GI
ANATOMY

#6

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NOTE ;- UNDERLINED RED TEXT ⇨ NOT MENTIONED BY THE DOCTOR , BUT IT WRITTEN IN SLIDES ⇨ SKIP :)

LYMPHATICS ON THE POSTERIOR ABDOMINAL WALL

➢ Lymph Nodes

• The lymph nodes are closely related to the aorta and form a preaortic and a right and left lateral aortic (Para-aortic or lumbar) chain .

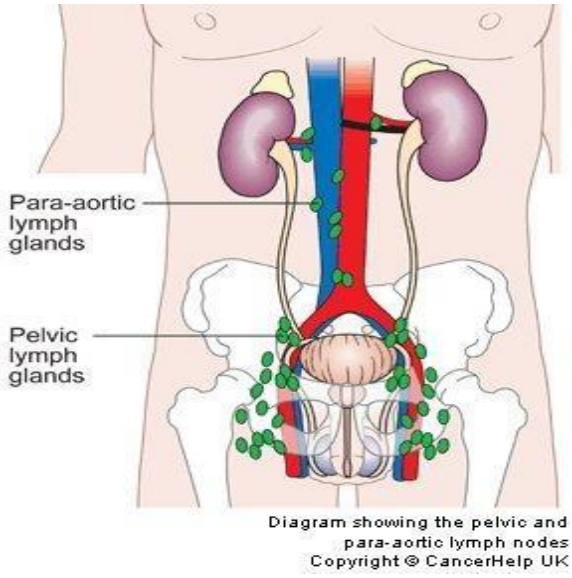

Diagram showing the pelvic and para-aortic lymph nodes
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❖ The preaortic lymph nodes

- ✓ located in front of the Aorta .
- ✓ They are **three** groups of lymph nodes.
- ✓ lie around the origins of the celiac, superior mesenteric, and inferior mesenteric arteries and are referred to as the **celiac, superior mesenteric, and inferior mesenteric lymph nodes**, respectively.
- ✓ They drain the lymph from the gastrointestinal tract, extending from the lower one third of the esophagus to halfway down the anal canal (upper half of the anal canal) , and from the spleen, pancreas, gallbladder, and ***greater*** part of the liver (upper surface of the lesser part of the liver >> through the right thoracic duch).
- ✓ Lymph from the foregut drains to celiac nodes .
- ✓ Lymph from the midgut drains to superior mesenteric nodes.
- ✓ Lymph from the hindgut drains to inferior mesenteric nodes.
- ✓ The efferent lymph vessels form the large intestinal trunk which leads to cisterna chyli .
- ✓ large intestinal trunk connects the inf.mesenteric with the sup.mesenteric and celiac nodes.

❖ The lateral aortic (para-aortic or lumbar) lymph nodes

- ✓ located on the both sides of Abdominal Aorta , especially in lumbar region .
- ✓ drain lymph from the kidneys and suprarenals; 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.

Side Note ;- Organs that exist in pairs , like the kidney , drains into para-aortic lymph nodes.

- ✓ The efferent lymph vessels form the right and left lumbar trunk , which drain into the cisterna chyli .

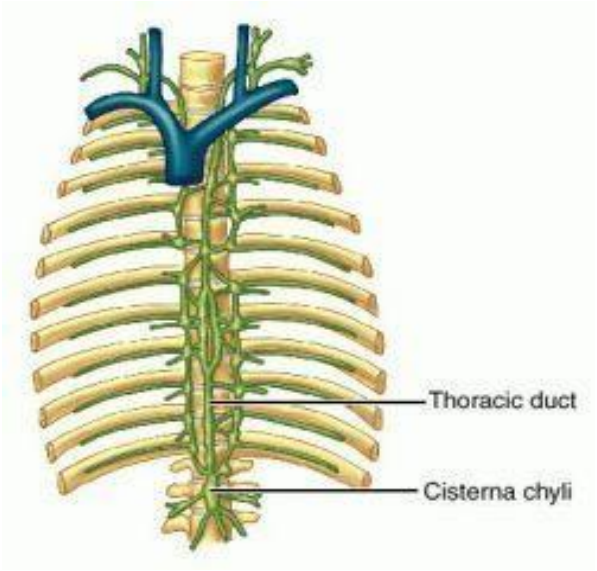
- ✓ The thoracic duct commences in the abdomen as an elongated lymph sac, the cisterna chyli. This lies just below the diaphragm in front of the first two lumbar vertebrae and on the right side of the aorta .
- ✓ The thoracic duct ascends upwards at the left side and ends at the junction of left subclavian and left internal jugular veins (beginning of the left brachiocephalic vein) .
- ✓ Brachiocephalic vein forms by the union of subclavian & internal jugular veins .

