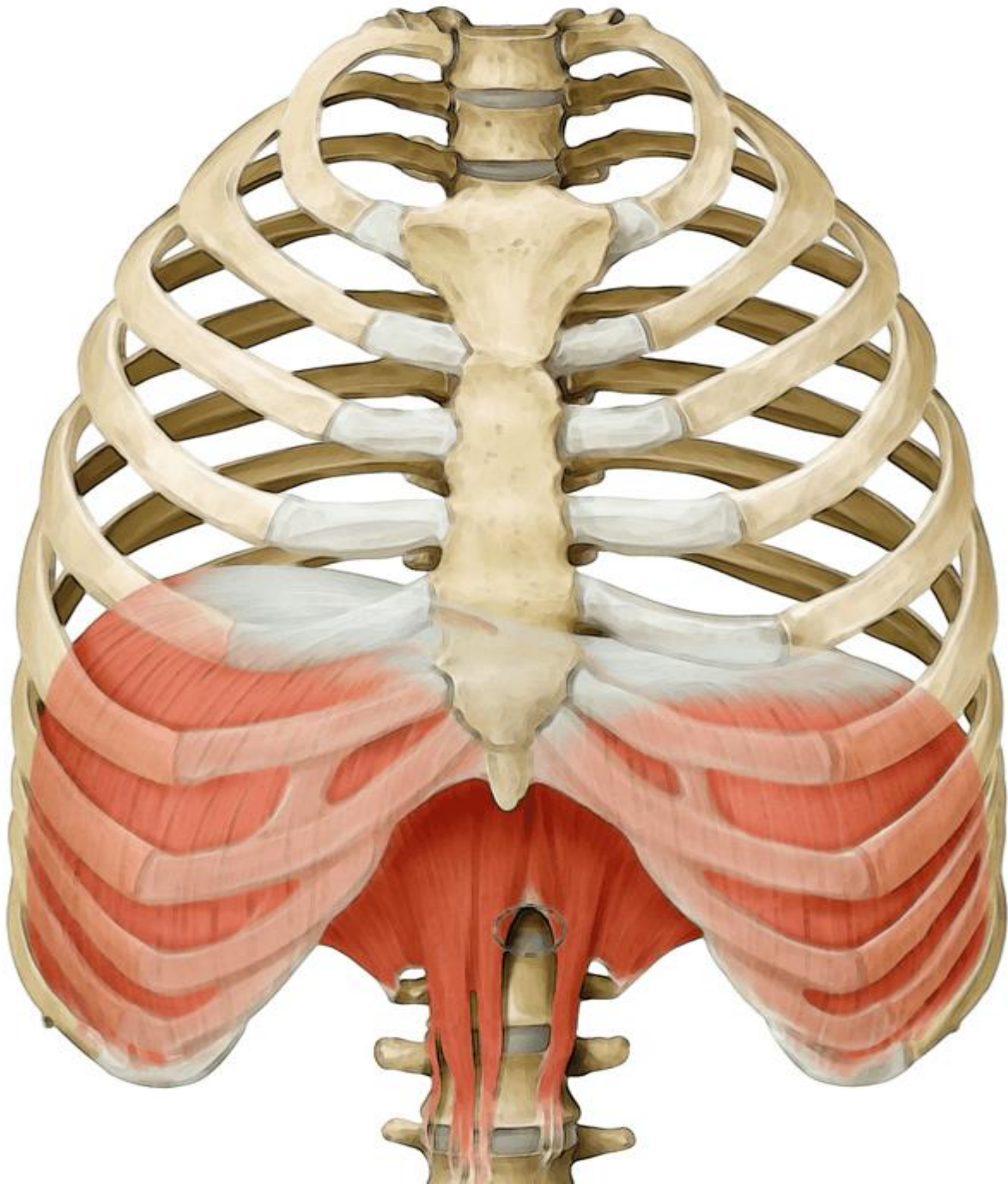


Posterior Abdominal Wall

Muscles of Posterior Abdominal Wall

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 copula**) is **higher** than its left side (called left copula) due to underlying large **right lobe of liver**.

★ **Origin:** It takes origin from three areas:

- (1) **Sternal origin:** from the back of **xiphoid process**.
- (2) **Costal origin:** from the inner 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) 2 crura:

- **The right crus:** arises from the bodies of the **upper 3 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 2 lumbar vertebrae**.

b) 5 Arcuate ligaments:

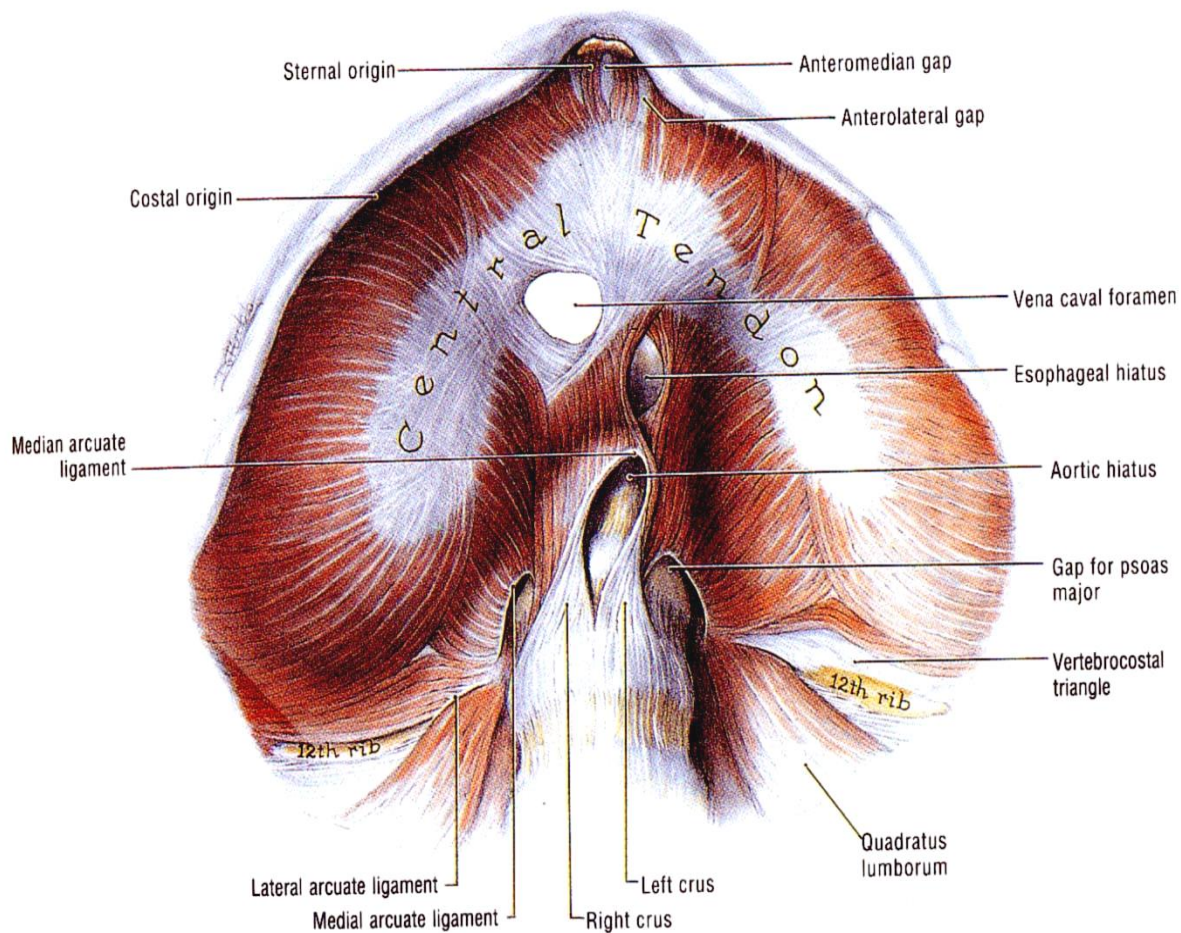
- 1) **Median arcuate ligament:** One only, lies in the median plane.
 - **It extends** between the right and left crura.
 - It **arches over** the aorta.

