratus posterior inferior** muscles help to depress the ribs while at the same time the vertebral column is flexed.

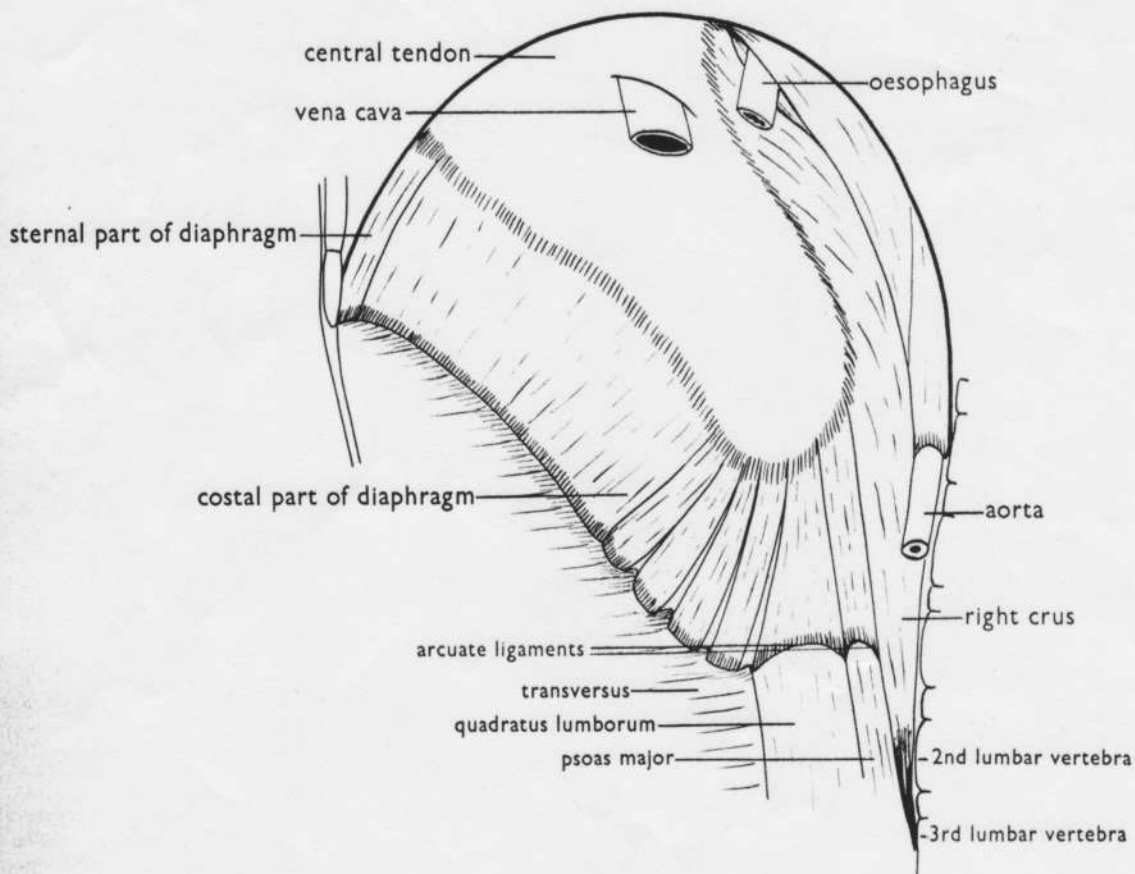
The Openings of the Diaphragm

The diaphragm is perforated to allow the passage of structures between the thorax and the abdomen. The three chief openings are:

1. the **aortic** opening which transmits the **aorta** and the **thoracic duct**,
2. the **oesophageal** opening which transmits the **oesophagus** and the **vagus** nerves,
3. the **vena caval** opening which transmits the **inferior vena cava**.



Diaphragm—viewed from beneath



Diaphragm—right half viewed from the side