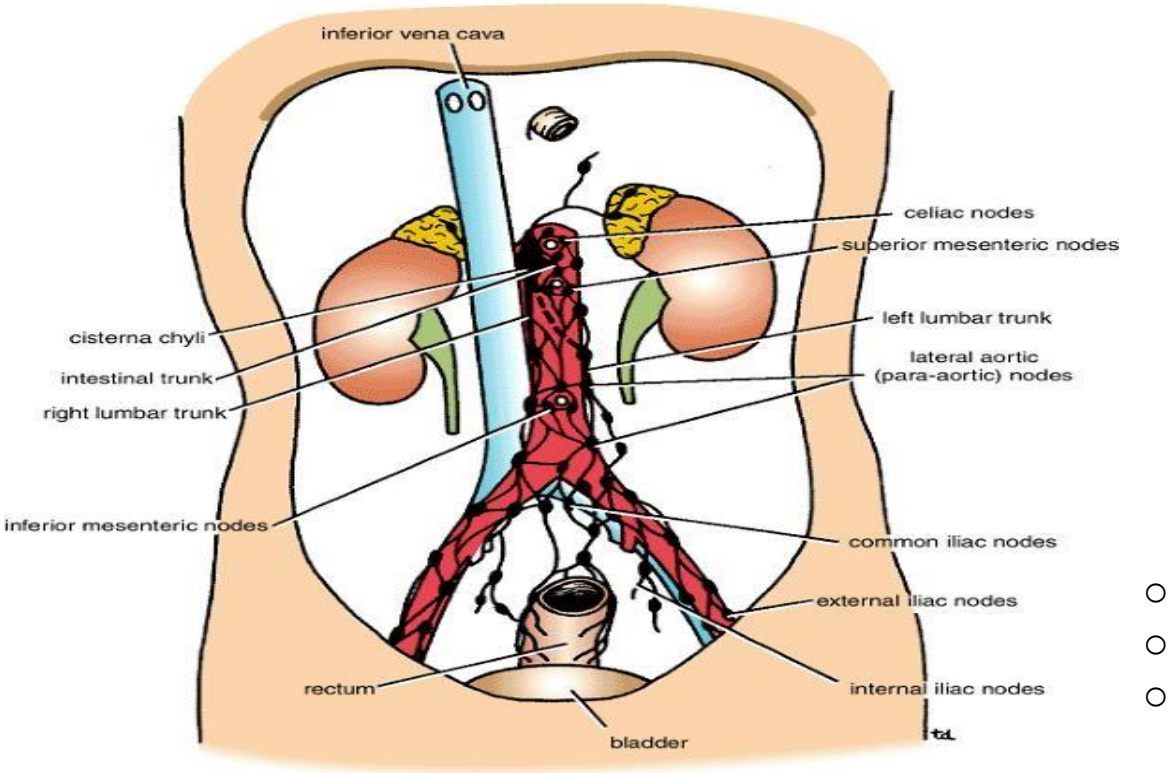
❖ **The cisterna chyli**

- ✓ dilated sac at the lower end of the thoracic duct .
- ✓ The right and left lumbar trunks under the diaphragm on the **right** side of the aorta .
- ✓ Receives lymph from ;-

i. The intestinal trunk.
ii. Some small lymph vessels that descend from the lower part of the thorax.
iii. Rt & Lt vessels from lower thorax.

- ✓ Again, Sac of Aortic orifice on the **right** side of abdominal aorta
- ✓ More Right to Sac >> the beginning of **azygos vein**



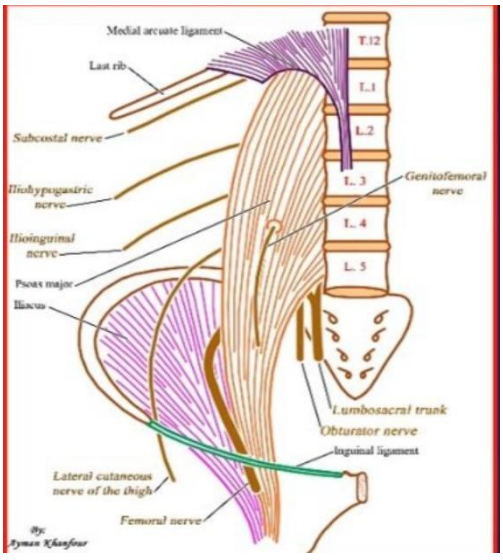


- The preaortic lymph nodes (celiac, superior mesenteric, and inferior mesenteric lymph nodes) >> large intestinal trunk >> the cisterna chyli .
- Internal iliac & external iliac node >> common iliac nodes >> para-aortic lymph nodes
- The lateral aortic (para-aortic or lumbar) lymph nodes >> the right and left lumbar trunk >> the cisterna chyli .

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 major muscle** from the **anterior** rami of the **upper four lumbar nerves** (L1-L4).
- The anterior rami receive gray rami communicates from the sympathetic trunk .The upper two only give off white rami communicates to the sympathetic trunk. (this will be discussed later in this sheet , so you can skip it) .
- The branches of the plexus emerge from the lateral and medial borders of the muscle (psoas major) and from its anterior surface (through the muscle) .



❖ Branches of the Lumbar Plexus

- 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 the fourth lumbar root of the lumbosacral trunk Emerge from the **medial** border of the psoas major at the brim of the pelvis.
- The genitofemoral nerve emerges from the **anterior** surface of psoas major.

✓ The iliohypogastric and ilioinguinal nerves (L1) enter the lateral and anterior abdominal walls.

✓ The iliohypogastric nerve - supplies the skin of the lower part of the anterior abdominal wall, above pubic symphysis (below umbilicus).

✓ The ilioinguinal nerve - passes through the inguinal canal to supply the skin of the groin and the scrotum or labium majus.

✓ The lateral cutaneous nerve of the thigh - Crosses the iliac fossa in front of the iliacus muscle toward **the anterior superior iliac spine** , and enters the thigh behind the lateral end of the inguinal ligament . It supplies the skin over the **lateral** surface of the thigh.

✓ The femoral nerve (L2, 3, and 4) . It is the largest branch of the lumbar plexus. It runs downward and laterally 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 (within the femoral triangle) , In the abdomen it supplies the iliacus muscle . It gives motor and sensory innervation to the lower limb.

✓ The Obturator nerve (L2, 3, and 4) crosses the pelvic brim in front of the sacroiliac joint and behind the common iliac vessels. It leaves the pelvis by passing through the Obturator foramen (the doctor said Obturator canal) to reach the medial compartment of the thigh , where it provides 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 takes part in the formation of the sacral plexus . It descends anterior to the ala of the sacrum and joins the first sacral nerve.