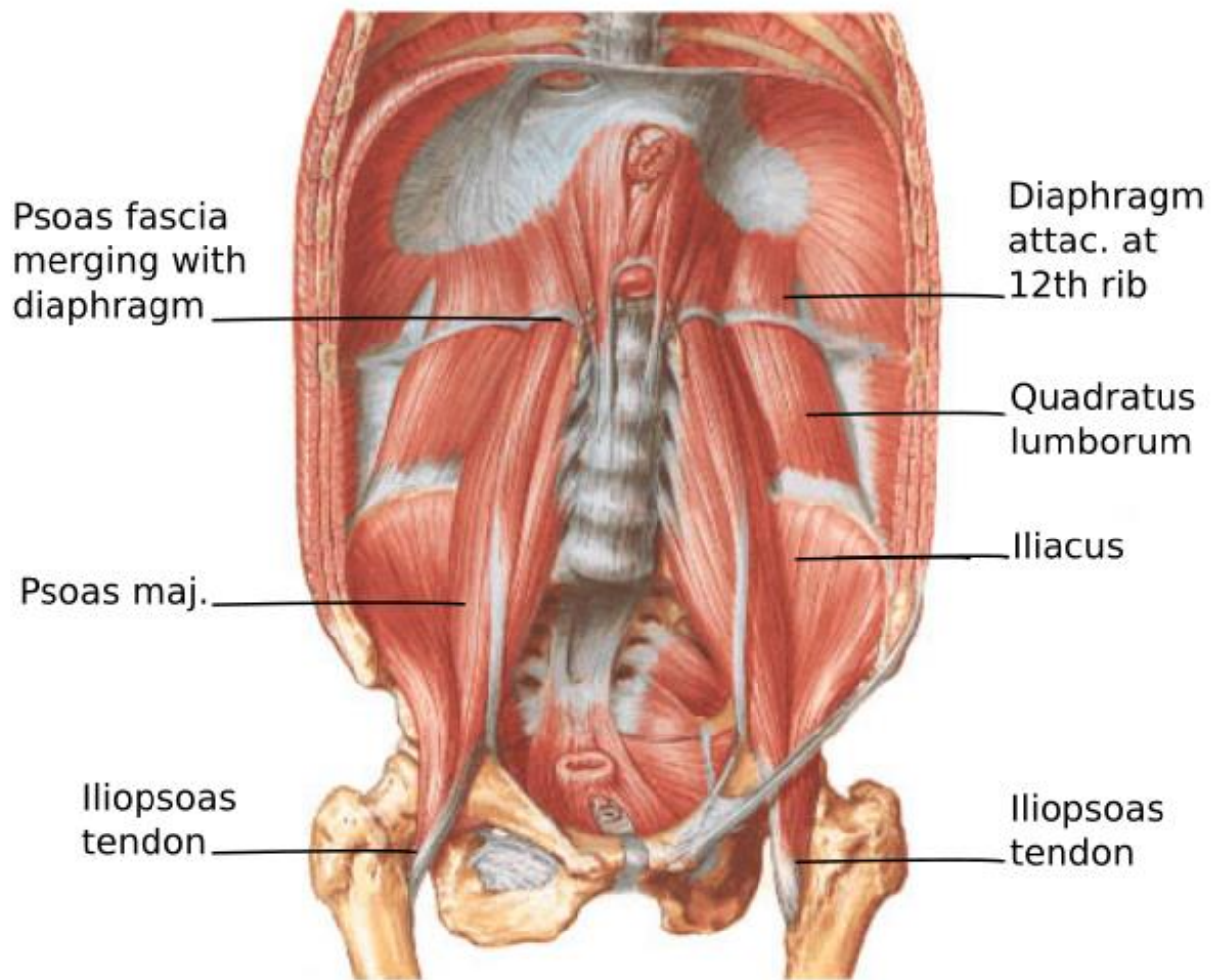
2) **2 medial arcuate ligaments:** One on each side.

- 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) **2 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 **filled with** loose areolar tissue **between the different parts of origin** of the diaphragm.

A. **Foramen of Morgagni:**

- It lies between the **sternal & costal** origin & transmitting **superior epigastric** vessels.
- It may be the site of **anterior diaphragmatic hernia**.

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

- It lies between the **costal & vertebral origins**.
- 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 pleuroperitoneal canal in the fetus.
- It may be the site of **posterior diaphragmatic hernia**.

★ **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.

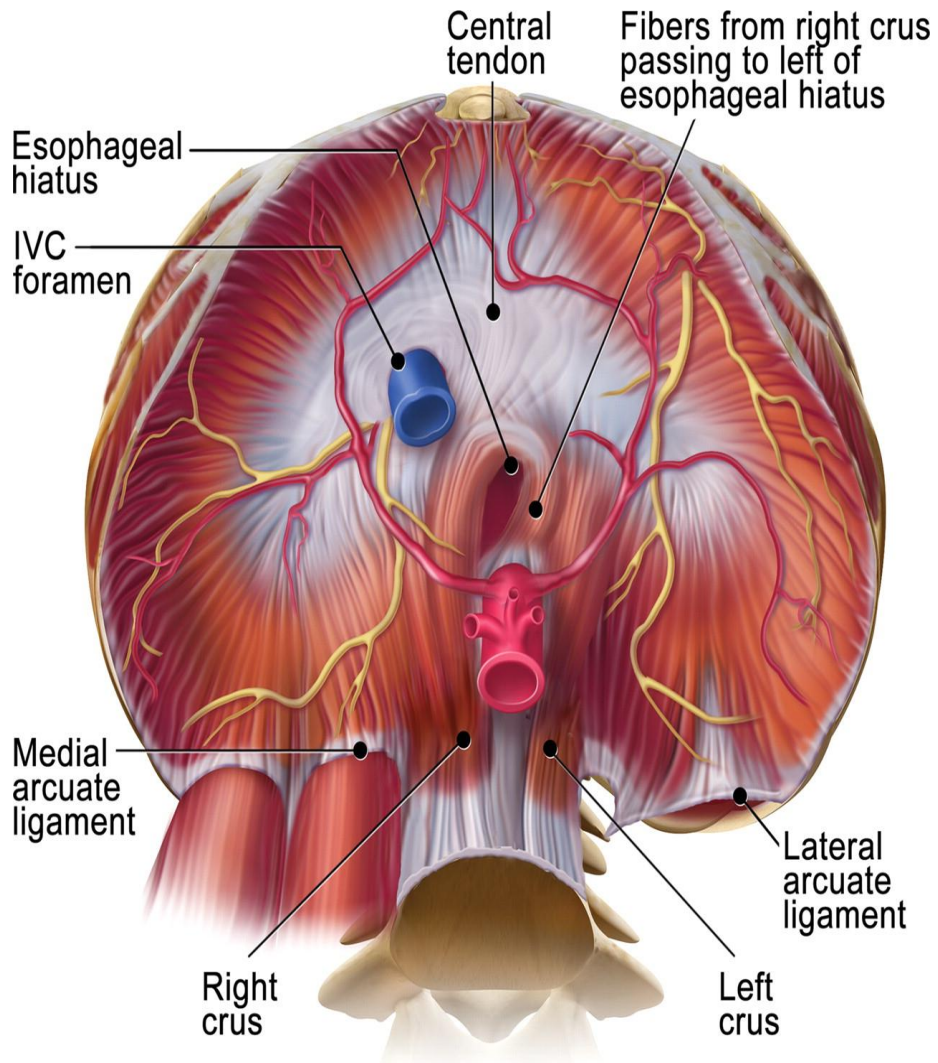
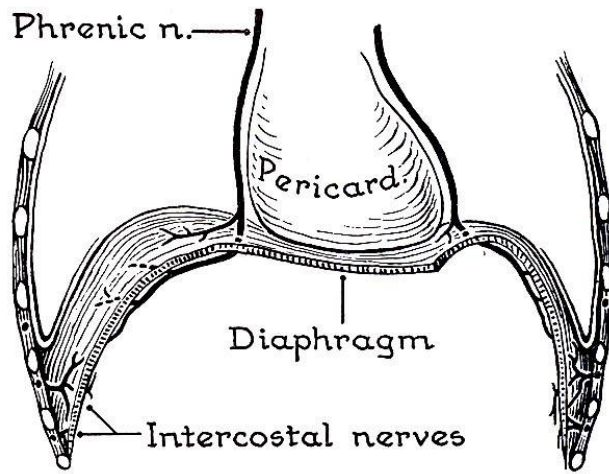
★ **Nerve Supply:**

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

* 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:

