



Anatomy

Faculty of Medicine - JU2017

Number >>

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Doctor

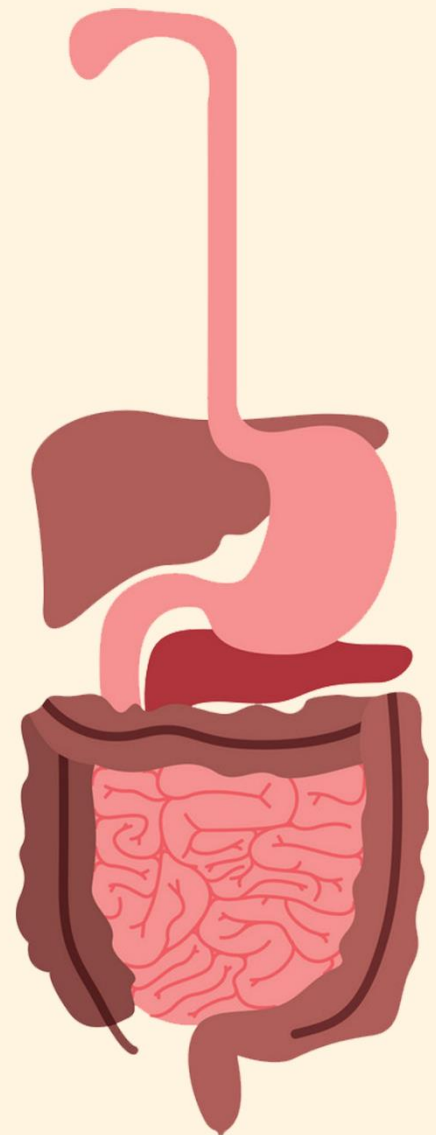
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2nd system - GI



Nerves on the Posterior Abdominal Wall

Lumbar Plexus

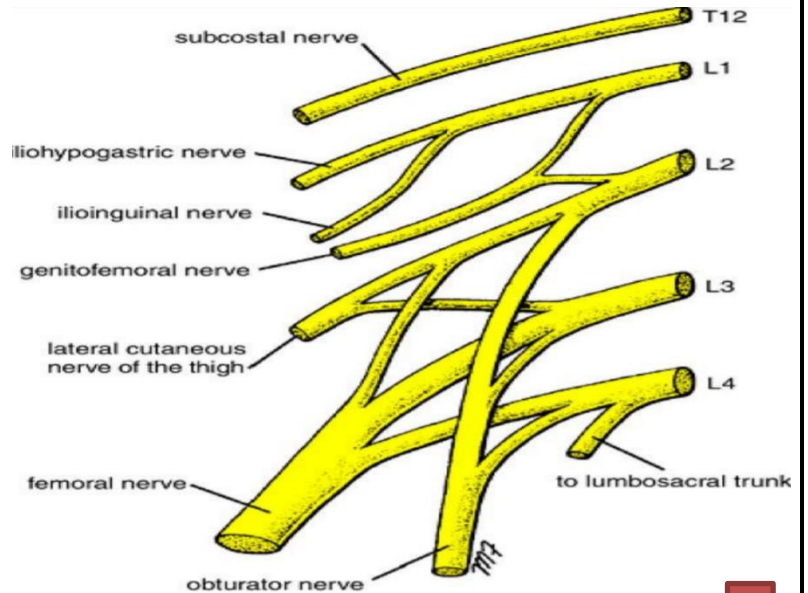
The lumbar plexus, which is one of the main nervous pathways supplying the lower limb, is formed in the psoas muscle in abdomen from the anterior rami of the upper four lumbar nerves (L1-L4), and the branches of the plexus emerge from the lateral and medial borders of the psoas muscle and from its anterior surface. (note: brachial plexus originates also from anterior divisions but from (C5-C8+T1))

-The iliohypogastric nerve, ilioinguinal nerve, lateral cutaneous nerve of the thigh, and femoral nerve emerge from the **lateral border of the psoas major**, in that order from above downward.

-The obturator nerve and lumbosacral trunk emerge from the **medial border of the psoas major**.

-The genitofemoral nerve emerges from the **anterior surface of psoas major**.