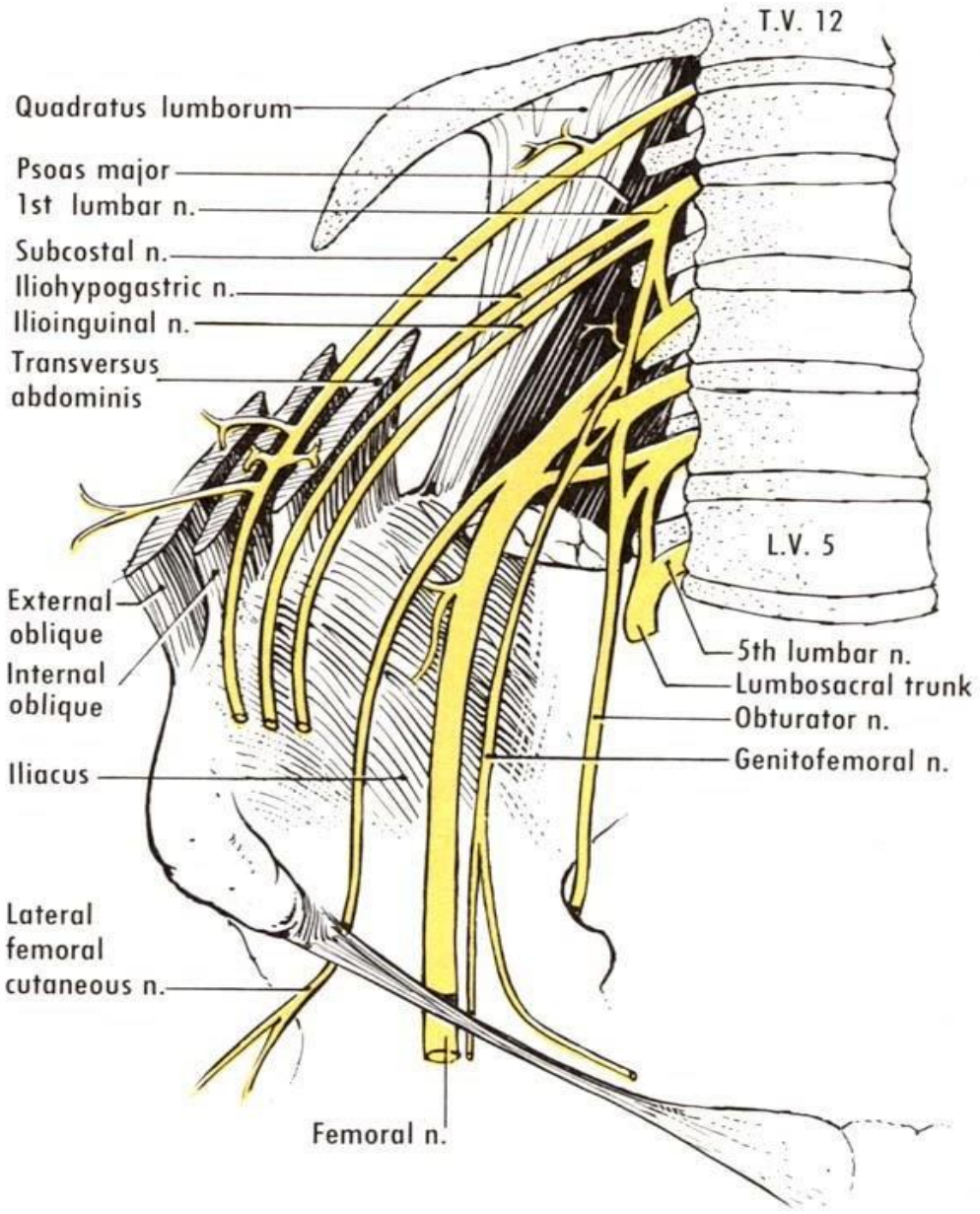
✓ The genitofemoral nerve (L1 and 2) emerges on the anterior surface of the psoas. It runs downward in front of the muscle and divides (before the inguinal ligament) into genital and femoral branch.

✓ the **only branch** of the lumber plexus that pierces psoas major muscle is **genitofemoral nerve**.

- **A genital branch**, which enters the inguinal canal (spermatic cord) and supplies the Cremasteric muscle thigh (**motor** innervation).
- **A femoral branch**, which runs **deep** to the inguinal ligament and supplies a small area of the skin of the thigh (**sensory** innervation) .

