

Diaphragm

Nature and shape:

- * It is a large dome shaped muscular tendinous partition which separating the thoracic cavity from the abdominal cavity.
- * It is convex upwards and concave downwards.
- * Its right side (called right cupula) is higher than its left side (called left cupula) due to underlying large right lobe of liver.

Origin:

- * It takes origin from three areas:

(1) **Sternal origin:** By two slips from the back of *xiphoid process*.

(2) **Costal origin:** from the deep surface of the *lower six costal cartilages* by slips inter-digitating with origin of the transversus abdominis muscle.

(3) **Vertebral origin:**

- * By two crura (right and left) and five arcuate ligaments (median, two medial and two lateral).

a) Two crura:

- * *The right crus*: arises from the bodies of the upper three lumbar vertebrae.

- It is larger than the left crus as it has to contract against the liver.

***The left crus**: It is smaller and arises from the bodies of the upper two lumbar vertebrae.

b) Arcuate ligaments:

1) **Median arcuate ligament:** One only, lies in the median plane.

- * *It extends* between the right and left crura.

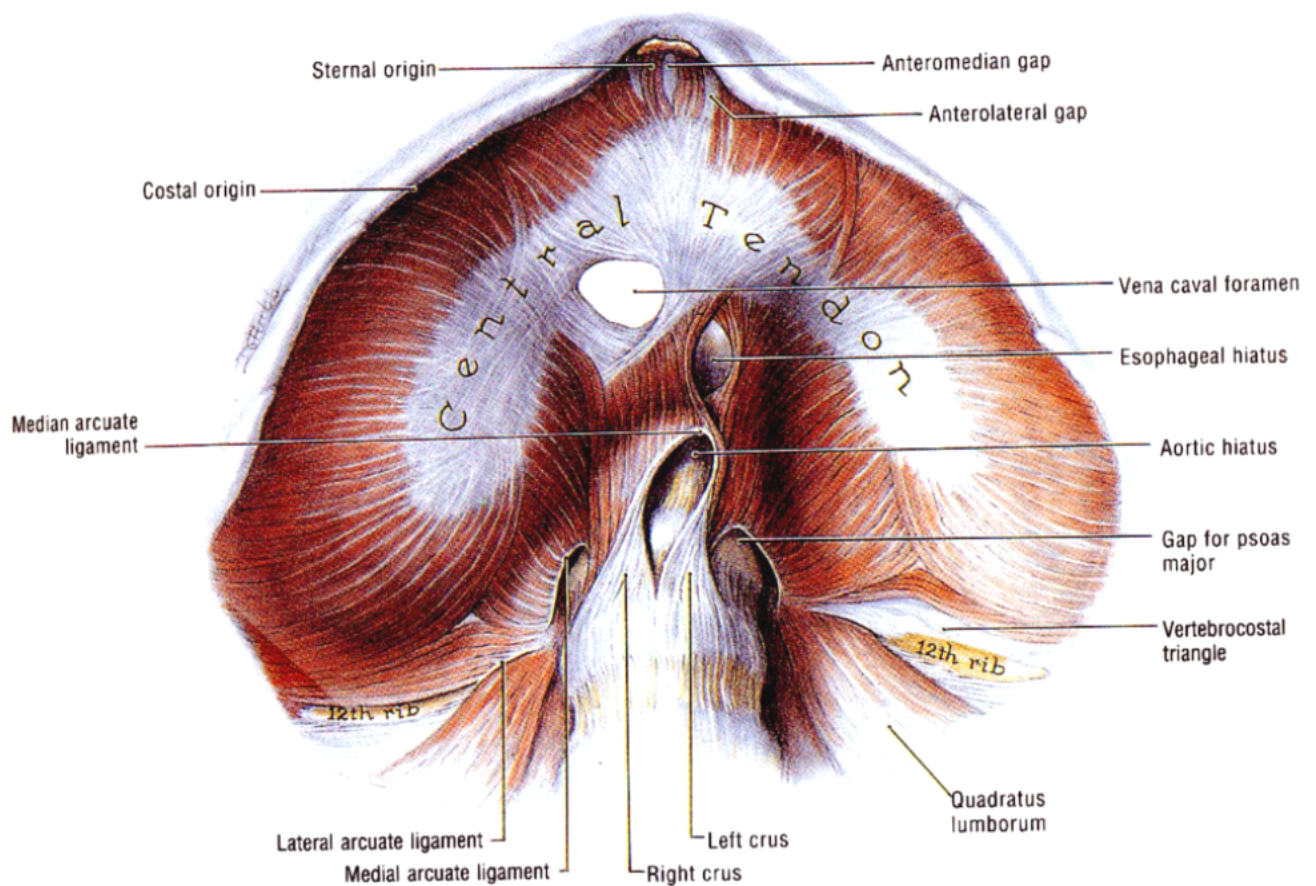
- * It **arches over** the aorta.