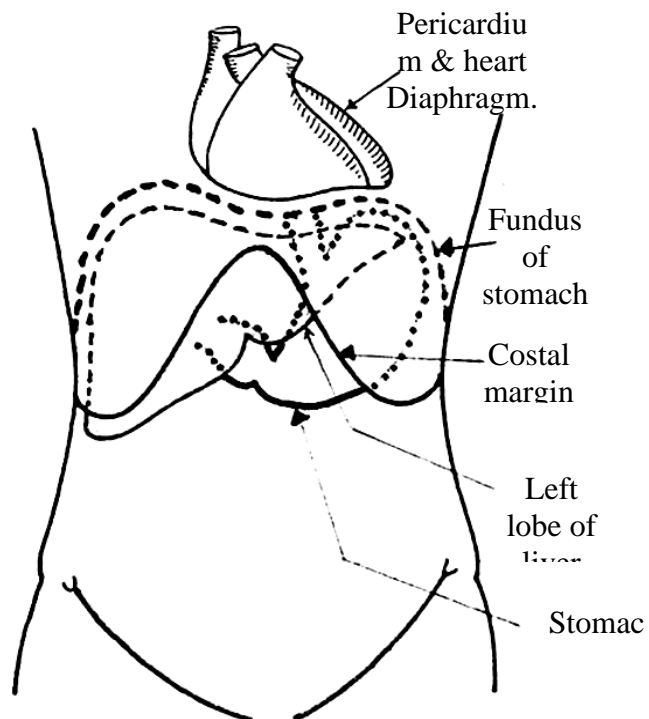
* **On the right:**

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

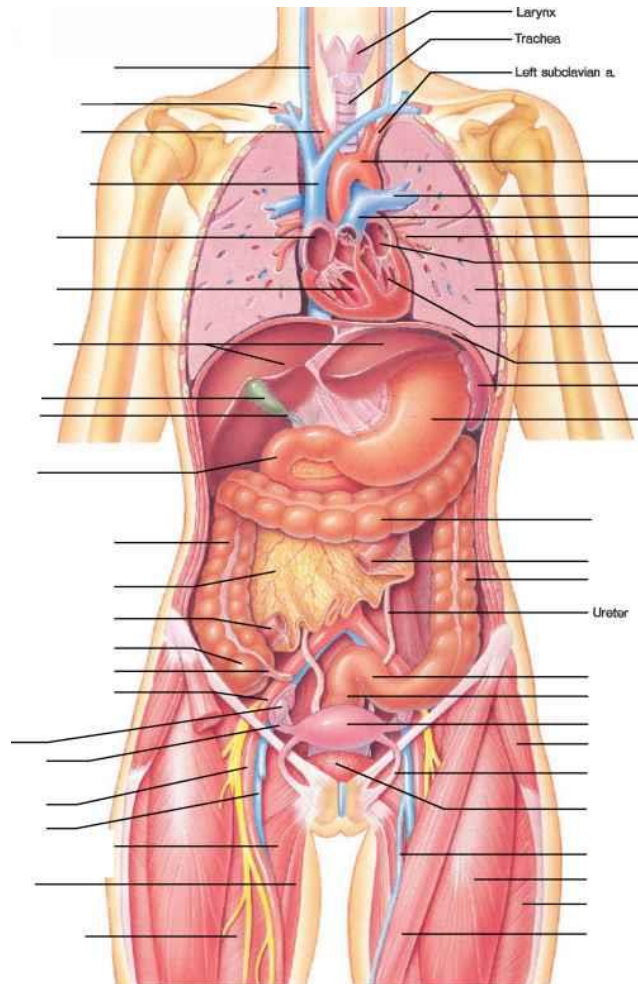
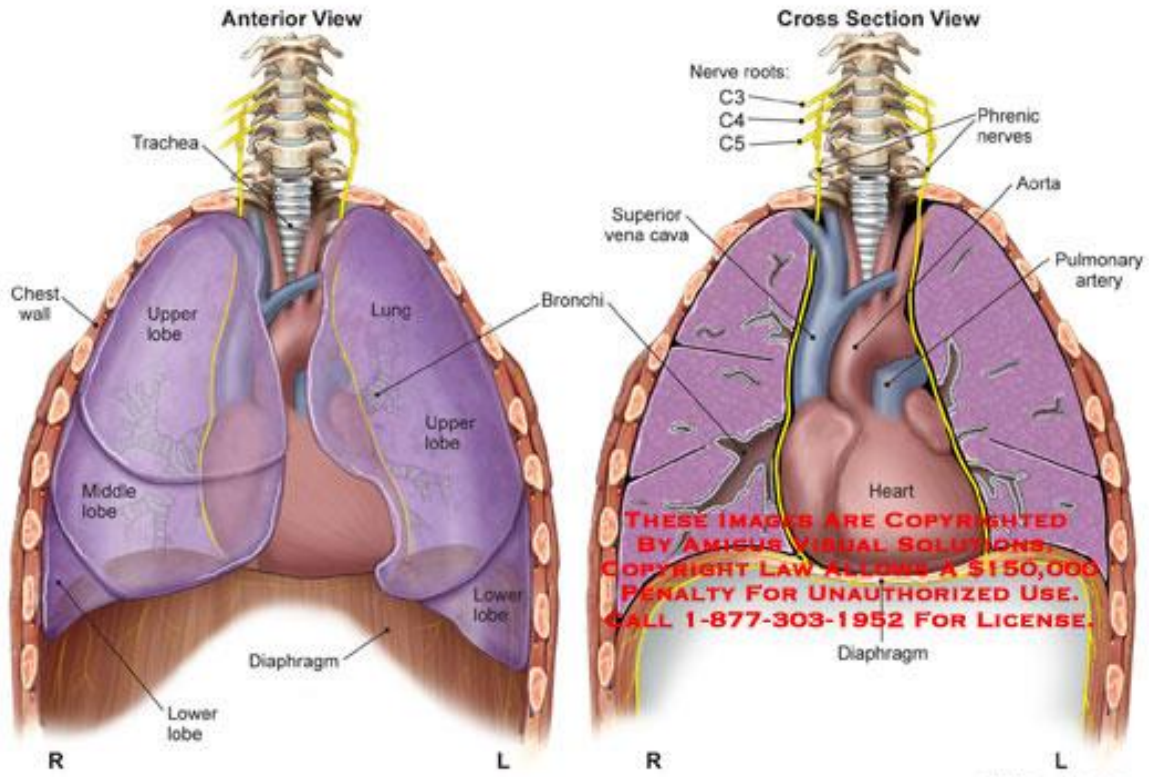
* **On the left:**

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

* **Relations of the diaphragm**

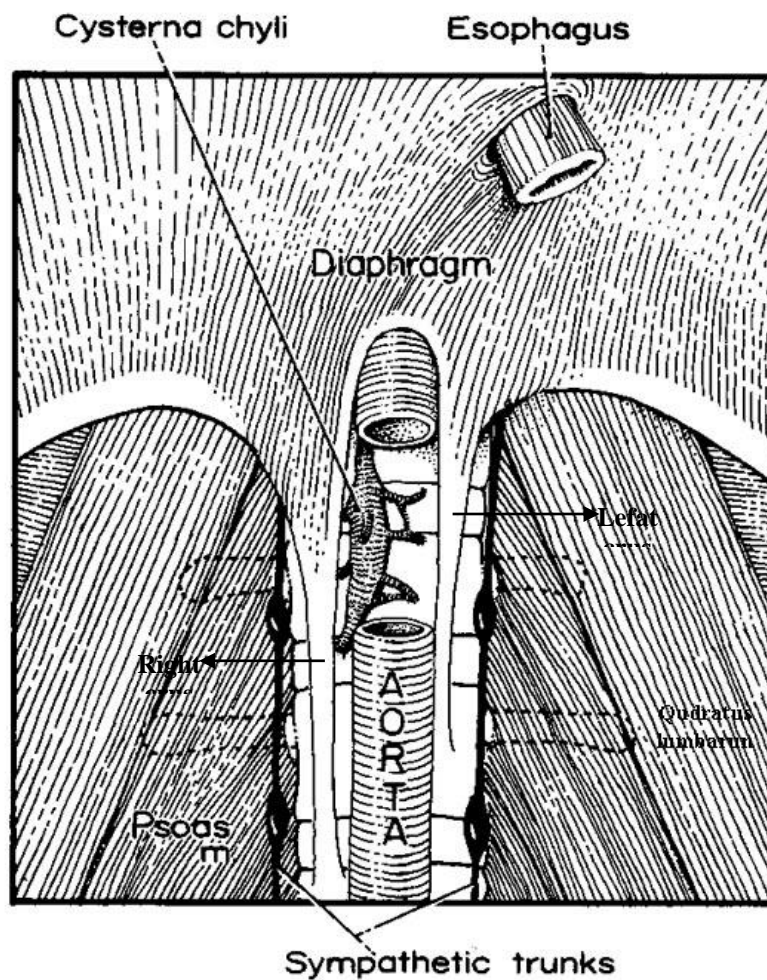


Anatomy of the Thorax



★ **Action of diaphragm:**

- 1) It is the chief muscle of respiration.
 - Its contraction leads to its descends with increase in the vertical diameter of the thoracic cavity and increases the negative pleural pressure with inflation of the lungs.
- 2) It increases the intra-abdominal pressure as during labour , coughing, defecation and micturation.