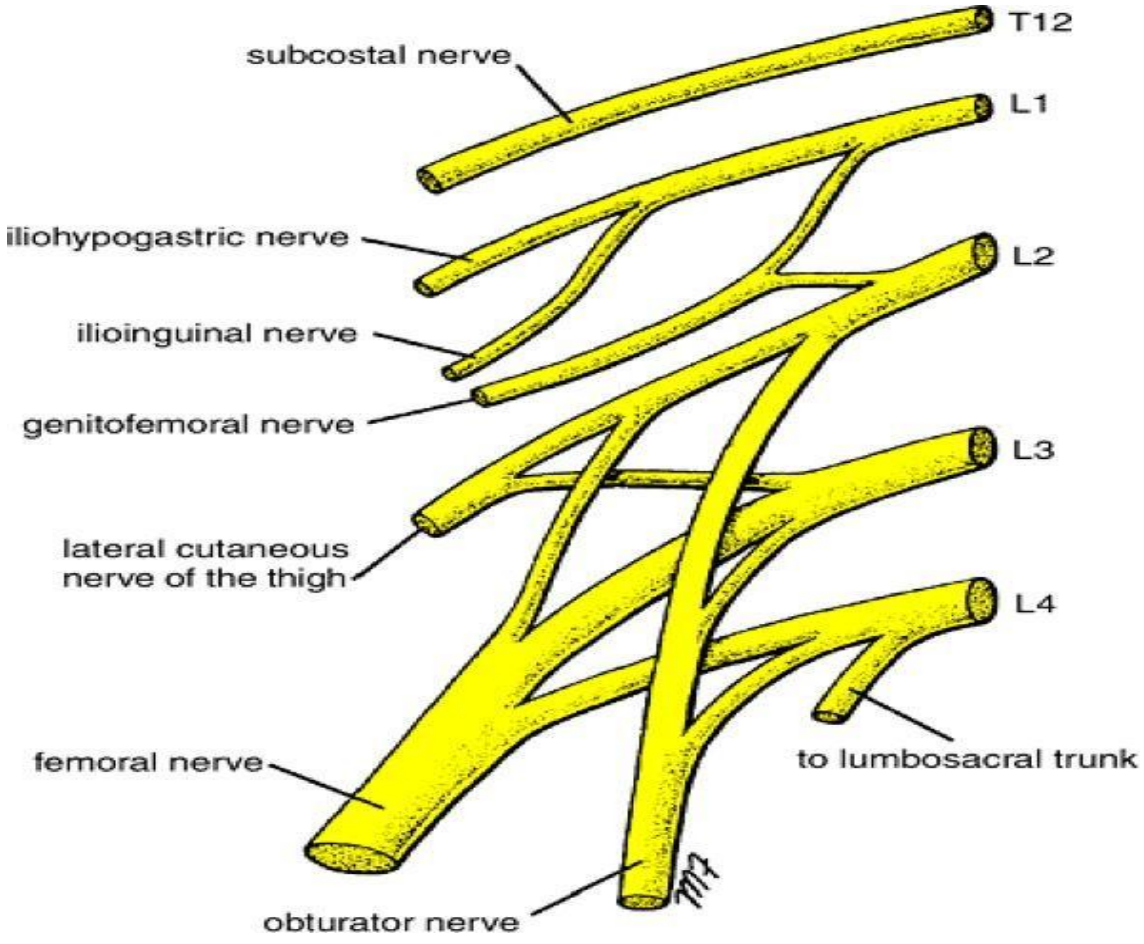
➢ Cremasteric reflex ;-

- it is the nervous pathway , in which stimulation of the skin of the **upper medial** side of the thigh in the male results in reflex contraction of the cremaster muscle and the drawing upward of the testis within the scrotum.
- Itching of the skin on upper medial part thigh will pull the testis upward
- Cremasteric reflex may be absent with: testicular torsion, 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.



- The iliohypogastric nerve, ilioinguinal nerve **(L1)**
- The genitofemoral nerve **(L1 and 2)**

- 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.
- the anterior division form the Obturator nerve .
- the posterior division form the Femoral nerve.
  - The femoral nerve **(L2, 3, and 4)** - pos.division
  - The Obturator nerve **(L2, 3, and 4)** – Ant.division
- The white ramus communicans carries **preganglionic** sympathetic fibers of the spinal cord to the sympathetic chain, while the gray ramus contains **postganglionic** sympathetic fibers rejoining the spinal 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 lumbosacral trunk **(L4,S1)**

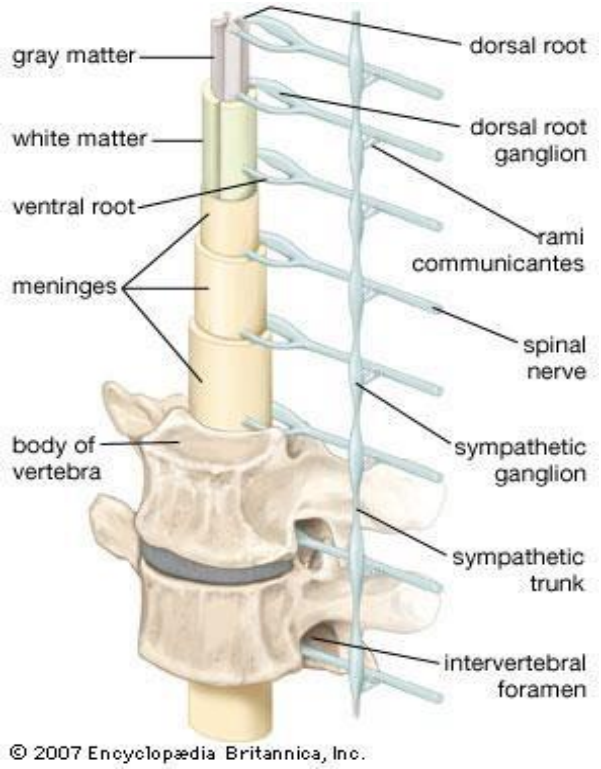


SYMPATHETIC TRUNK (ABDOMINAL PART)

- 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.
  - Side Note ;- 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.

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

- **White ramus communicans**
  - 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 communicans**
  - It's the branch that exits the gang lia to return to the spinal cord and contains postganglionic nerve fibers distributed to blood vessels, sweet gland and skin.
  - communicantes join each ganglion to a corresponding lumbar spinal nerve.



- Once these preganglionic fibers pass through the sympathetic trunk with or without synapsing.
- Again … 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.
- Notice that each spinal nerve contains postganglionic sympathetic fibers (gray ramus), so there are 31 pairs of them, but only spinal nerves of sympathetic segments contain preganglionic sympathetic fibers (white ramus), so there are 14 pairs (The columns are part of the gray matter of the thoracic (T1-T12) and upper lumbar (L1-L2) -- Thoracolumbar)

○ Within the abdominal region , the first and second lumbar nerve (L1-L2) send white rami communicans to the corresponding ganglia in the sympathetic chains .

•The abdominal part of the sympathetic trunk is continuous above with the thoracic and below with the pelvic parts of the sympathetic trunk.

• It runs downward along the medial border of the psoas muscle on the bodies of the lumbar vertebrae .

•It enters the abdomen from behind the medial arcuate ligament and gains entrance to the pelvis below by passing behind the common iliac vessels.

• The right sympathetic trunk lies behind the right border of the inferior vena cava; the left sympathetic trunk lies close to the left border of the aorta.

