

Structures of posterior abdominal wall:

- Bony boundaries: 5 lumbar vertebra and their intervertebral disc, iliac fossa and iliac crest.
- Muscles: psoas major, quadrates lumborum, transversus abdominis, iliacus.

Muscle	Psoas major	Quadratus lumborum	iliacus
Origin	body & transverse process of lumbar vertebra & intervertebral disc	Iliolumbar lig.& iliac crest	Iliac fossa.
Insertion	Lesser trochanter of femur	12th rib	Lesser trochanter of femur
Nerve supply	nerve plexus(T12,L1,L2.L3)	: nerve plexus(T12,L1,L2.L3)	Femoral nerve
Action	flexion of hip & thigh	fix or depresses 12th rib during respiration & lateral flexion of the trunk	Lateral flexion of hip and thigh for lying position

**Iliolumbar ligament:** forms a connection between L5 and iliac crest.

Arteries of the posterior abdominal wall:

**- Abdominal Aorta**

it is retroperitoneal at the posterior abdominal wall, Aorta enters the abdomen through the aortic opening of the diaphragm at the level of T12 in the midline, and continues as the abdominal aorta which ends at the level of L4 to the left. (The IVC is deviated to the right; starts at the level of L5 and ends at the central tendon of diaphragm at the level T8).

\* Remember there are 3 openings in the diaphragm, one at the level of T12 for abdominal aorta, at the level of T10 for esophagus and at the level of T8 for the IVC.

Relations:

- **Anteriorly:** pancreas, 3rd part of duodenum, coils of small intestines and it is crossed by left renal vein; left renal vein which drains into the IVC that lies at the right side of abdominal aorta.
- **On its right side:** IVC, the cisterna chyli (sac of lymph nodes on the right side in the aortic opening, at the level of T12), Azygos vein which ascends upwards.
- **On its left side:** left sympathetic chain. (on the edge)

*Branches of the abdominal aorta are divided into:*

- **Single branches:** usually from the *front* of abdominal aorta: celiac trunk, superior mesenteric and inferior mesenteric arteries. And from the *back* the median sacral artery which lies posteriorly and descends downwards to the rectum, supplying the pelvis and rectum, in embryology it is considered a continuation of the abdominal aorta.
- **Paired branches** (found on the right and left):  
*in front:* testicular(male)/ovarian artery(female) at level of L2; in males, testicular artery supplies the testes and epididymis. In females, ovarian artery supplies the ovaries and fallopian tubes.  
*From back:* 4 lumbar arteries at the level of lumbar vertebra.  
*On the sides:*
  1. inferior phrenic artery to the lower surface of diaphragm "cupulas of diaphragm", it gives off a branch to the suprarenal glands which is the superior suprarenal artery.
  2. Middle suprarenal: goes to the suprarenal glands from the aorta directly.
  3. Renal artery at the level of L2, supplies the kidneys, and gives the inferior suprarenal artery.

\*suprarenal glands, as they are endocrine glands they are rich in blood vessels; supplied by the previous mentioned 3 arteries; superior, middle and inferior suprarenal arteries.

### **Celiac trunk**

at the lower border of T12 and upper border of L1, it's called trunk because it is very short around 1 cm, has 3 terminal branches:

1. left gastric artery
2. Splenic artery
3. Hepatic artery: branches arise from it: right gastric artery, supraduodenal and gastroduodenal and ends as the right and left hepatic arteries, the right hepatic gives the cystic artery.

### **Superior mesenteric artery**

originates behind the body of pancreas and it crosses in front of the uncinate process and the horizontal part of the duodenum.

Superior mesenteric artery branches:

1. At the root of mesentery it gives jejunal and ileal branches which forms arcades and vasarecta.
2. inferior pancreaticoduodenal artery
3. middle colic to the transverse colon
4. right colic to the ascending colon,
5. iliocolic to ileum, caecum and ascending colon,
6. gives rise to the anterior and posterior cecal arteries, posterior cecal artery gives the appendicular artery.

## Inferior mesenteric artery

originates at the level of L3 behind the horizontal part of the duodenum; it gives off:

1. Left colic arteries, superior and inferior left colic to the descending colon and the lateral third of transverse colon.
2. Sigmoid artery to the sigmoid colon  
Ends as superior rectal artery which supplies the rectum and upper half of anal canal.

## Marginal artery:

anastomosis between the colic arteries (continuous artery between the end branches of the colic arteries), which supplies the ascending, transverse and descending colons, at the medial edge of the colon, it has an advantage that it keeps giving blood supply to the colon.

Q: blood supply to the lower part of the anal canal?