- The anterior rami receive gray rami communicates from the sympathetic trunk, and only the upper 2 lumbar segments of the spinal cord give off white rami communicates to the sympathetic trunk (this will be discussed later in the sheet so you can skip it).



Some books say that T12 is part of lumbar plexus as it gives a branch to (L1) but in SNELL it's not considered part of lumbar plexus (that's what we follow)

L1 → Iliohypogastric + Ilioinguinal

L1 + L2 → Genito femoral nerve

L2 + L3 → Lateral cutaneous nerve of the thigh

L2 + L3 + L4 → (Anterior division → Obturator nerve) (posterior division → Femoral nerve)

Ant. ramus of L1 gives iliohypogastric and ilioinguinal nerves which run between transversus abdominus muscle and internal oblique muscle and enter the lateral and anterior abdominal walls.

Femoral nerve and obturator nerve have the same origin which is the anterior rami of L2- L4 but the anterior rami of L2- L4 divides into anterior division and posterior division.

anterior division > Obturator nerve

posterior division > Femoral nerve

L4 divides into 2 parts: The upper one takes part in the formation of lumbar plexus, while the lower part takes part in the formation of lumbosacral trunk that's part of sacral plexus.

* The iliohypogastric nerve

- supplies the skin of the lower part of the anterior abdominal wall, above symphysis pubis and it's motor to abdominal muscles (motor and sensory).

* The ilioinguinal nerve

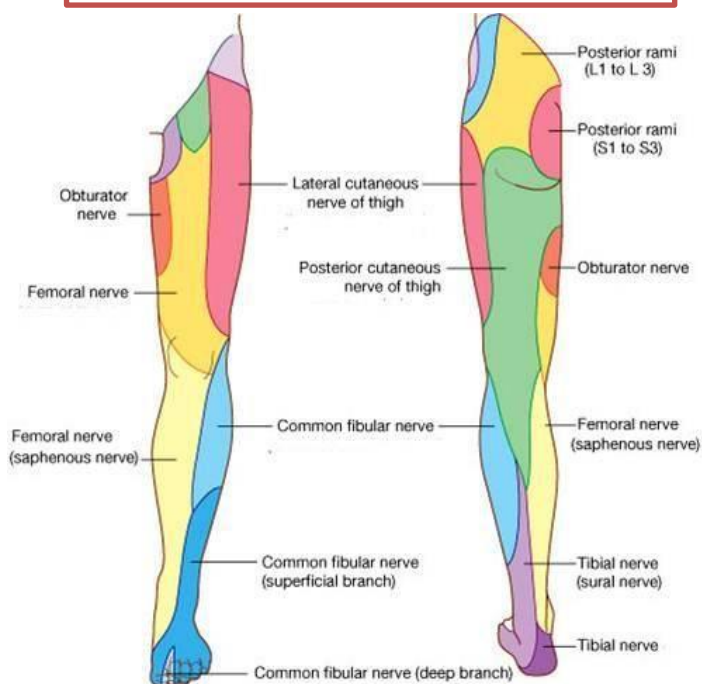
- passes through the inguinal canal to supply the skin of the groin and the scrotum or labium majora as it crosses the posterior wall of inguinal canal, pass in inguinal canal with spermatic cord (its sensory to labium majora in female, scrotum in males, and gives cutaneous branch to the thigh)

* The lateral cutaneous nerve of the thigh

- Crosses the iliac fossa in front of the iliacus muscle and enters the thigh behind the lateral end of the inguinal ligament. It supplies the skin over the lateral surface of the thigh.

Sensory innervation of skin over the lower limb

Just memorize the ones mentioned in the text



* The femoral nerve (L2, 3, and 4)

the largest branch of the lumbar plexus.

- It runs downward and laterally in the pelvis between the psoas and the iliacus muscles and enters the thigh behind the inguinal ligament and lateral to the femoral vessels and the femoral sheath through the femoral triangle then it divides into anterior and posterior divisions.

-Mainly supply muscles of the anterior compartment of the thigh and iliacus muscle in the abdomen, it's also sensory in front of the thigh and to the medial side of leg through saphenous nerve (branch of femoral)

* The Obturator nerve

- It emerges from the medial border of the psoas at the brim of the pelvis then crosses the pelvic brim in front of the sacroiliac joint and behind the common iliac vessels and leaves the pelvis by passing through the obturator foramen with obturator vessels to reach the medial compartment of the thigh.