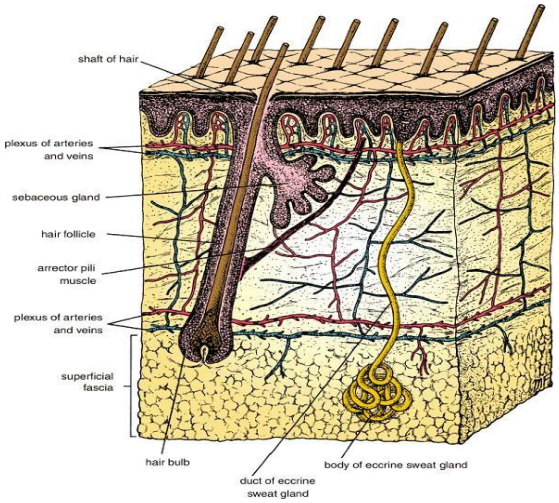
•The sympathetic trunk possesses four or five segmentaly arranged ganglia, the first and second often being fused together.

➢ Post gangilionic fibers ;-

•Distributed through the branches of the spinal nerves to the blood vessels, sweat glands, and arrector pili muscles of the skin.

•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.)

•Fibers 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.



➢ Aortic Plexuses

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

✓ (plexus = sympathetic and parasympathetic fibers)

A. Preganglionic and postganglionic **sympathetic** fibers .

B. Preganglionic **parasympathetic** fibers, and visceral afferent fibers form a plexus of Nerves, the aortic plexus, around the abdominal part of the aorta .

✓ 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.

❖ **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.
- The ganglia receive the greater and lesser splanchnic nerves (Preganglionic sympathetic fibers).
- Greater splanchnic nerves -- It arises from thoracic segment of spinal cord; (T5-T9) or 10th thoracic ganglia
- Postganglionic branches accompany the branches of the celiac artery and follow them to their distribution.
- Parasympathetic vagal fibers also accompany the branches of the artery.

❖ **The renal plexuses** ;-

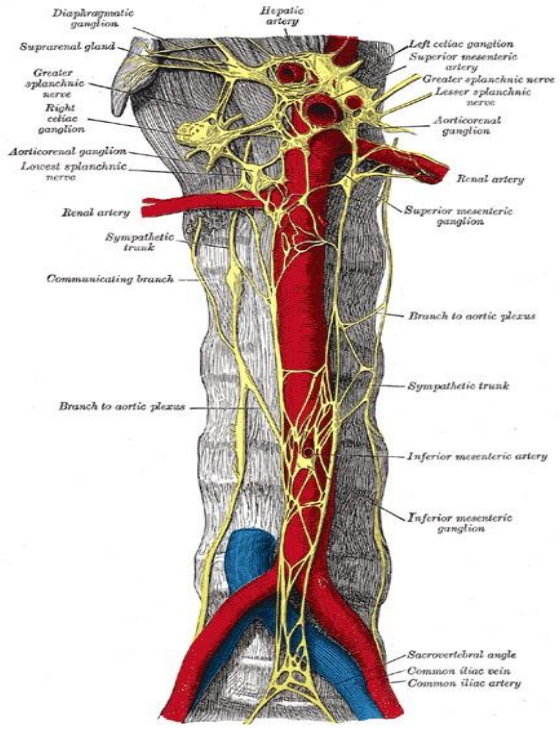
- are smaller than the celiac plexus.
- They are distributed along the branches of the corresponding arteries.
- The ganglia receive the Lowest splanchnic nerves .
- Lowest splanchnic nerves -- It arises from the last one or two thoracic ganglia.

❖ **The inferior mesenteric plexus ;-**

- It distributed along the branches of the inferior mesenteric artery
- The ganglia receive the first two lumbar ganglia.

❖ **The superior mesenteric plexus ;-**

- It distributed along the branches of the superior mesenteric artery
- The ganglia receive the Lesser splanchnic nerves.
- Lesser splanchnic nerves -- It arises from the 9th & 10th thoracic ganglia.