Middle and inferior rectal arteries; branches from the internal iliac artery.

Abdominal aorta ends at the level of L4 to the left and gives 2 common iliac arteries, each common iliac artery gives internal and external iliac arteries, the internal is the blood supply to the pelvic viscera, external iliac artery gives off the inferior epigastric and deep circumflex iliac branches, then it passes behind the inguinal ligament to become the femoral artery.

Remember: inferior epigastric artery is important to differentiate between the direct and indirect inguinal hernia, deep circumflex goes toward the anterior superior iliac spine.

## **Internal iliac artery gives off anterior and posterior divisions:**

### Posterior branches:

- **Iliolumbar artery** along with the iliolumbar ligament between L5 and iliac crest.
- **lateral sacral arteries** they are two, each one is divided into two branches; the 4 branches enter the sacral foramina.
- **Superior gluteal artery**, it passes above the piriformis muscles along with the superior gluteal nerve and vessels.

### Anterior branches:

- **obturator artery** which passes at the medial side of the thigh along with the obturator nerve.
- **Inferior gluteal artery**, it passes below the piriformis muscle.
- **umbilical artery**, which will be obliterated and converted to the umbilical ligament, but before that it gives off the **superior vesical artery** that supplies the upper surface of urinary bladder.
- **Inferior vesical artery** to the urinary bladder.
- In females, it gives the **uterine artery and vaginal artery**, which supply uterus and vagina.
- In males, it gives the deferential artery. (Wasn't mentioned during the lecture but it is written in the slides).
- **middle rectal artery** that supplies the rectum and lower half of anal canal.
- **Internal pudendal artery** that gives off the **inferior rectal artery**.

### Veins of the posterior abdominal wall:

#### **-Inferior Vena Cava**

lies on the right side of the abdominal aorta, originates at the level of L5 on the right side, it is formed by the union of common iliac veins.

It opens at the level of T8 through the central tendon of the diaphragm and drains into the right atrium of heart. Can be seen on the back of the liver, making a groove on its posterior surface. Hepatic veins drain directly into the IVC.

#### **Tributaries of the IVC:**

- 2 common iliac veins.
- Median sacral vein.
- Inferior phrenic.
- Lumber veins.
- Right testicular/ ovarian vein (the left vein drains into the left renal vein).
- Renal veins.
- The right suprarenal vein (the left suprarenal vein drains into the left renal vein)
- Hepatic veins (3 of them)

\*the rest of veins drains into the portal veins, will be mentioned at the PORTAL vein section.

#### **Relations:**

*anteriorly:* coils of small intestine, 3rd and 1st part of duodenum, head of pancreas and common bile duct, foramen of Winslow, portal vein, and it lies in deep groove of liver on the posterior surface.

#### **- Portal Vein**

- It is formed behind the neck of pancreas by the union of the **superior mesenteric** with the **splenic vein**.
- Inferior mesenteric vein may drain into the superior mesenteric vein or into the junction between the superior mesenteric and splenic vein.
- 5 cm in length, found at the free edge of lesser omentum.
- At porta hepatis it divides into right and left terminal (portal) branches, cystic vein drains into the right portal, left portal vein drains the paraumbilical vein from the anterior abdominal wall around the umbilicus.
- Also, ligamentum venosum which was called ductus venosum, opens in the left portal vein.

#### **Tributaries of portal vein:**

splenic vein, superior and inferior mesenteric, right and left gastric veins and cystic vein (which drains into right portal vein).

#### **Portal systemic anastomosis:**

connection between portal veins and systemic veins which usually drains into the IVC to the right atrium of the heart.

Causes:

This connection occurs in portal hypertension; obstruction in front of portal vein as in case of:

- liver diseases, e.g: liver cirrhosis, liver fibrosis.
- congenital anomalies as if ductus venosum wasn't obliterated.
- Valvular disease of the heart.

Region	Name of the clinical condition	Portal circulation	Systemic circulation
Lower third of esophageous	Esophageal varices	Left gastric vein	Azygos vein
paraumbilical	Caput medusa (dilated and tortuous radiating around the umbilicus as a star)	Paraumbilical vein	Superficial (superior and inferior) epigastric veins.
Rectal (around the rectum and anal canal)	Hemorrhoids/ piles بواسير ( veins become congested, tortuous and dilated)	Superior rectal vein	Middle rectal veins and inferior rectal veins.
retroperitoneal	(no clinical name)	Right colic veins, middle colic vein, inferior colic vein, left colic vein	Renal vein, suprarenal vein, paravertebral vein and gonadal vein.
Intrahepatic	Patent ductus venosus	Left branch of the portal vein	IVC.