-Its motor to the medial compartment of the thigh & sensory to skin on medial side of the thigh.

*The fourth lumbar root of the lumbosacral trunk

- The fourth lumbar root of the lumbosacral trunk takes part in the formation of the sacral plexus . It descends anterior to the ala of the sacrum and joins the first sacral nerve in the pelvis.

* The genitofemoral nerve (L1 and 2)

- It emerges on the anterior surface of the psoas then runs downward in front of the muscle and divides into:

1- A genital branch, which enters inguinal canal through the deep ring as a component of the spermatic cord then exits through the superficial ring to supply the Cremasteric muscle (motor).

2- A femoral branch, which crosses deep to inguinal ligament & supplies a small area of the skin in front of the thigh.

Cremasteric reflex

- It is the nervous pathway, in which stimulation by itching of skin on the medial side of thigh in the male results in reflex contraction of the cremasteric muscle and the drawing upward of the testis within the scrotum, because this will transmit stimulation through femoral division to L1- L2 which return through the genital branch as a reflex.

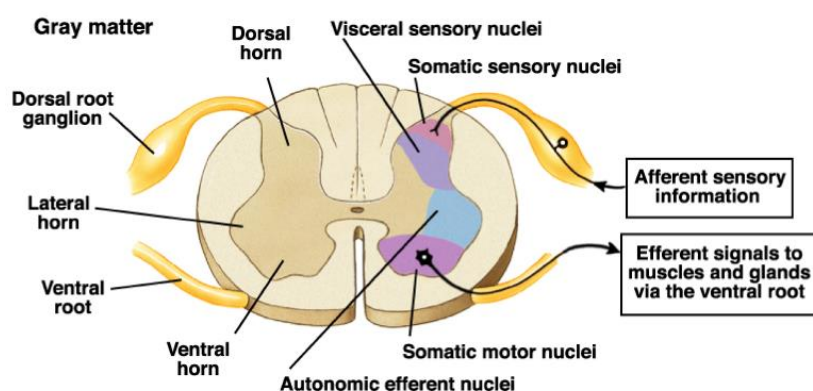
- Cremasteric reflex may be absent if there's any abnormality in spermatic cord or testis such as: testicular torsion, undescended testis, upper and lower motor neuron disorders, as well as a spine injury of L1-L2. It can also occur if the ilioinguinal nerve is accidentally cut during a hernia repair.

Sympathetic Trunk

Sympathetic trunk: It's Sympathetic ganglia that's connected to each other and there's 2 chains; one on the right and one on the left of the vertebral column.

-Spinal cord is divided into 31 segments (8 cervical, 10-12 thoracic, 5 lumbar, 5 sacral, 1 Coccygeal), each segment gives a spinal nerve that's related to the ganglia's in the sympathetic chain

-Each segment contains H shaped gray matter and white matter around it and each gray matter is divided into anterior, posterior, & lateral horns. In the thoracic segments and first 2 lumbar segments there's sympathetic nucleus in the lateral horn. So there are 14 sympathetic nuclei (12 thoracic & 2 lumbar)



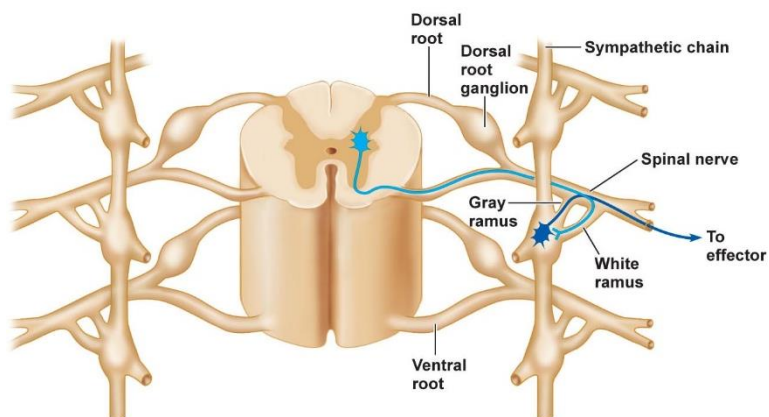
There are 2 branches (rami) that communicate with the ganglia and contain sympathetic fibers that originates from sympathetic nuclei:

* **White ramus:** It's the branch that enters the ganglia and contains preganglionic nerve fibers and afferent sensory nerve fibers.