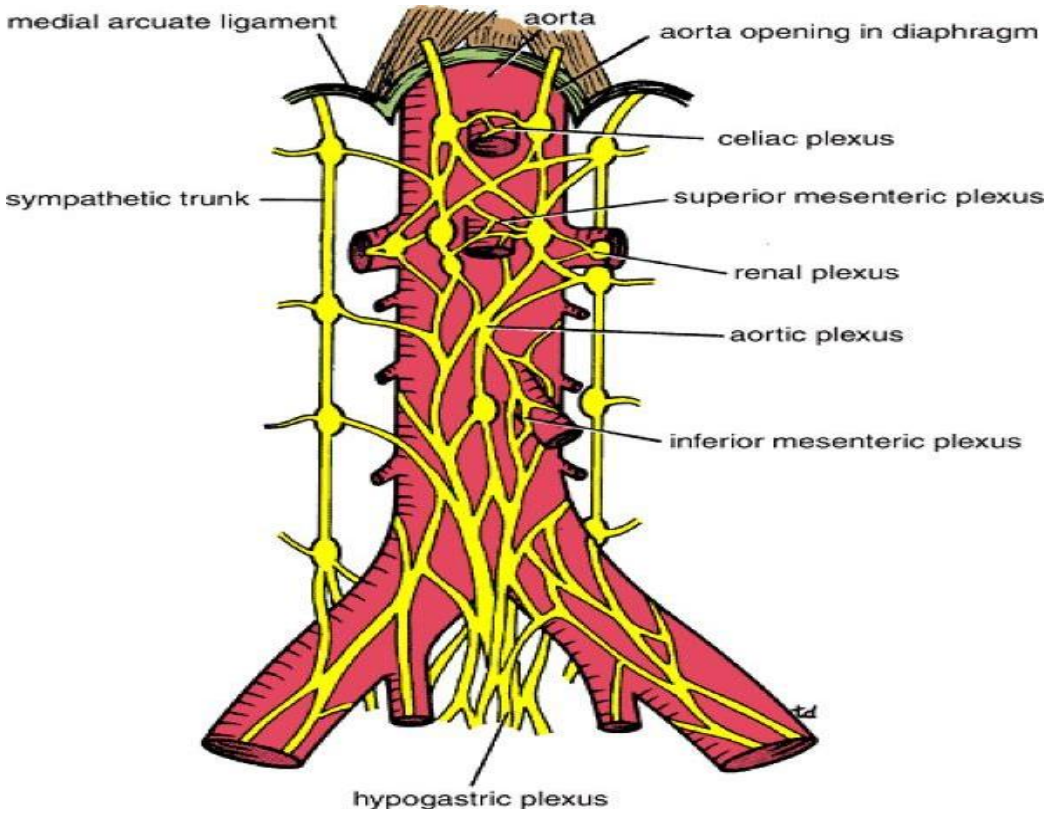


➢ Relation to sympathetic chain ;-

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 inf. mesenteric plexus or sup. mesenteric plexus depending on the blood supply of the organ.

- ➢ **Celiac** ganglia -- **foregut** -- Greater splanchnic nerves -- (T5-T9 or T10)
- ➢ **Sup. mesenteric** ganglia -- **midgut** -- Lesser splanchnic nerves – (T9-T10)
- ➢ **Inf. mesenteric** ganglia – **hindgut** – (L1&L2)

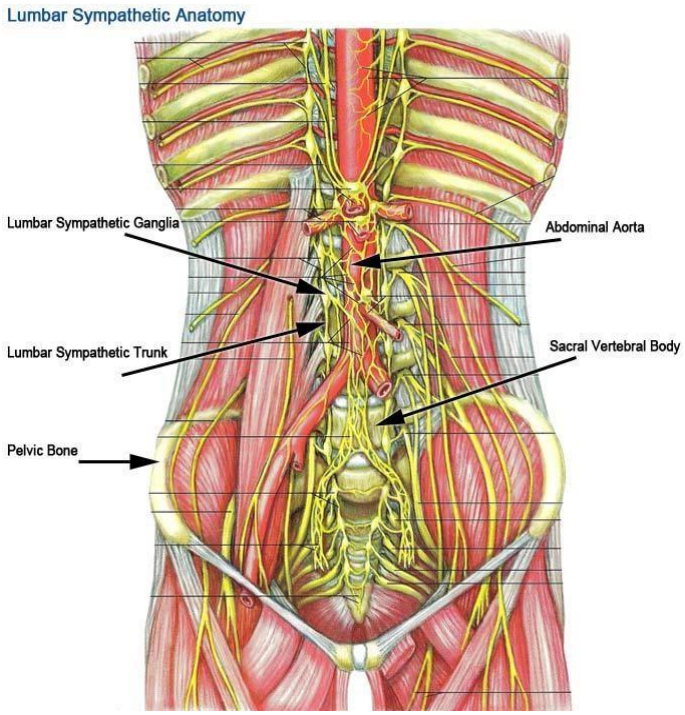
- ✓ the vagus nerves are the ones responsible of parasympathetic innervation of the foregut and the midgut, including the liver, gallbladder, spleen, stomach, Small intestine, cecum, ascending colon and proximal two third of the transverse colon.
- ✓ However, the hindgut (distal one third of the transverse colon , descending colon , sigmoid colon , the rectum and the upper half of the anal canal) is supplied with parasympathetic fibers that originate form S2, S3 and S4 spinal nerves.
- ✓ the parasympathetic nerves are craniosacral .
- ✓ the sympathetic nerves are thoracolumbar.
- ✓ The inferior mesenteric plexus is similar to renal plexus receives parasympathetic fibers from the sacral parasympathetic spinal nerves (S2,S3,S4).
- ✓ the hypogastric plexus is a collection of nerves that extend from the aortic plexus to supply the pelvic viscera.



SYMPATHETIC CHAIN

➢ It shows as 2 chains 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 sympathetic ganglia S.C.S.G , middle cervical sympathetic ganglia M.C.S.G , & inferior cervical sympathetic ganglia L.C.S.G)
- ✓ Chest (Thoracic): 10 - **12** (11) thoracic sympathetic ganglia
  - -- The doctor said **12** thoracic sympathetic ganglia.
- ✓ Abdomen (lumbar): 4 or 5
- ✓ Pelvis (sacral): 4 or 5
- ✓ Coccygeal: 1 (ganglion impar)



- Side Note ;- single ganglia at the end of spiral cord in which right & left Sympathetic chain ends in

➢ Pregangilonic fibers:

- ❖ Origin: sympathetic nucleus present in lateral Horn cell of thoracic and upper 2 lumber region of spinal cord = 14 (14 white rami)
- ❖ Leave the spinal cord throw the ant. Root and then leave the spinal nerve as white rami to join the symp.chain (14 white rami)
- ❖ Preganglionic fibers when it enters the sympathetic chain may :