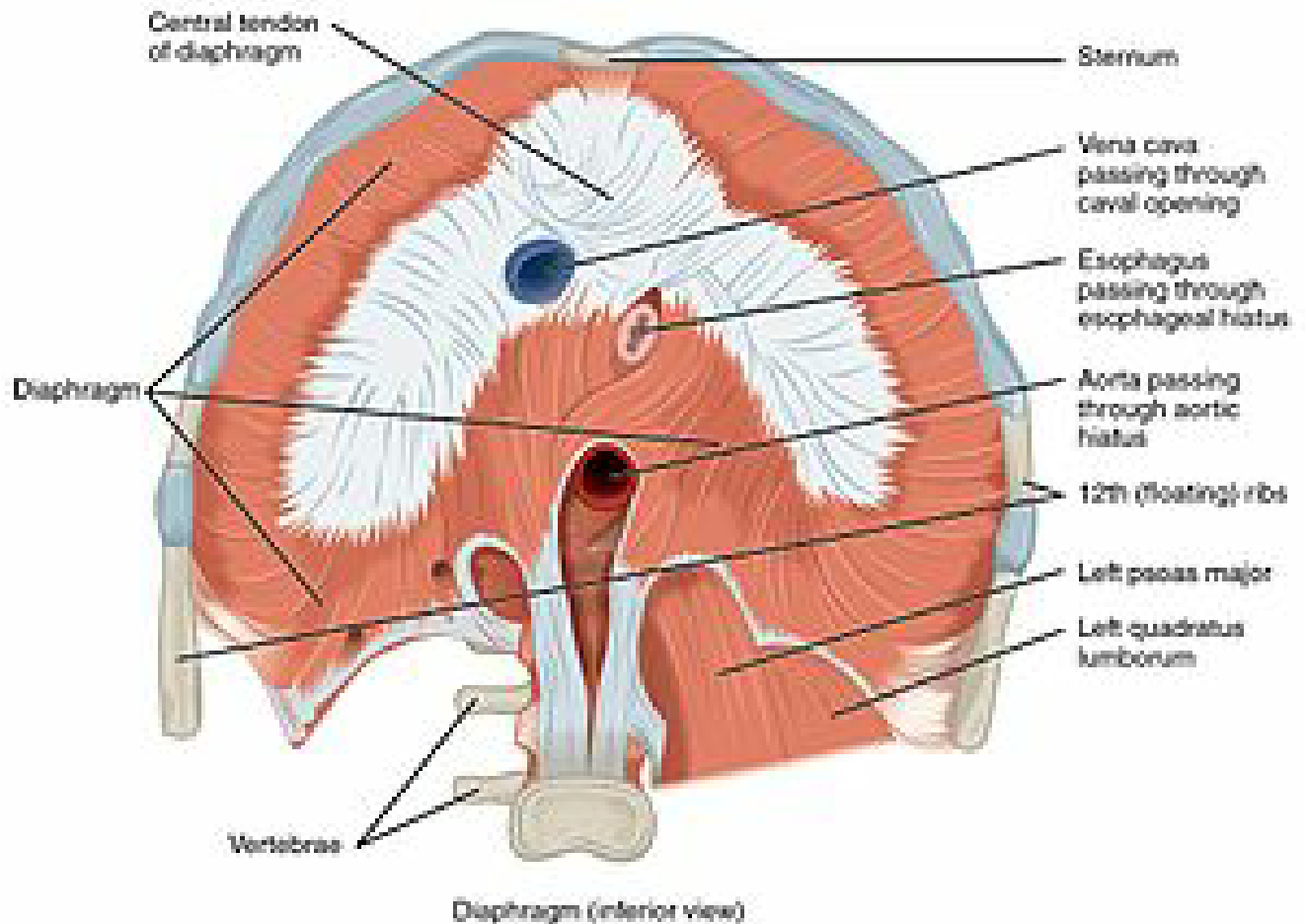
2) **Two medial arcuate ligaments:** One on each side.