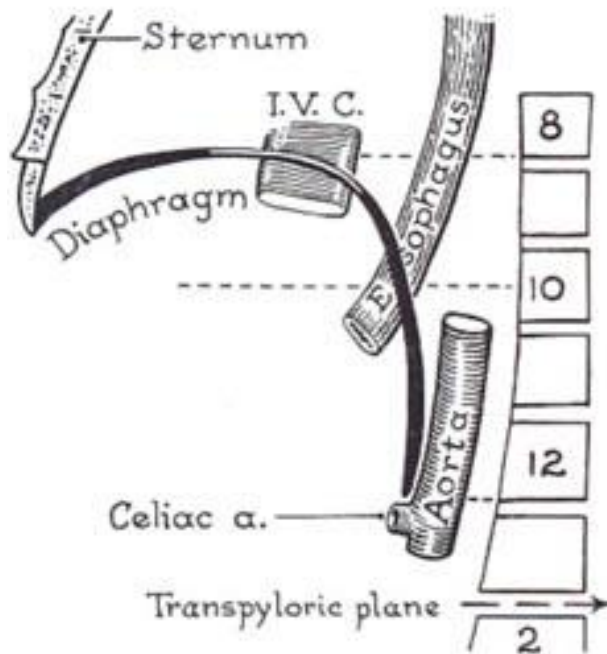
*** Diaphragm ***

- **Aortic opening and crura** •

★ **Openings in the Diaphragm:**

(A) Major Openings in Diaphragm:

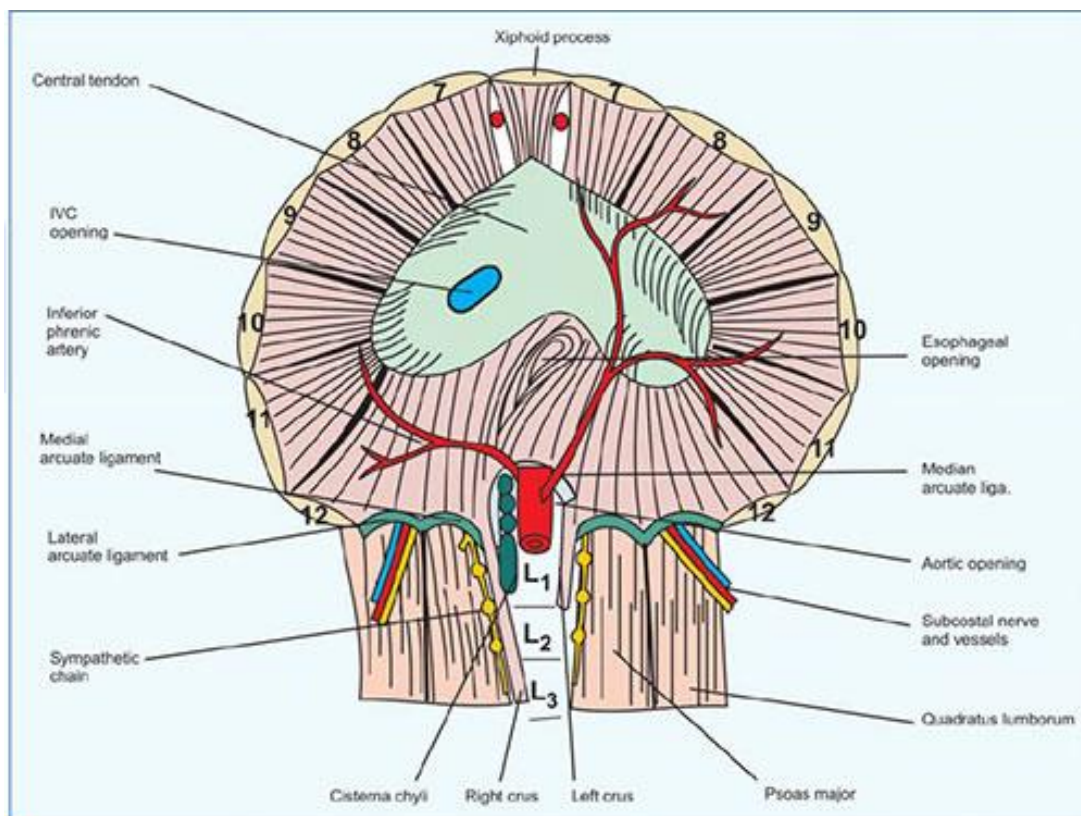
	Aortic opening	Esophageal opening	IVC opening
1. Site:	• T ₁₂ vertebra	• T ₁₀ vertebra	• T ₈ vertebra
	• In the middle line.	• 1 inch to left of middle line.	• 1 inch to right of middle line.
	• Behind median arcuate ligament.	• In the right crus.	• In the central tendon.
2. Structures inside:	<ul style="list-style-type: none"> • Aorta to left • Thoracic duct in between. • Azygos vein to the right. 	<ul style="list-style-type: none"> • Oesophagus • 2 Vagi. • Oesophageal branches of left gastric vessels. 	<ul style="list-style-type: none"> • I.V.C , right Phrenic nerve & lymphatics.



*** Major Openings In the diaphragm**

(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:** passes 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.