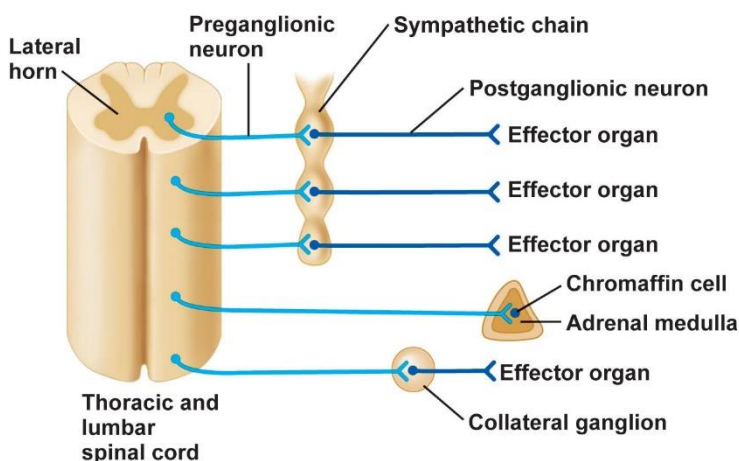
- communicants join the first two ganglia to the first two lumbar spinal nerves.

* **Grey ramus:** It's the branch that exits the ganglia to return to the spinal cord and contains postganglionic nerve fibers distributed to blood vessels, sweat gland and skin.

- communicants join each ganglion to a corresponding lumbar spinal nerve.



Fibers that exits from sympathetic nuclei is called preganglionic sympathetic fibers (white ramus), it goes through the ventral root then spinal nerve then enters the ganglia. After synapsing inside the ganglia, the fibers that exits the ganglia is called postganglionic sympathetic fibers (gray ramus) that returns to the spinal nerve then goes to innervate blood vessels, sweat glands, or arrector pili muscle in the skin.



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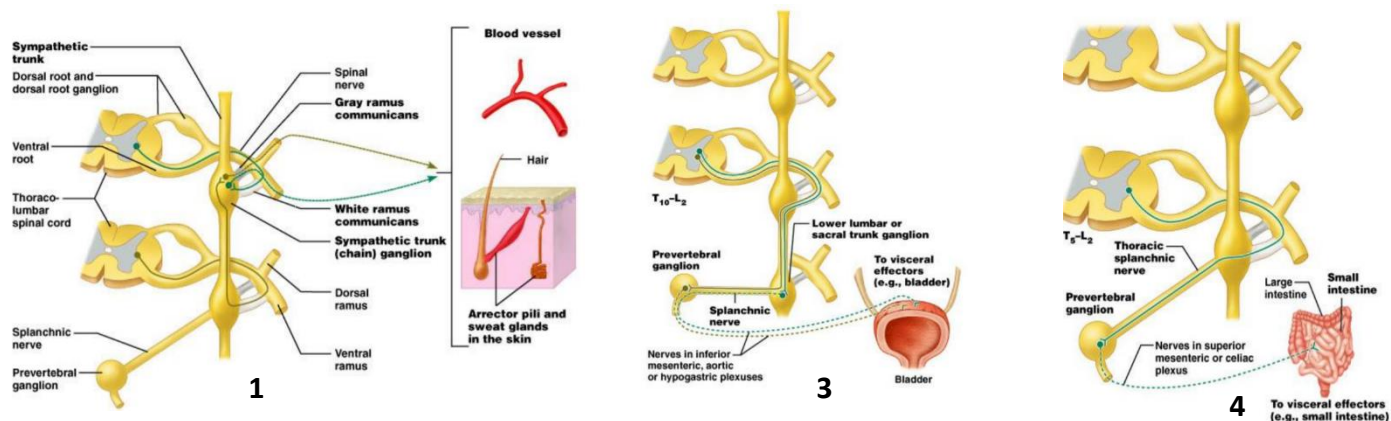
Preganglionic fibers:

Originates from the sympathetic nuclei and leave the spinal cord throw the anterior root then leave the spinal nerve as white rami to join the sympathetic chain (14 white rami)

* Preganglionic fibers (white rami) when it enters the sympathetic chain may:

- 1- Synapse with cells in the corresponding ganglia it enters (ganglia of the same number) (e.g. middle thoracic segments)
- 2- Pass up to synapse in higher ganglia (upper thoracic segments go to the 3 cervical segments)
- 3- Pass down to synapse in lower ganglia (lower thoracic & upper 2 lumbar segments go to lumbar & sacral ganglia)

4- May not synapse in sympathetic chain & continue as preganglionic fibers to form splanchnic nerves that synapse in pre-aortic (pre-vertebral) ganglia.



Splanchnic nerve: preganglionic sympathetic fiber that didn't synapse in the sympathetic chain but synapsed in pre-vertebral ganglia.

Postganglionic fibers

They're distributed through the branches of the spinal nerves to the blood vessels, sweat glands, and arrector pili muscles of the skin.

Its fibers pass medially to the sympathetic plexuses on the abdominal aorta and its branches. (These plexuses also receive fibers from splanchnic nerves and the vagus), and then pass downward and medially in front of the common iliac vessels into the pelvis, where, together with branches from sympathetic nerves in front of the aorta, they form a large bundle of fibers called the superior hypogastric plexus under common iliac vessels and goes to pelvic viscera.

((Notice that each spinal nerve contains postganglionic sympathetic fibers so there are 31 pairs of them, but only spinal nerves of sympathetic segments contain preganglionic sympathetic fibers so there are 14 pairs))

It shows as 2 chains that extend from level of atlas till coccyx, so there are parts of the chain that lies in the neck, chest, abdomen, & pelvis and the number of ganglia (in pairs):

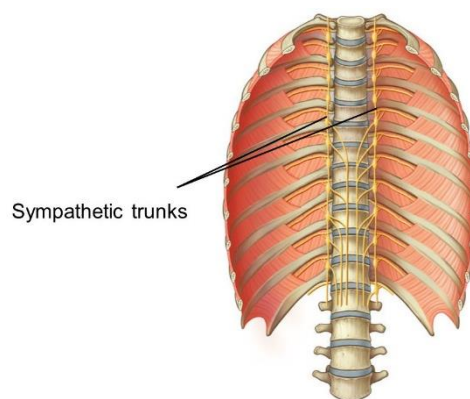
Neck (cervical): 3 ganglia (superior cervical-S.C.S.G , middle cervical- M.C.S.G , & inferior cervical-I.C.S.G sympathetic ganglia)

Chest (Thoracic): 10 – 12 thoracic sympathetic ganglia

Abdomen (lumbar): 4 – 5

Pelvis (sacral): 4 – 5

Coccygeal: 1 (ganglion impar: single ganglia at the end of spinal cord in which right & left Sympathetic chain ends in)



* Nerves which leave the sympathetic chain:

A- gray rami (31 post ganglionic fibers join spinal nerves to reach sweat glands, arrector pili & blood vessels):

- S.C.S.G going to head and neck: lower 4 cranial nerves + upper 4 cervical
- M.C.S.G: 5th, 6th cervical nerves
- I.C.S.G: 7th, 8th cervical nerves
- Thoracic, lumbar, sacral ganglia to thoracic, lumbar, and sacral nerves respectively.

B- visceral nerves > reaches viscera through blood vessels.