- * It *extends* from the crus of diaphragm to the tip of transverse process of L₁ vertebra.
- * It *arches over* the psoas major muscle & sympathetic chain .

3) **Two lateral arcuate ligaments:** One on each side.

- * It *extends* from the tip of transverse process of L₁ vertebra to the last rib.
- * It *arches over* the upper part of quadratus lumborum muscle & subcostal vessels .





Defects in the diaphragm:

*There are small defects between the different parts of origin of the diaphragm. They are filled with loose areolar tissue.

A. **Foramen of Morgagni**: Lies between the sternal & costal origin & transmitting superior epigastric vessels. It may be the site of anterior (parasternal) diaphragmatic hernia.

B. **Foramen of Bochdalek**: (Vertebro-costal triangle)

- It lies between the costal & vertebral origins it may be the site of posterior diaphragmatic hernia.

* At this triangle, the pleura of costo- diaphragmatic recess comes in contact with

posterior surface of the kidney which separated only by areolar tissue.

- * This triangle is the remnants of the pleuro-peritoneal canal in the fetus.

Insertion:

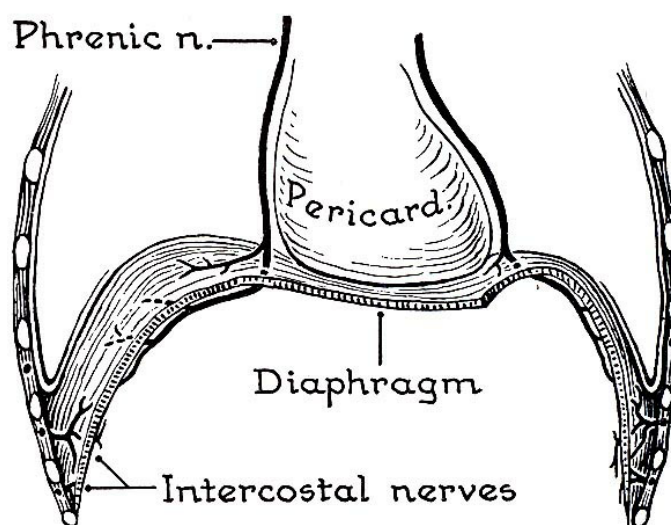
- * It has no bony insertion, but all the fibers converge to be inserted into the ***Central Tendon*** of diaphragm.
- * This tendon is a strong aponeurosis, semilunar in shape and formed of one median and two lateral folia (i.e trifoliate). The median folia is related to the pericardium and heart.

Nerve Supply:

A) Motor: Right and left phrenic nerves (C3,4,5) , arise in the cervical region and descend to ramify on the inferior surface of the diaphragm.

- * Cervical origin of the phrenic nerve is due to that the diaphragm developed in the cervical region and migrated downwards (phenomenon of migration).
- * The nerve supplies the inferior (abdominal) surface due to folding of the embryo. (phenomenon of folding).