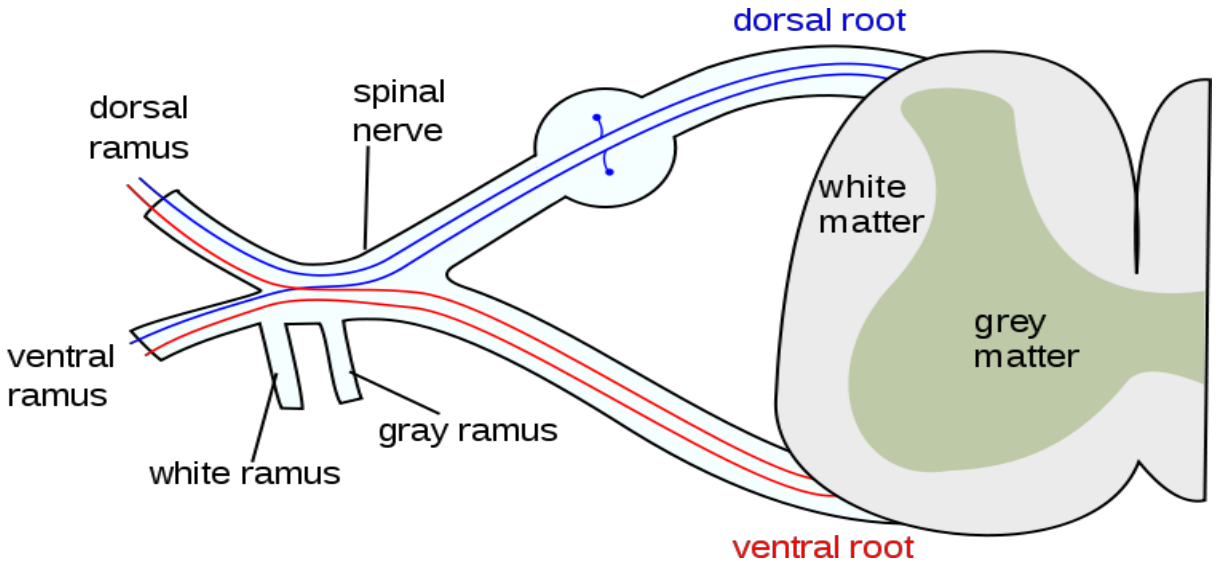
1- Synapse with cells in the corresponding ganglia it enters (e.g. middle Thoracic Segments) -- Ganglia of the same number ((e.g ; fibers from T5 synapse in the T5 ganglia)) .

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 Th & upper 2 lumber go to lumber & sacral ganglia)

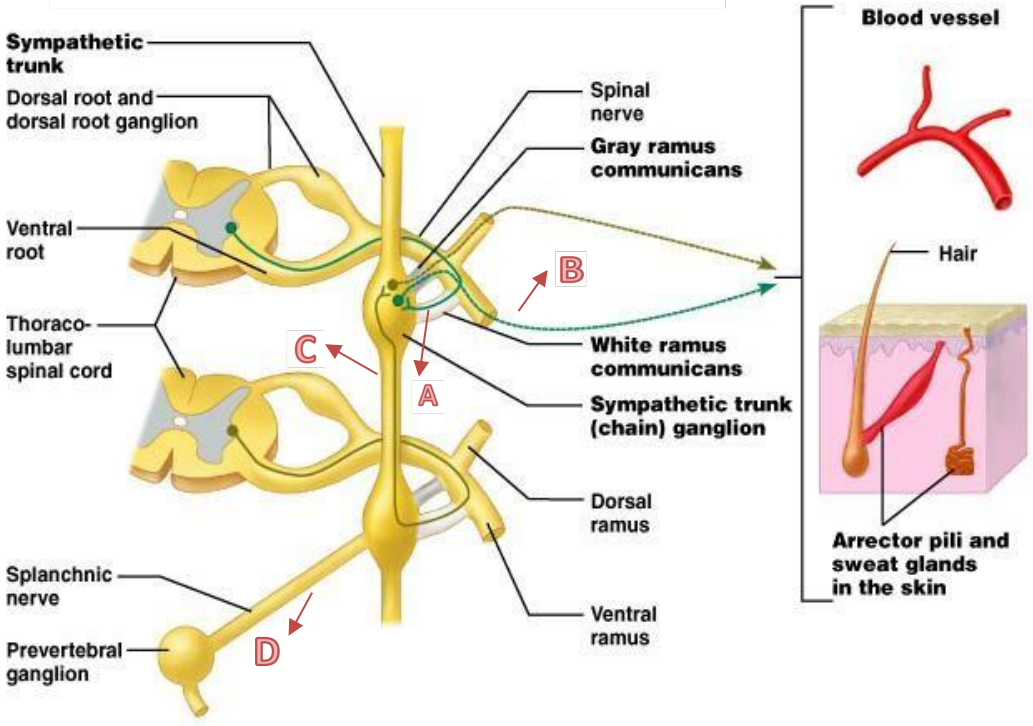
4- May not synapse in sympathetic chain & continue as preganglionic fibers to form (splanchnic nerves) that synapse in pre-aortic (pre-vertebral) ganglia ;- Celiac ganglia , Sup. mesenteric ganglia and Inf. mesenteric ganglia.

- Splanchnic nerve: preganglionic sympathetic fiber that didn't synapse in the sympathetic chain but synapsed in pre-vertebral ganglia.
- 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) .
- Side Note ;- Each segment contains H shaped gray matter and white matter around it and each gray matter is divided into anterior, posterior, & lateral horns.
- The preganglionic sympathetic fibers leave the sympathetic nucleus through the ventral root of the 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) .



- Synapse in chain ganglia at same level or different level .
- Pass through ganglia and synapse in prevertebral ganglion .

Synapse in chain ganglia
at same level or different level



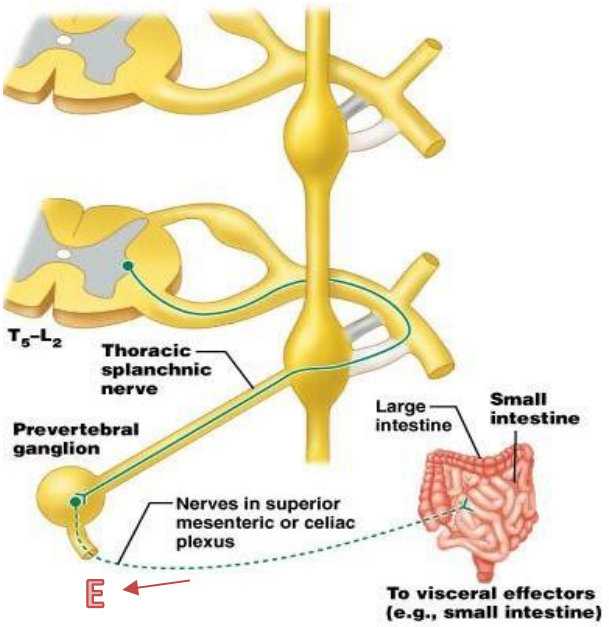
A- Fibers that exits from sympathetic nuclei is called preganglionic sympathetic fibers (white ramus) .