**Hematemesis:** vomiting of blood, manifested as a result of esophageal varices.

**Lymphatic drainage of the posterior abdominal wall**

they are important as they get enlarged in case of cancer.

Lymph nodes here are divided into:

**1. Preaortic lymph nodes:** lie anterior to the abdominal aorta; they drain lymph from the GIT extending from the lower third of the esophageous to the anal canal.

- *celiac lymph nodes* drain the foregut.
- *superior mesenteric lymph nodes* drain the midgut.
- *inferior mesenteric lymph nodes* drain the hindgut.

\*lymphatics at GIT correspond to the blood supply of each region (foregut, midgut and hindgut).

At the end lymphatics from the preaortic lymph nodes drain into to the intestinal trunk which ends in the cisterna chyli (lymphatic sac that lies at the right side of the aorta at the aortic orifice and thoracic duct ascends from it.)

**2. Lateral aortic (par-aortic) lymph nodes:**

- At the lateral side of the abdominal aorta.
- Drain lymph from the kidneys and suprarenal gland; from the testes in the male and from the ovaries, uterine tubes, and fundus of the uterus in the female; from the deep lymph vessels of the abdominal walls; and from the common iliac nodes.
- The efferent lymph vessels form the right and left lumbar trunk, which at the end drains into the cistern chyli.

**Thoracic duct:**

drains the abdomen and lower limb, at the beginning it lies at the right side of the esophagoes then behind it at level of T5, and ascends at the left side, at the root of the neck it ends at the beginning of the left brachiocephalic vein.

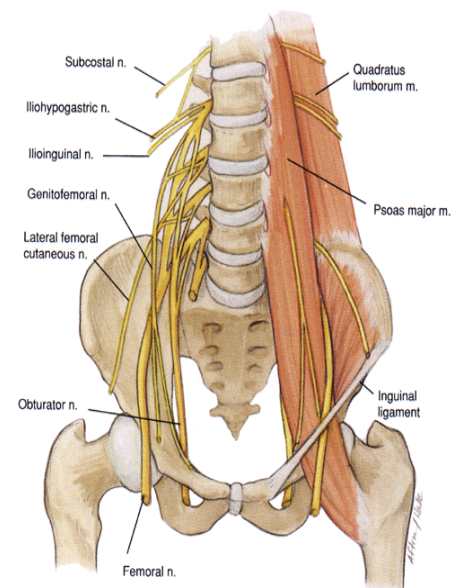
At the right side, in contrast, there is a duct that starts from the upper surface of the liver (most of the lymphatic drainage of the liver drains into cisterna chyli except the upper surface) that drains into **the right lymphatic duct** that ascends through the opening of IVC (at the right side of abdominal aorta) and drains the right side of chest, right side of upper limb and right side of head and neck, it ends at the beginning of the right brachiocephalic vein.

**Nerve Supply of the posterior abdominal wall**

( Lumber plexus)

In the posterior abdominal wall we saw few nerves like:

- T12 subcostal on the post. abdominal wall behind kidney,
- L1 (iliohypogastric and ilioinguinal) to the lower part of the anterior abdominal wall,
- Lateral coetaneous nerve of the thigh from L2,3 to the ASIS and lateral side of the thigh.
- Femoral nerve L2,3,4 anterior primary rami, from their posterior divisions, passes at the lateral side of psoas major.
- Obturator nerve L2, 3, 4 anterior primary rami from their anterior divisions. It passes at the medial side of psoas major.
- Genitofemoral from L1,2 gives two branches (femoral and genital)



- notice lumbosacral trunk which locates in front of ala of sacrum.

\* Remember: *cremasteric reflex*: itching on the upper medial side of the thigh goes through femoral brach to L1 and L2 and to genital branch to cremasteric muscle and causes contraction and ascending to the testis.

### Sympathetic Chain

Related to abdominal aorta on the left side and to IVC on the Right side.

Abdominal sympathetic chain (4-5 ganglia)

Indeed, it is a continuation to the thoracic sympathetic chain (10-12 ganglia)

Number of ganlia in each region:

- Pelvic sympathetic chain (4-5 ganglia)
- Cervical (3 ganglia)
- Lumber (4-5 ganglia)
- Sacral (4-5 ganglia)
- Coccygeal (1 ganglion)

Thoracic sympathetic chain enters the abdomen deep to the medial arcuate ligament, it descends to the abdomen and the abdominal descends deep to the common iliac vessels to the pelvis, giving the pelvic sympathetic chain.