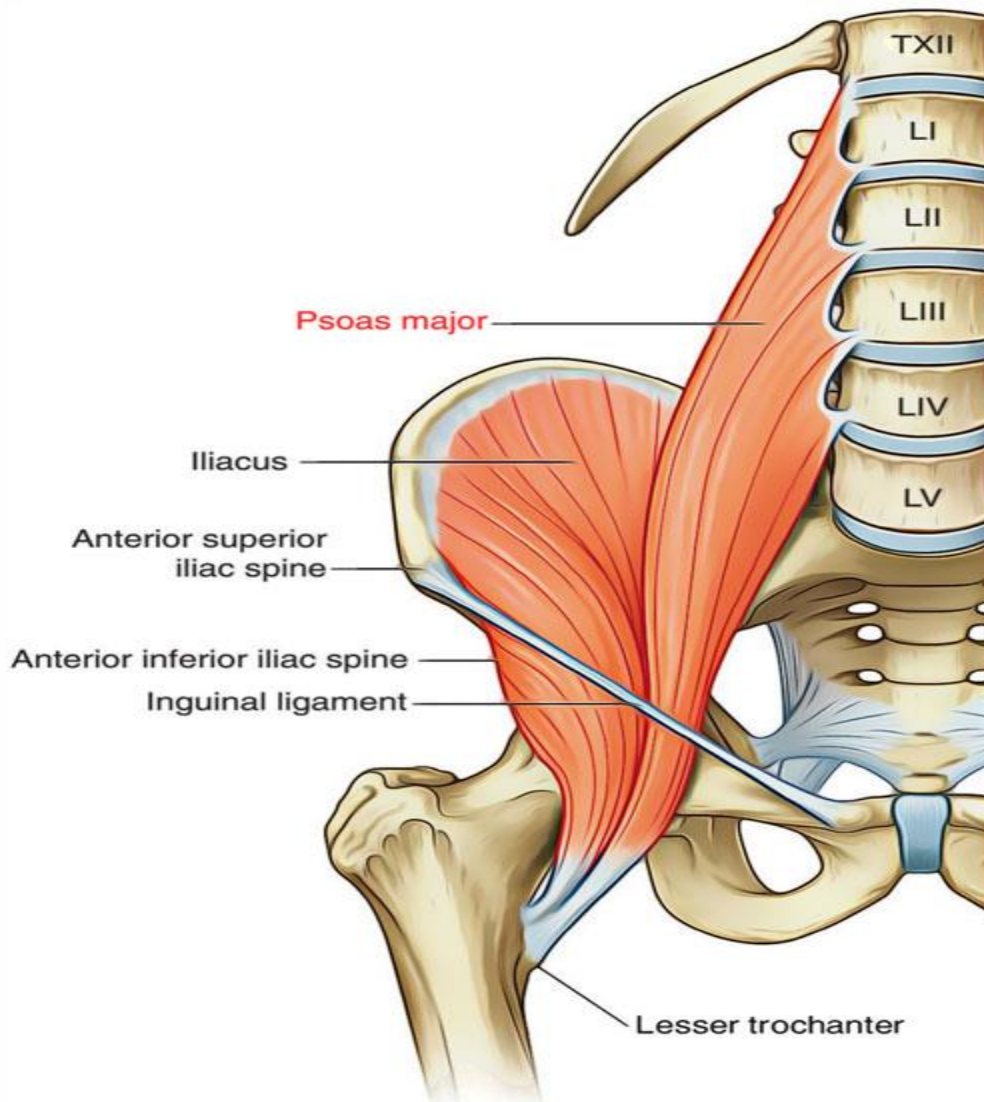


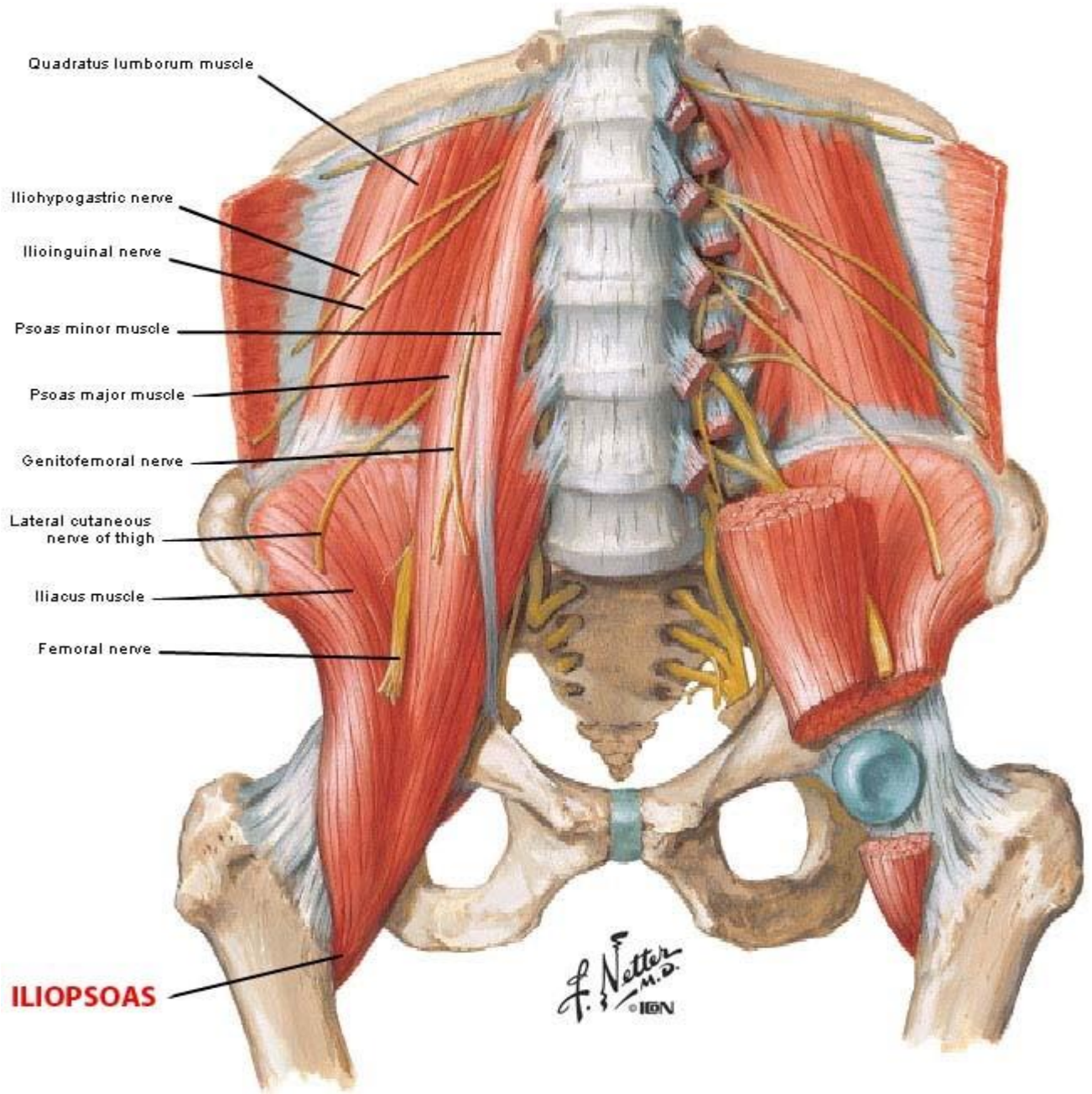
Psoas major muscle

★ **Origin:** From:

- 1) The transverse processes, sides of the bodies & intervertebral discs from **T12 to L5 vertebrae**.
- 2) The tendinous arches bridging over the lumbar vessels.

★ **Insertion:** the muscle descends along the brim of pelvis medial to the iliacus where both muscles join to form the iliopsoas muscle, it passes deep to the inguinal ligament to enter the thigh to be inserted into the lesser trochanter of femur.





★ **Nerve supply:** Branches from lumbar plexus (L1,2 & 3).

★ **Action:**

- The main flexor and medial rotator of the thigh.
- Causes lateral bending of the trunk.
- Both psoas muscles, bend the trunk forwards.
- Lateral rotator of the thigh, only when the neck of femur is fractured due to change of the axis of rotation.

★ **Relations:**

(a) In the abdomen & pelvis:

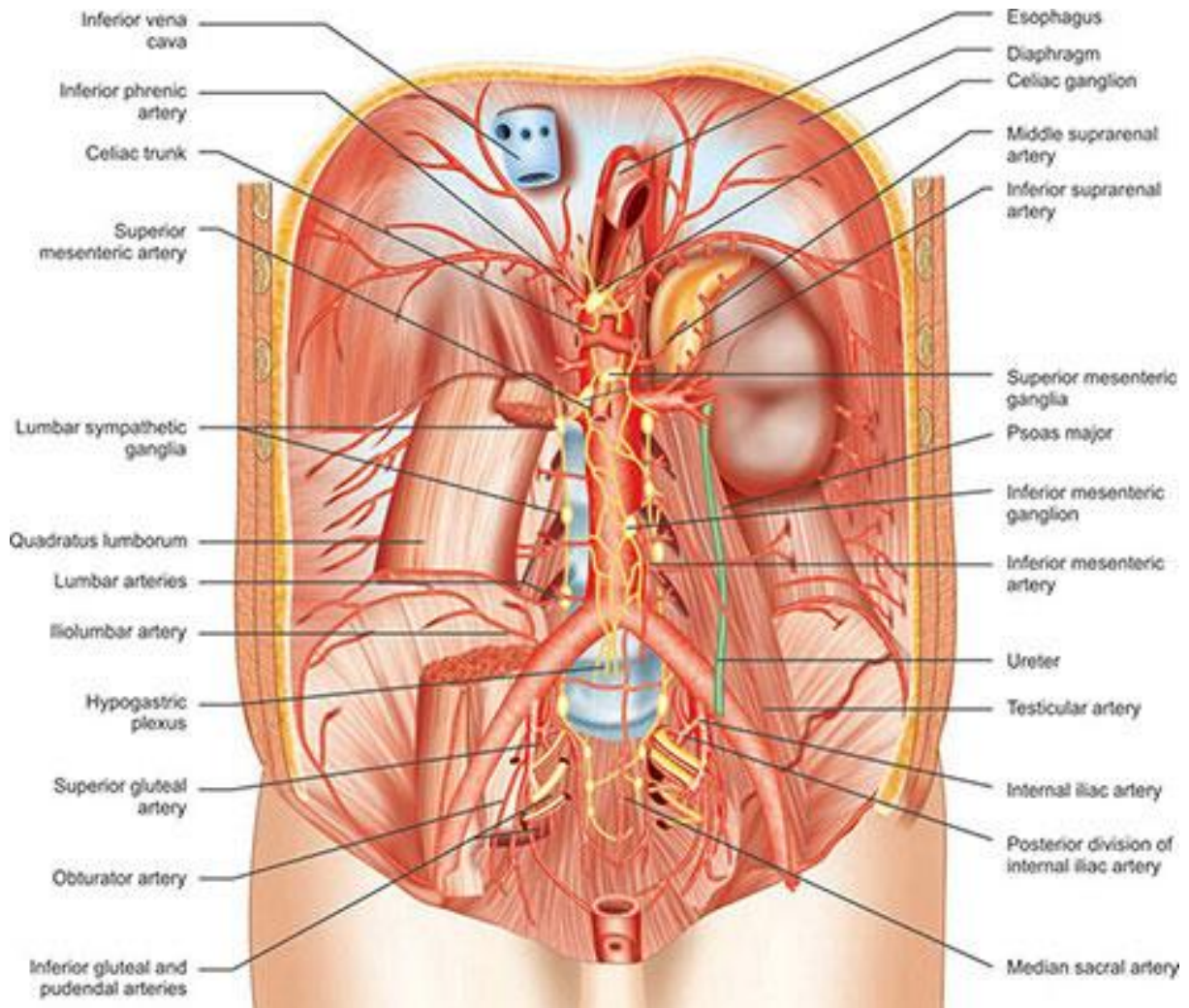
I) Anteriorly:

- 1- Medial arcuate ligament of the diaphragm.
- 2- Kidney & renal vessels.
- 3- Renal pelvis and ureter.
- 4- Gonadal vessels.
- 5- Genito- femoral nerve.
- 6- Psoas minor " if present".
- 7- 3rd part of duodenum on the right side and 4th part of duodenum on the left side.
- 8- End of ileum on the right side and descending colon on the left side.
- 9- Inguinal ligament.

II) Posteriorly:

- 1- Transverse processes of the lumbar vertebrae.
- 2- Lumbar arteries.
- 3- Lumbar nerves which form the lumbar plexus are embedded in the posterior part of the muscle.

4- The medial border of the quadratus lumborum.