1. Int. & Ext. carotid nerves from S.C.S.G to corresponding arteries
2. pharyngeal branch: from S.C.S.G to pharyngeal plexus
3. pulmonary nerves to lungs and pleura: 2nd, 3rd & 4th thoracic ganglia
4. cardiac nerves: 2nd, 3rd & 4th thoracic ganglia + 3 cervical ganglia
5. splanchnic nerves from thorax to abdomen without synapsing in the sympathetic chain: greater, lesser and lowest splanchnic nerves

Greater splanchnic nerves: 5 in number

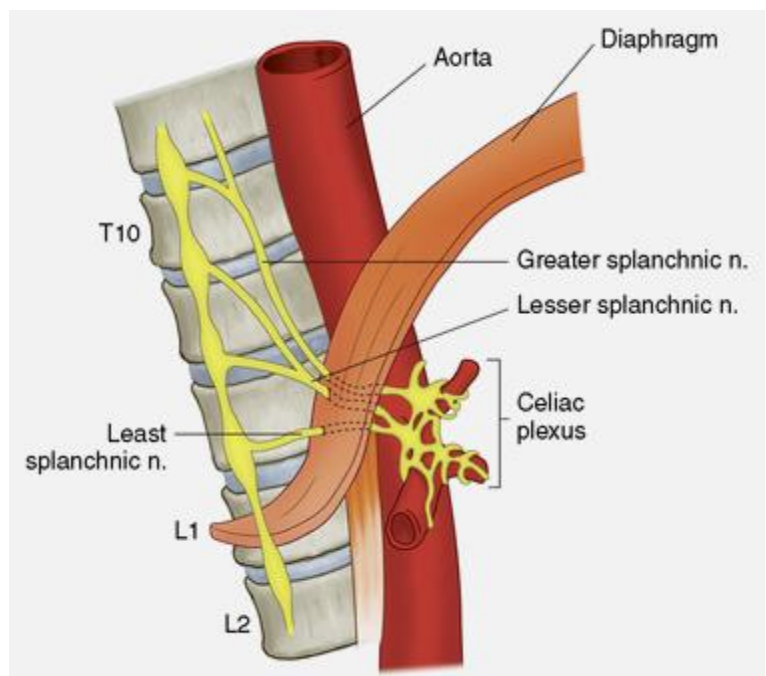
-It arises from thoracic segment of spinal cord; (T5-T9) or 10th ganglia, then pierces the crus of the diaphragm to end in the celiac ganglia.

-Post ganglionic fibers follow the branches of celiac artery to reach the smooth muscles, and glands of the foregut (stomach, upper half of duodenum, and upper half of pancreas)

Lesser splanchnic nerves:

-It arises from the 9th & 10th thoracic ganglia, then pierces the crus of diaphragm to end in the superior mesenteric ganglia

-Postganglionic fibers supply the smooth muscles, glands of the midgut (to the extent of proximal 1/3 of transverse colon)



Lowest splanchnic nerves:

- May be absent, if present arises from the last one or two thoracic ganglia, then pierces the diaphragm to end in the renal plexus.

Lumber splanchnic branch

- It arises from L1-L2 ganglia to ends in inferior mesenteric ganglia
- Postganglionic fibers go to sigmoid and pelvic colon, other postganglionic fibers form the descending hypogastric plexus to supply bladder, rectum and genitalia.
- Branches from sacral part of the chain go to pelvic viscera

Abdominal Part of Sympathetic Trunk

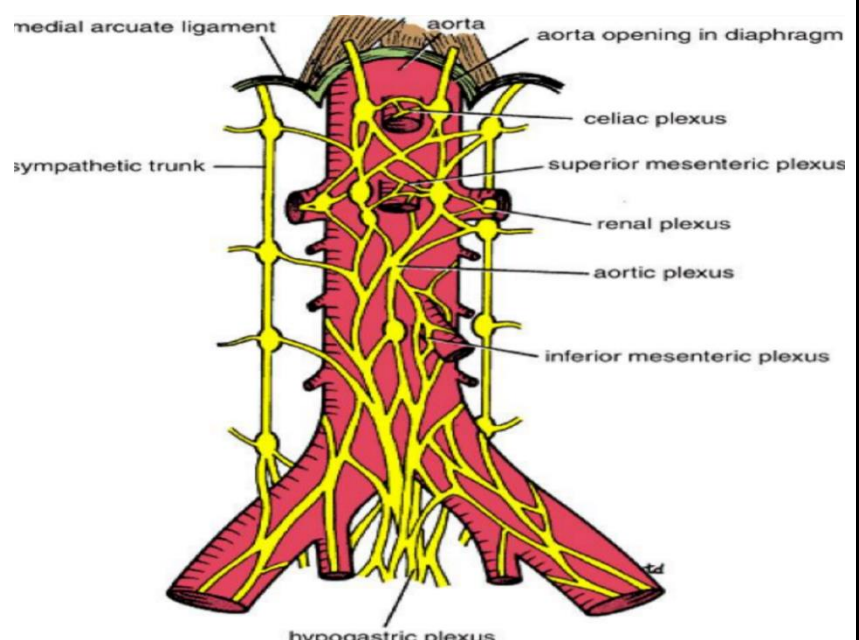
- The abdominal part of the sympathetic trunk is continuous above with the thoracic and below with the pelvic parts of the sympathetic trunk.
- It enters the abdomen from behind the medial arcuate ligament and runs downward along the medial border of the psoas muscle on the bodies of the lumbar vertebrae then it gains entrance to the pelvis below by passing behind the common iliac vessels.
- In abdomen, there are 2 chains: Right abdominal sympathetic & left abdominal sympathetic.