B)Sensory : Lower 5 intercostal nerves & subcostal , are sensory to the peripheral parts. Phrenic nerves are sensory to the central part of the diaphragm.



Relations:

(1) The superior surface:

- The right copula is related to right pleura and lung.
- The left copula is related to left pleura and lung.
- The central tendon is related to inferior surface of heart and pericardium.

(2) The inferior surface:

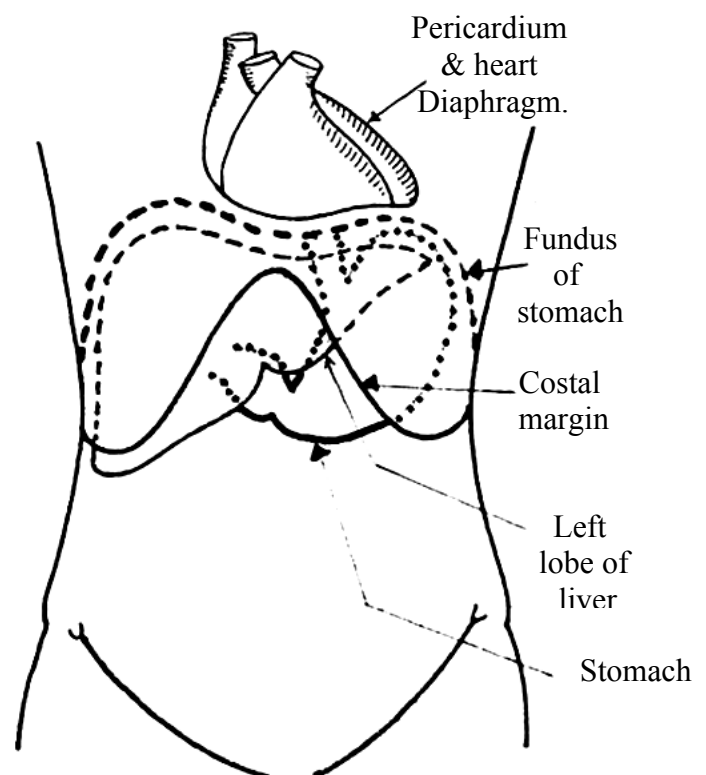
* *On the right.*

- Right lobe of the liver.
- Right kidney and right suprarenal gland.

* *On the left.*

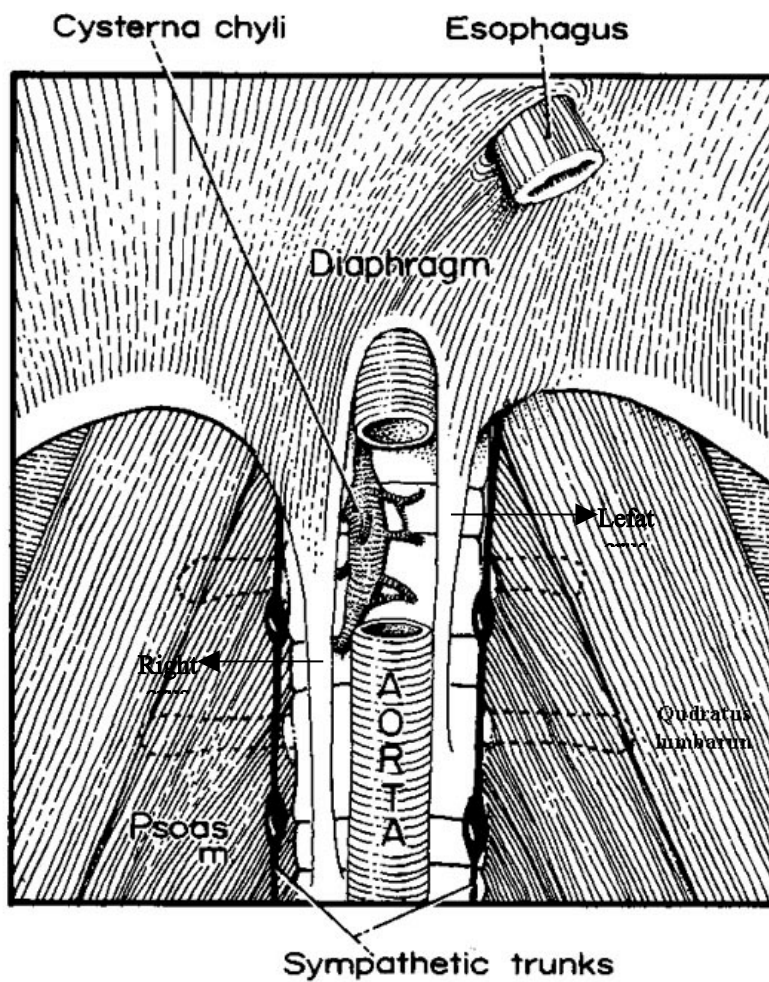
- Left lobe of the liver.
- Fundus of stomach and spleen.
- Left kidney and left suprarenal gland.