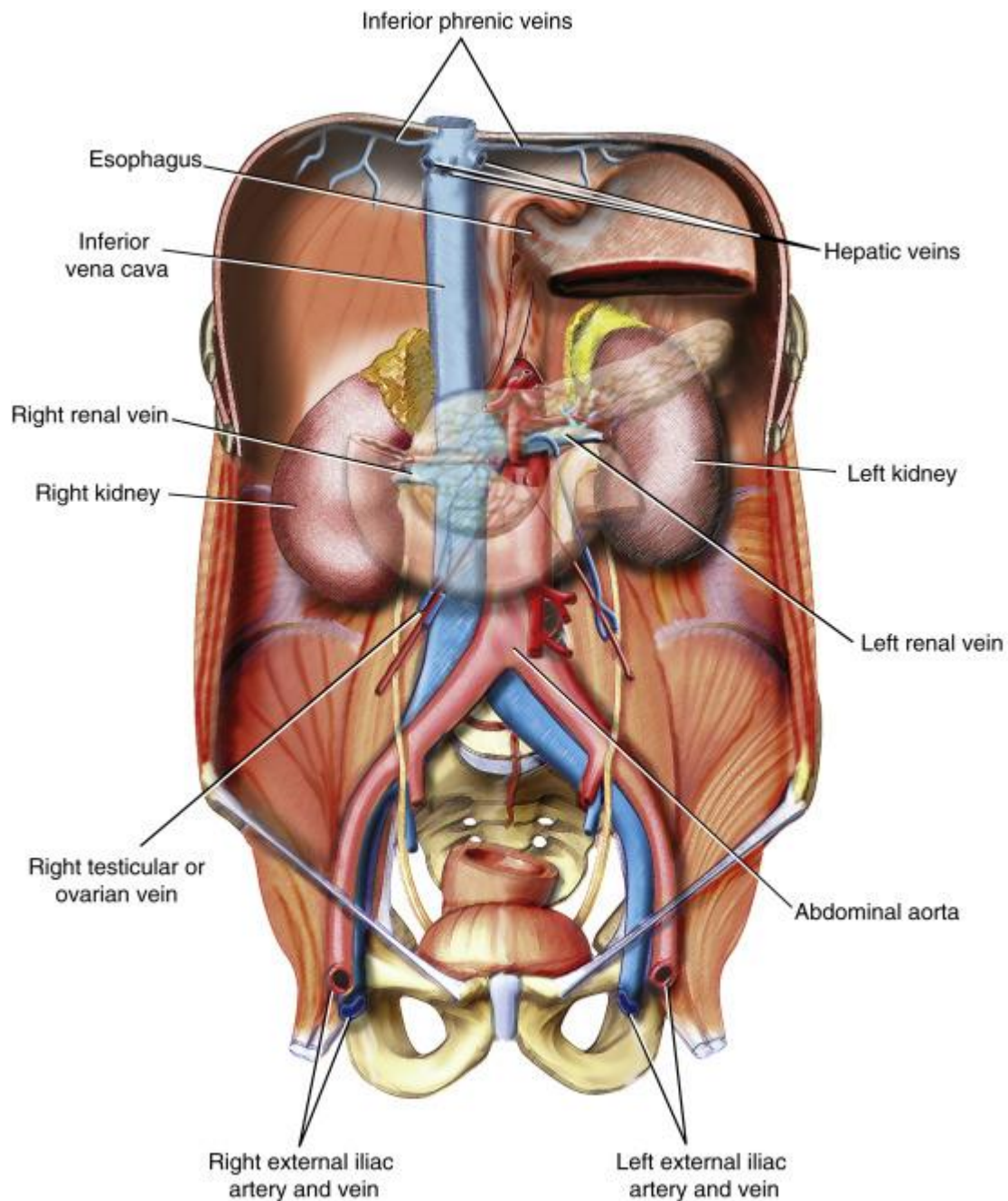
III) Medially:

- 1- Sympathetic chain, along its medial border.
- 2- External iliac vessels.
- 3- Obturator nerve & lumbosacral trunk.
- 4- The aorta medial to the left psoas, while the inferior vena cava is medial to the right psoas.

IV) Laterally:

- 1- The quadratus lumborum. (lateral to its upper part).

- 2-The iliacus. (lateral to its lower part).
- 3-Iliohypogastric nerve.
- 4-Ilioinguinal nerve.
- 5- Lateral Cutaneous nerve of thigh.
- 6- Femoral nerve.



(b) In the thigh:

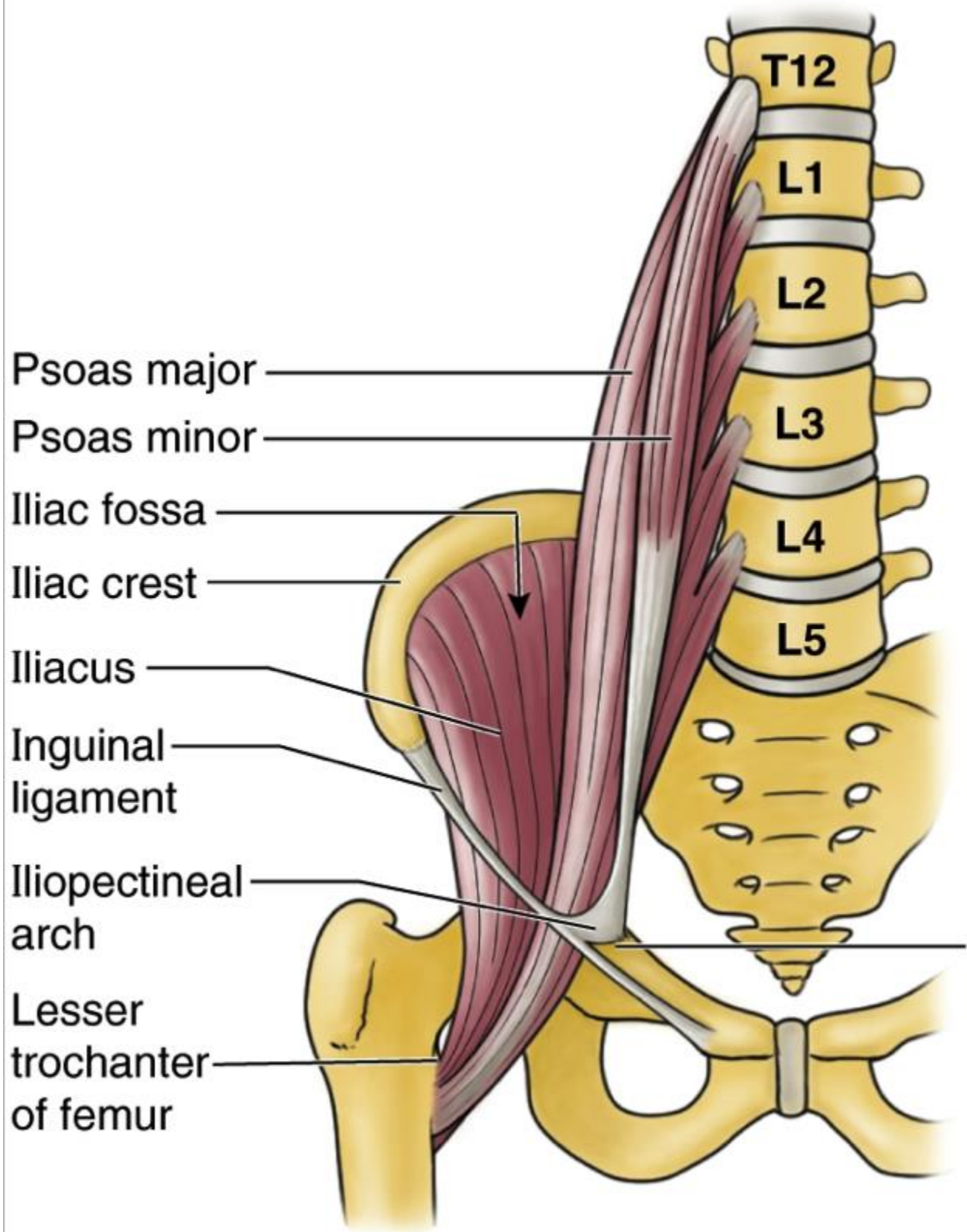
- 1- Anteriorly:** Femoral artery inside femoral sheath.
- 2- Posteriorly:** Capsule of hip joint, separated by a bursa.
- 3- Medially:** Pectineus muscle.
- 4- Laterally:** Femoral nerve. (between psoas & iliacus) .

★ **Psoas Fascia:**

- It envelops psoas major muscle and is **thickened above** to form the **medial arcuate ligament**.
- It is attached **medially** to the bodies of **lumbar vertebrae &** intervertebral discs.
- **Laterally**, blends above with fascia on **quadratus lumborum**, while below it continues with the **fascia iliaca**.
- **In T.B of spine**, collection of caseous material between psoas major muscle and its fascia leading to formation of psoas cold abscess which present as abdominal swelling and swelling in the upper part of the thigh with cross fluctuation in between.

Psoas minor muscle

- ★ **Origin:** From adjoining parts of last thoracic & 1st lumbar vertebra & inter-vertebral discs in between.
- ★ **Insertion:** .The muscle descends in front of psoas major muscle to be inserted into the ilio-pectineal eminence.
- ★ **Nerve Supply.:** From the 1st. lumbar nerve.
- ★ **Action:** If it is present (60%), it will assist in the flexion of the trunk.