The right sympathetic trunk lies behind the right (lateral) border of the IVC; the left sympathetic trunk lies close to the left border of the aorta.
- The sympathetic trunk possesses four or five segmentally arranged ganglia, the first and second often being fused together, i.e. number of ganglia in abdomen is 4-5 connected in chain

Aortic Plexuses

A plexus of nerves around the abdominal part of the aorta formed by:

1. Preganglionic and postganglionic sympathetic fibers.
2. Preganglionic parasympathetic fibers (as it doesn't synapse in the ganglia/plexus), and visceral afferent fibers.



***Differences between sympathetic chain ganglia & pre-aortic or pre-vertebral ganglia:**

1. These ganglia are called pre-aortic or pre-vertebral ganglia and located around the origin of blood vessels, and they're different than ganglia of sympathetic chain which are lateral at each side of vertebral column.
2. Sympathetic chain ganglia receive white ramus from segments of spinal cord while pre-vertebral ganglia receive splanchnic nerve.

* Regional concentrations of this plexus around the origins of the celiac, superior mesenteric, inferior mesenteric, and renal arteries forms celiac, superior mesenteric, inferior mesenteric, and renal plexuses respectively.

1. The celiac plexus: consists mainly of two celiac ganglia connected together by a large network of fibers that surrounds the origin of the celiac artery.

-Sympathetic: The ganglia receive preganglionic sympathetic fibers from the greater and lesser splanchnic nerves and sends postganglionic branches which accompany the branches of the celiac artery and follow them to their distribution.

-Parasympathetic: Parasympathetic vagal fibers also accompany the branches of the artery.

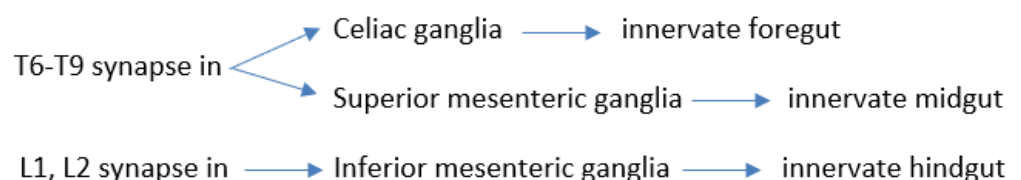
2. The renal plexuses are smaller than the celiac plexus. They are distributed along the branches of the corresponding arteries.

3. The inferior mesenteric plexus is similar to renal plexus but receives parasympathetic fibers from the sacral parasympathetic (S2,S3,S4).

Relation to sympathetic chain:

Celiac and superior mesenteric ganglia receive preganglionic sympathetic fibers from the chest (T5 – T10) and post ganglionic fibers go with the aortic plexus or celiac plexus or sup mesenteric plexus depending on the blood supply of the organ.

That's the sympathetic innervation of GI tube



Thoracic sympathetic chain

It enters the thorax in front of neck of 1st rib and leaves it by passing behind the medial arcuate ligament.