* Relations of the diaphragm*



Action of diaphragm:

- 1) It is the chief muscle of respiration (inspiration & expiration).
- 2) Its contraction leads to its descends: with increase in the vertical diameter of the thoracic cavity, increases intra-abdominal pressure and increases the negative pleural pressure with inflation of the lungs to facilitate rush of air to the respiratory tract.
- 3) It is used to increase the intra-abdominal pressure in different circumstances as; labour , coughing, defecation and micturation.



*** Diaphragm ***

● Aortic opening and crura ●

Openings in the Diaphragm:

(A) Major Openings in Diaphragm:-

	Aortic Opening	Oesophageal Opening	I. V. C. Openig
1. Site:	• T₁₂ vertebra • In the middle line. • Behind median arcuate ligament.	• T₁₀ vertebra • 1 inch to left of middle line. • In the right crus.	• T₈ vertebra • 1 inch to right of middle line. • In the central tendon.
2. Structures inside:	• Aorta to left • Thoracic duct in between. • Azygos vein to the right.	• Oesophagus & 2 Vagi. • Oesophageal branches of left gastric vessels.	• I.V.C , right Phrenic nerve & lymphatics.

(B) Minor openings of diaphragm and the structures passing through:

- 1) **Musculo-phrenic artery:** between the slips of origin of the diaphragm from 7th. and 8th. costal cartilages.
- 2) **Superior epigastric artery:** pass, between sternal and costal origins .
- 3) **Lower 5 posterior intercostal nerves & vessels:** between costal slips of diaphragm.
- 4) **Subcostal nerve and vessel:** behind lateral arcuate ligament.
- 5) **Inferior hemiazygos vein:** pierces left crus to enter the chest.
- 6) **Sympathetic chain:** Behind the medial arcuate ligament.
- 7) **Greater and Lesser splanchnic nerves;** pierce the crus of the

corresponding side.

8) Left phrenic nerve pierces the left cupola.

*** Arterial supply of the diaphragm:**

- a) Superior Phrenic artery: from thoracic aorta.
- b) Lower 5 posterior intercostals & subcostal arteries: from thoracic aorta.
- c) Inferior Phrenic artery: from abdominal aorta.
- d) Musculo-phrenic artery: from internal thoracic artery.
- e) Pericardio-phrenic artery: from internal thoracic artery.

Applied Anatomy:

* Diaphragmatic hernia may be one of the followings:

- 1- *Hiatus hernia*: stomach pass through the esophageal opening.
- 2- *Hernia of Bochdalek*: between the costal & vertebral origins
- 3- *Parasternal hernia of Morgagni*: between the sternal & costal origins of diaphragm.



*** Major Openings
In the diaphragm**