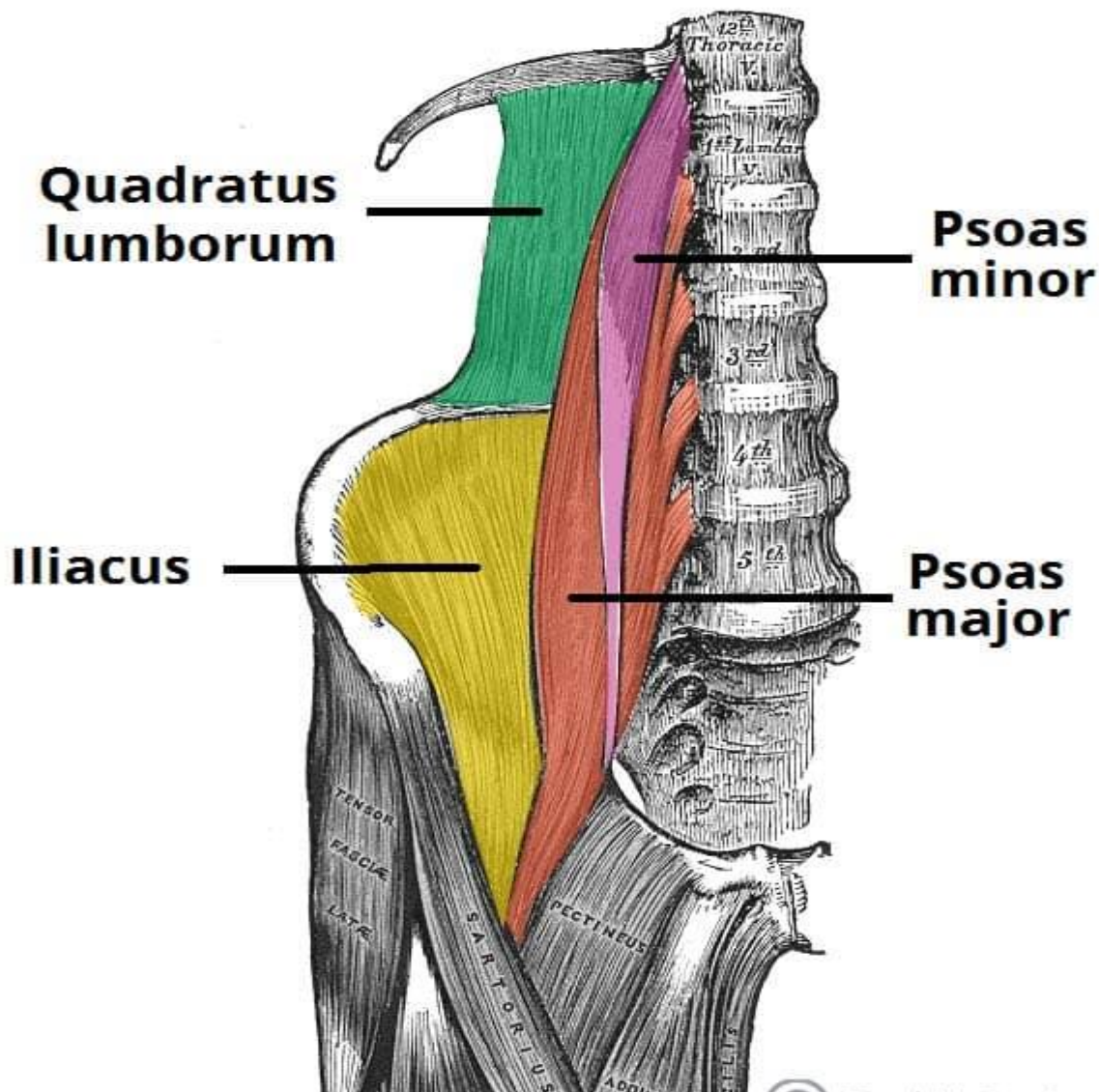
Quadratus lumborum muscle

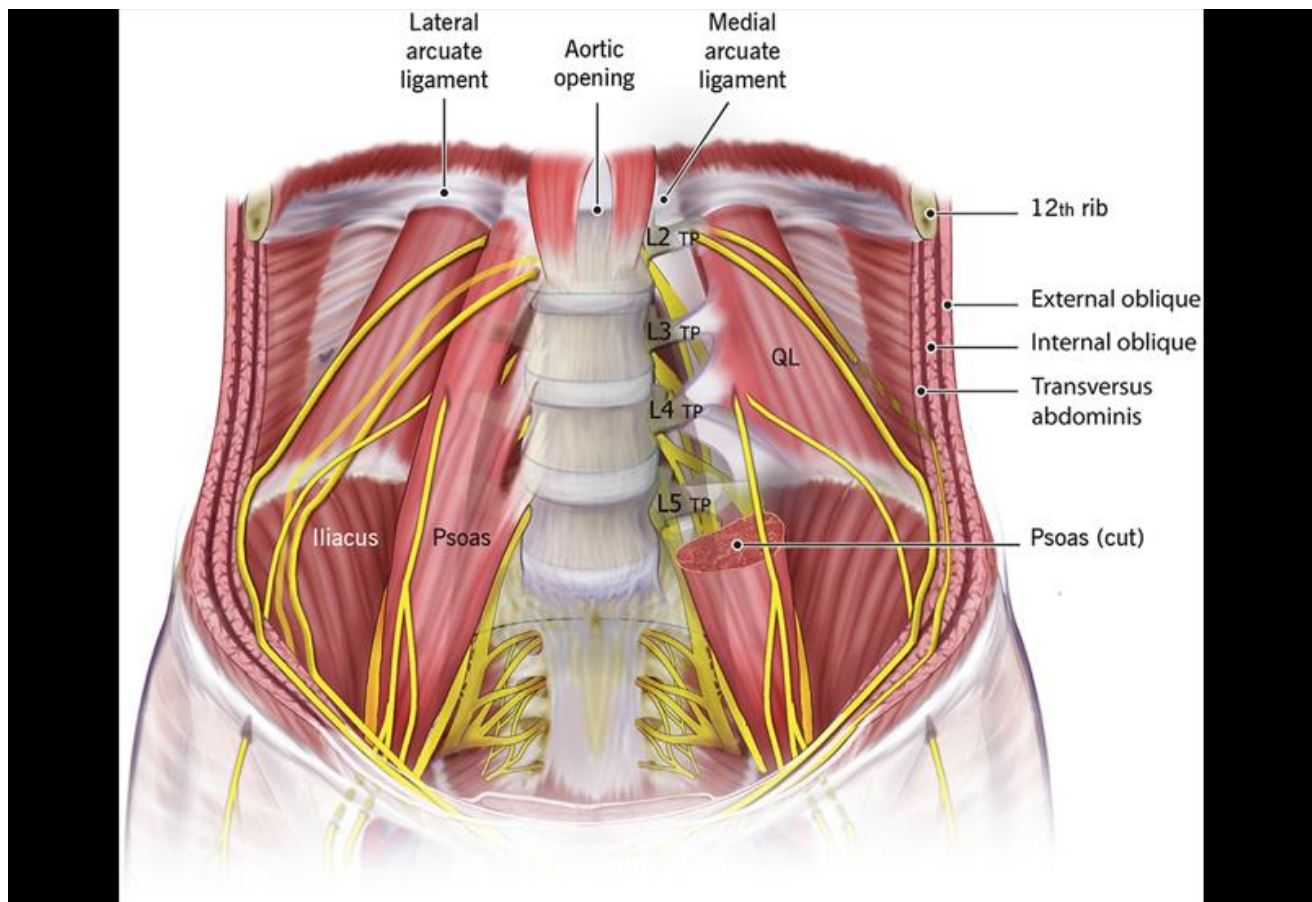
★ **Origin:** From:

- 1) Ilio-lumbar ligament.
- 2) Posterior two inches & medial part of inner lip of iliac crest.

★ **Insertion:**

- 1- Medial 1/2 of the last rib.
- 2- By tendinous slips into the tips of transverse processes of upper four lumbar vertebrae





★ **Nerve supply:** By the T12 & L1,2&3 nerves.

★ **Action:**

- (a) Fixes last rib, so help diaphragm to contract more effectively during respiration.
- (b) Lateral flexion (bending) the vertebral column to the sides.
- (c) If the two muscles act together, they extend the lumbar part of the vertebral column.

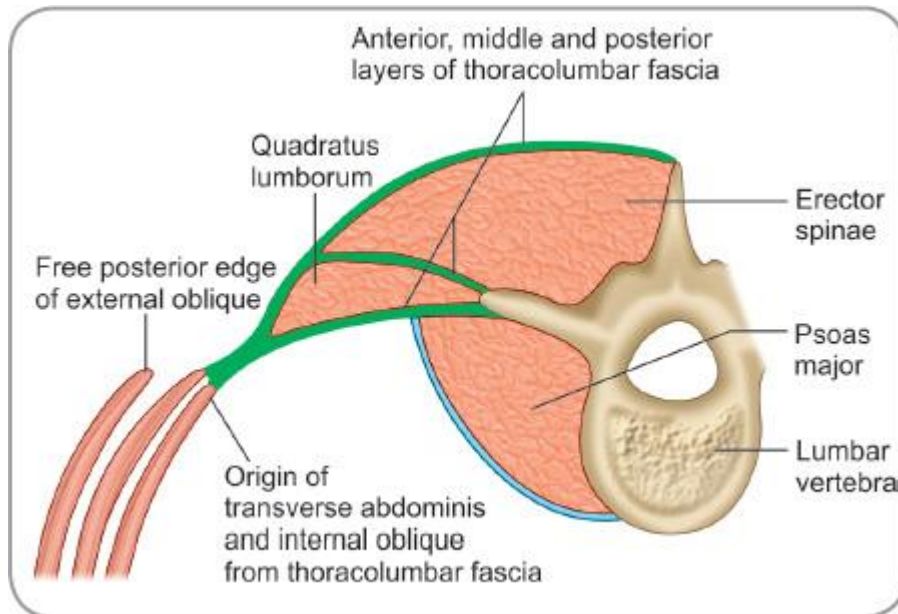
Iliacus muscle

- ★ **Origin:** From the iliac fossa of the hip bone and passes deep to the inguinal ligament to enter the thigh.
- ★ **Insertion:** Lesser trochanter of femur together with the psoas major muscle.
- ★ **Nerve Supply:** Femoral nerve in the abdomen.
- ★ **Action:** Main flexor of thigh