The ganglia in the sympathetic chain may receive preganglionic sympathetic fibers that may synapse in it and may pass through the ganglia without synapse and pass upward or downward and synapse in the celiac ganglia, superior mesenteric ganglia or inferior mesenteric ganglia.

#### **Preganglionic fibers from spinal cord:**

the origin of sympathetic fibers is from thoracic and upper two lumber segments of spinal cord.

Remember: if we take a cross section from the spinal cord we can see anterior horn, posterior horn and lateral horn. Lateral horn contains a nucleus "sympathetic nucleus" sympathetic nerve leaves it as preganglionic, the sympathetic nucleus present in lateral horn of all thoracic segments and L1-L2, so we have 14 preganglionic sympathetic fibers they are called white rami.

- White Ramus (preganglionic sympathetic fibers) :
  - Contains pre-ganglionic fibers.
  - 14 in number
  - Originate from all the thoracic and L1 and L2 regions of the spinal cord.
  - When Pre-ganglionic fibers enter the sympathetic chain, there are 4 possibilities:
    1. Synapse in corresponding ganglia (Example: Fiber from L2 goes to L2 ganglia in the abdomen and synapses there)
    2. Ascend upward up to synapse in higher ganglia
    3. Descend to synapse in lower ganglia
    4. Not synapsing in the sympathetic chain and going eventually to the superior mesenteric and forming Splanchnic Nerves

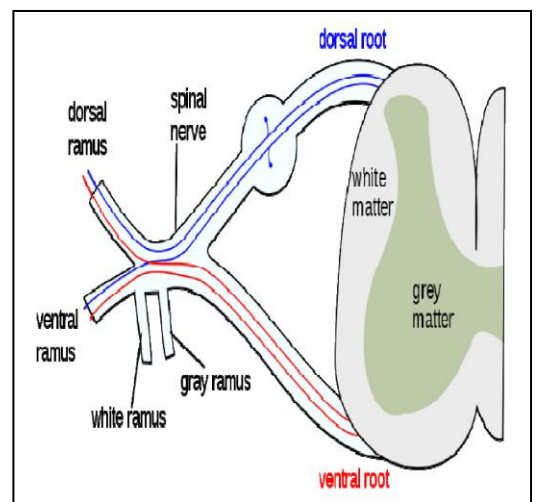
(Note: The word Splanchnic refers to those fibers coming from the chest to the abdomen, we have the greater Splanchnic, The Lesser Splanchnic, The lowest Splanchnic and they synapse in the celiac, the superior mesenteric or the renal ganglia)

Eventually they all go to the GI tract.

- Gray Ramus:
  - Contains postganglionic sympathetic fibers. Extend from sympathetic ganglia and then return to the spinal nerve, after that the fibers are distributed to the organs.
  - 31 in number, more than the number of the pre-ganglionic sympathetic (only 14).
  - All spinal nerves have gray ramus post- ganglionic sympathetic fibers.
  - Some fibers remain only as pre-ganglionic and usually form a plexus of nerves. Such as those going to the:
    - Celiac Ganglia
    - Superior Mesenteric
    - Inferior Mesenteric

Examples of the plexuses they form are The Aortic Plexus by the celiac and The Renal Plexus around the superior and inferior mesenteric. Those plexuses all have both sympathetic fibers and parasympathetic ones from The Vagus Nerve, except for the hindgut which receives parasympathetic fibers from S2 and S3 →the Splanchnic Nerves.

-Slide 17: You can see in this image the white mater and the grey mater, as well as dorsal and ventral roots. The ventral root carries the sympathetic fibers and may give white ramus fibers which go to ganglia. Gray ramus fibers come from the ganglia.



-There are also visceral nerves that leave the sympathetic chain. Those go to viscera:

1. **The Greater Splanchnic:** arises from the sympathetic ganglia 5-9, and goes to the celiac ganglia. The post ganglionic fibers are distributed along the blood supply (the branches of the celiac trunk to the viscera)
2. **The Lesser Splanchnic:** arises from 9<sup>th</sup> and 10<sup>th</sup> ganglia. Penetrates the crus of the diaphragm and goes to the superior mesenteric ganglia. Post ganglionic fibers accompany the branches of the superior mesenteric artery until the lateral third of the transverse colon.
3. **Lowest Splanchnic:** sometimes absent. Once present it forms the renal plexus.
4. **Lumber Splanchnic:** from L1 and L2 goes to inferior mesenteric ganglia. Post ganglionic fibers go towards the hindgut along with the branches that come from the sacral (S2) parasympathetic fibers and go to the pelvic viscera.