In the upper part it lies on the necks of the ribs while in the lower part it lies on the side of the bodies of thoracic vertebrae

-Ganglia: (10 -12), 1st sometimes fuses with the I.C.S.G to form stellate ganglia

* Branches:

A- Gray & white rami communicants

B- 2nd, 3rd & 4th ganglia (cardiac & pulmonary)

C- The upper five ganglia give aortic esophageal branches

D- Greater, lesser and lowest splanchnic nerves

We can notice here the difference between sympathetic and parasympathetic fibers:

Sympathetic:

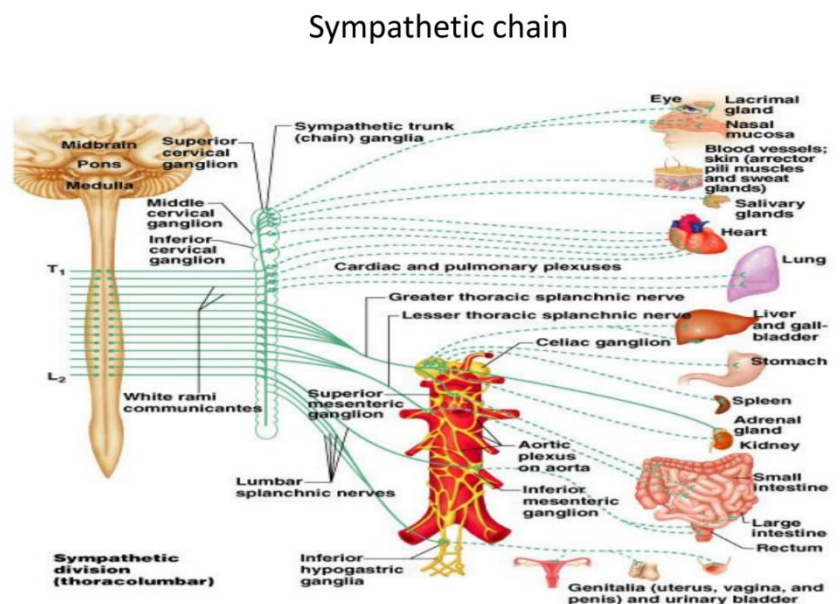
-Has short pre ganglionic & long post ganglionic

-Originates from thoracic segments + L1-L2

Para Sympathetic

-Has very long pre ganglionic & very short post ganglionic (because it synapse in the wall of organs. they don't synapse in plexuses)

-Originates from S2,S3,S4 & cranial nerves (III, VII, IX, X)



Visceral sensory and autonomic neurons participate in visceral reflex arcs

* Many are spinal reflexes such as defecation and micturition reflexes

--Defecation & micturition at the beginning are reflexes through spinal cord and after complete growth of spinal cord they become under control of higher center

* Some only involve peripheral neurons: spinal cord not involved (not shown)*

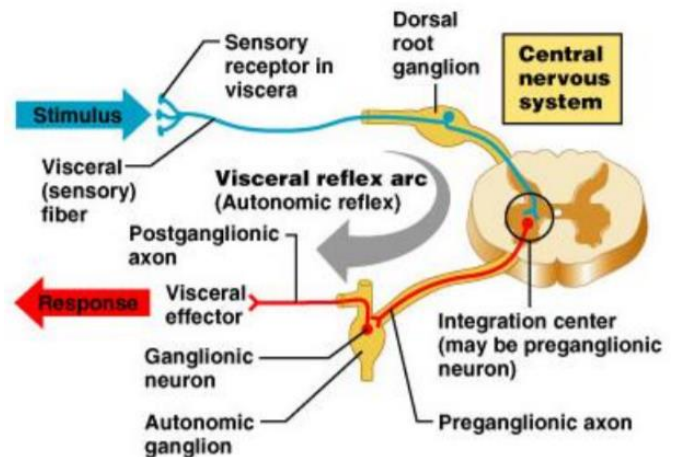
*How reflex is made?

Stimulation → dorsal root → spinal cord → synapse

motor reflex → ganglionic neuron → viscera

*There are reflexes through enteric plexus in the wall of organs that doesn't involve spinal cord. e.g pancreas contains 2 types of cells: α (release glucagon) & β (release insulin) which depend of concentration of glucose in blood and release these hormones depending on it.

- “enteric” nervous system: 3 neuron reflex arcs entirely within the wall of the gut



I know it's somehow confusing but many things were just read in the lecture, and honestly I tried my best to organize it and make it simpler

Good Luck 😊