Thoracolumbar Fascia

- * It extends high up to the back of neck and below to the sacrum.
- * It binds the muscles of the back to the sides of the vertebral column.
- * In the lumbar region, it is well formed and thickened and sometimes called lumbar fascia and is composed of **three layers**:
 - (1) Anterior layer:** Covers the anterior surface of quadratus lumborum muscle, it is thickened above as the lateral arcuate ligament.
 - (2) Middle layer:** Covers the posterior surface of quadratus lumborum muscle, and fuse with the anterior layer at the lateral margin of this muscle. Medially, it reaches the back of transverse processes of lumbar vertebrae and separates quadratus lumborum muscle from sacrospinalis muscle.
 - (3) Posterior Layer:** Covers the back of the sacrospinalis muscle. Medially this layer gains attachment to the spines of vertebrae, while laterally, it is fused with the back of the middle layer of lumbar fascia.

- * The **lateral border** of the lumbar fascia gives origin to the internal oblique and transversus abdominis muscles.



Nerves of posterior abdominal wall

- ★ They include (I) Lumbar plexus.
- (II) Lumbar part of sympathetic chain.
- (III) Autonomic plexuses.
- (IV) Subcostal nerve.

(I) The Lumbar Plexus

- ★ It is formed in the substance of psoas major muscle from the ventral 1ry ramus of upper four lumbar nerves.
- ★ It supplies psoas major muscle & quadratus lumborum muscles.

★ Branches of lumbar plexus:

- 1) Iliohypogastric nerve (L₁):** It emerges on the lateral border of psoas major, passes downwards & laterally on quadratus lumborum

behind the kidney to pierce the transversus abdominis above the iliac crest , it then pierces the internal & external oblique muscles to supply the skin above the inguinal ligament & also it supplies the lower part of the anterior abdominal muscle and the skin about two inches above the medial part of the inguinal ligament. It gives lateral cutaneous branch to the skin of gluteal region.

2) Ilioinguinal nerve (L₁): It lies below the iliohypogastric nerve & has the same course and relation, however it does not pierce the external oblique muscle, but enters the inguinal canal and passes through the superficial inguinal ring.

- The ilioinguinal nerve supplies the lower lateral part of the anterior abdominal wall and the skin of the upper part of medial side of thigh as well as part of skin of scrotum in male or labium magus in female.

3) Lateral cutaneous nerve of thigh (L₂ & 3): It emerges from the lateral border of psoas major below the ilio inguinal nerve. It crosses the iliacus muscle in the pelvis where it enters the thigh deep to the inguinal ligament just medial to anterior superior iliac spine (A.S.I.S.).

4) Femoral nerve (posterior division of L_{2,3} &4): It emerges from lateral border of psoas major below the lateral cutaneous nerve of the thigh then passes in the groove between it and iliacus muscle.

- It supplies the iliacus in the abdomen and descends under cover of inguinal ligament lateral to the femoral sheath in the femoral triangle, where, it rapidly divides into muscular and cutaneous branches.

5) Genito-femoral nerve (L1&2): It descends on the anterior surface of psoas major muscle where it is crossed anteriorly by the ureter and gonadal vessels then it divides into two branches:

a) **Genital branch:** enters the deep inguinal ring to supply cremasteric muscle.

b) **Femoral branch:** enters the femoral sheath lateral to femoral artery and supplies the skin of the upper part of the front of thigh just below the inguinal ligament.

6) Obturator nerve (anterior divisions of the ventral rami of L2,3 & 4): It emerges on its medial side of psoas major at the pelvic brim. Then descends on the lateral wall of the pelvis accompanied by the obturator vessels to enter the obturator canal where, it divides into anterior and posterior divisions to supply the adductor muscles of the thigh.

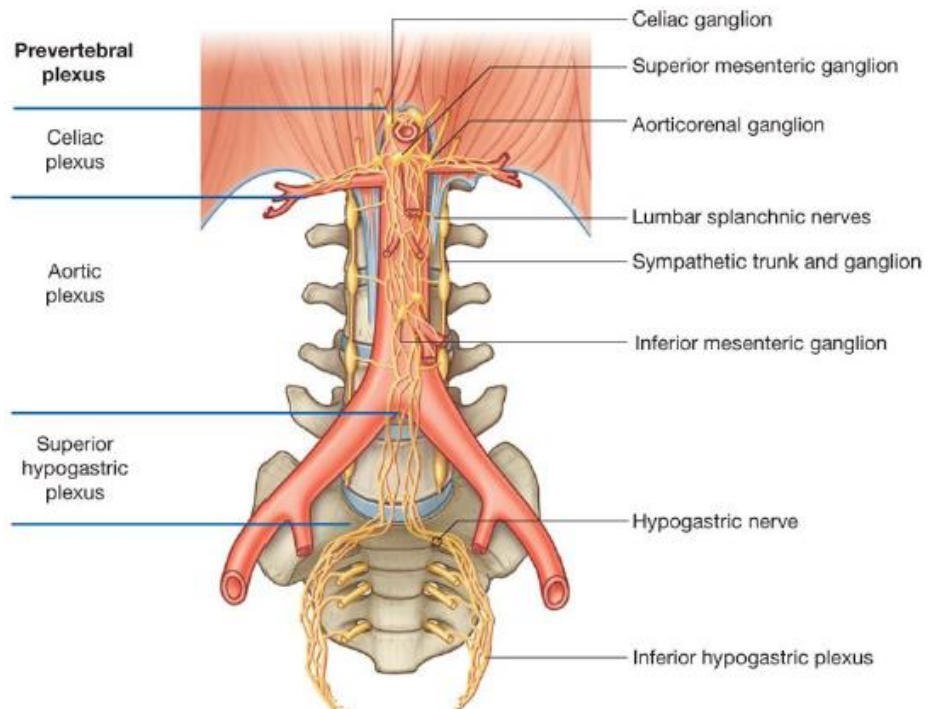
7] Lumbo-sacral trunk (L4&5): It descends on the medial side of psoas major deep to the obturator nerve where it lies close to ala of the sacrum to share in the formation of the sacral plexus.

(II) Lumbar Part of Sympathetic Chain

★ The sympathetic chain enters the abdomen behind the **medial arcuate ligaments** of diaphragm, one on each side. It passes downwards in a **groove between** vertebral column & medial border of psoas major muscle. Then enters the **pelvis** behind the **common iliac vessels** and descends **medial to the anterior sacral foramina** to end by uniting with the chain of the opposite side in **front of coccyx** to form the **ganglion impar**.

- ★ The **right** chain lies **behind the I.V.C** while the **left** chain is on the **left side of aorta** (therefore, the left chain is more exposed).
- ★ Each chain has **four lumbar ganglia**.

Lumbar part of sympathetic chain



★ Branches:

1) Rami Communicants:

- The four ganglia give off grey rami communicants (postganglionic) to all lumbar nerves.
- The 1st. and 2nd lumbar nerves send white rami communicants (preganglionic) to the corresponding ganglia.

2) Lumbar splanchnic nerves:

- There are 4 nerves, one from each ganglion
- They join the abdominal autonomic plexuses (celiac, aortic & hypogastric).

3) Vascular branches: surround the aorta & iliac arteries.

(III) Autonomic Plexuses

(1) Celiac plexus:

- It is present around the **celiac trunk** and is composed of two large **celiac ganglia**, one on each side of celiac artery, the **lower part** of the celiac ganglion is partly detached and is called **aortico-renal ganglion**.
- It is **formed by:**
 - a) **Sympathetic** fibers: from the **greater & lesser splanchnic** nerves coming from the thoracic sympathetic chain.
 - b) **Parasympathetic** fibers: from **vagal** branches.
- The celiac plexuses give off **secondary plexus** around **branches** of the celiac artery as well as the **renal** and **superior mesenteric** arteries.

(2) Aortic plexus:

- It **covers the aorta** between the origin of the two mesenteric arteries. It is **formed by:**
 - a) Branches from **celiac plexus**.
 - b) Branches from the **lumbar sympathetic chain**.
- It **gives** off 2ry plexus around the **inferior mesenteric, testicular** and **iliac** arteries.

(3) Superior Hypogastric plexus (Presacral nerve):

- It lies just **below the bifurcation of aorta** in front of 5th lumbar nerve and promontory of scrotum it is **formed by:**

- a) Filaments descending on each side from **aortic plexus**.
- b 3rd & 4th **lumbar splanchnic** nerves.
- It divides into right and left branches which descends into the pelvis to join **the inferior hypogastric (pelvic)** plexuses that lie one on each side of rectum.