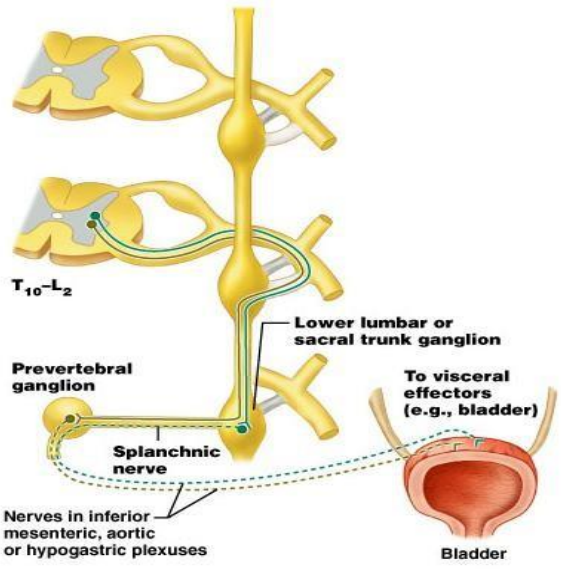
B- After synapsing inside the ganglia, the fibers that exits the ganglia is called postganglionic sympathetic fibers (gray ramus) .

C- Preganglionic fibers pass up to synapse in higher ganglia.

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

E- splanchnic nerves synapses in celiac ganglia & post gangilionic fibers toward the GI.





➢ **Nerves which leave the sympathetic chain:**

i. gray rami (31 post ganglionic fibers join spinal nerves to reach sweat glands, errectore papillae & blood vessels) ;-

A. S.C.S.G→ lower 4 cranial nerves + upper 4 cervical

B. M.C.S.G → 5th , 6th cervical nerves

C. I.C.S.G → 7th , 8th cervical nerves

❖ Thoracic , lumber, sacral ganglia to corresponding nerves (thoracic, lumber, and sacral nerves respectively).

ii. visceral nerves (reaches viscera through blood vessels) ;-

A. Int, & Ext. carotid nerves from S.C.S.G to corresponding arteries .

B. pharyngeal branch : from S.C.S.G to pharyngeal plexus .

C. pulmonary nerves around the trachea : 2nd , 3rd& 4th thoracic ganglia .

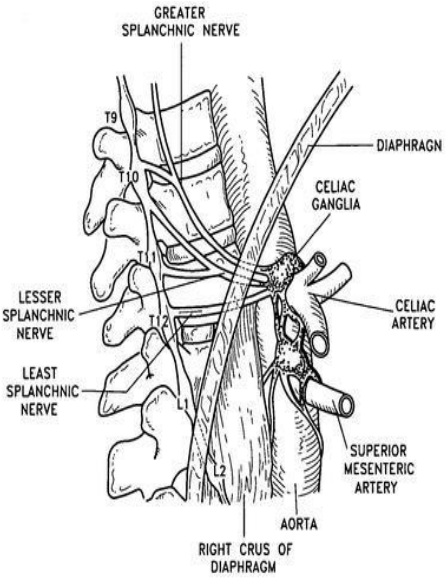
D. cardiac nerves : 2nd , 3rd& 4th thoracic ganglia + 3 cervical ganglia

E. 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 (lateral horn) 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:**

✓ Arise from the 9th & 10th Thoracic ganglia , then pierces the crus of diaphragm to end in the superior mesenteric ganglia.

✓ Post. Ganglia fibers supply the smooth muscles, glands of small intestine, ascending and the proximal 1/3 transverse parts of colon (the midgut)

- **Lowest splanchnic nerves**:

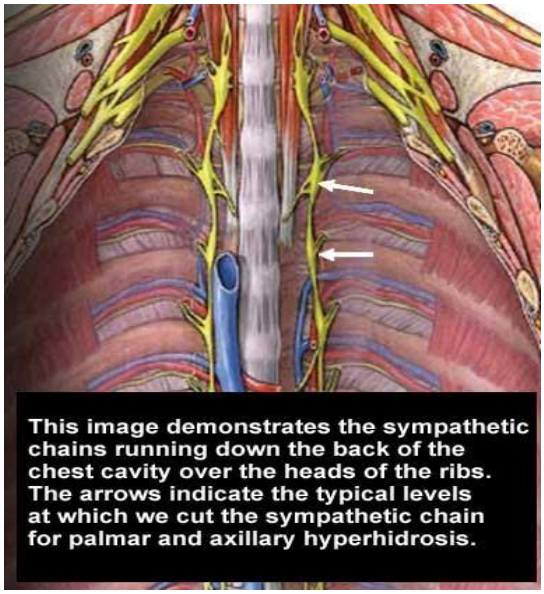
✓ May be absent ,if present arises from the last one or two thoracic ganglia, then pierces the diaphragm to end in renal plexus

- **Lumber splanchnic branch**

✓ Arise from L1 &L2 ganglia to ends in inferior mesenteric ganglia.

- ✓ Post .Gangilionic fibers go to hindgut - sigmoid and pelvic colon ,other post .Gangilionic fibers form the descending hypogastric plexus to supply bladder ,rectum and genetalia.
- ✓ Branches from sacral part of the chain go to pelvic viscera.

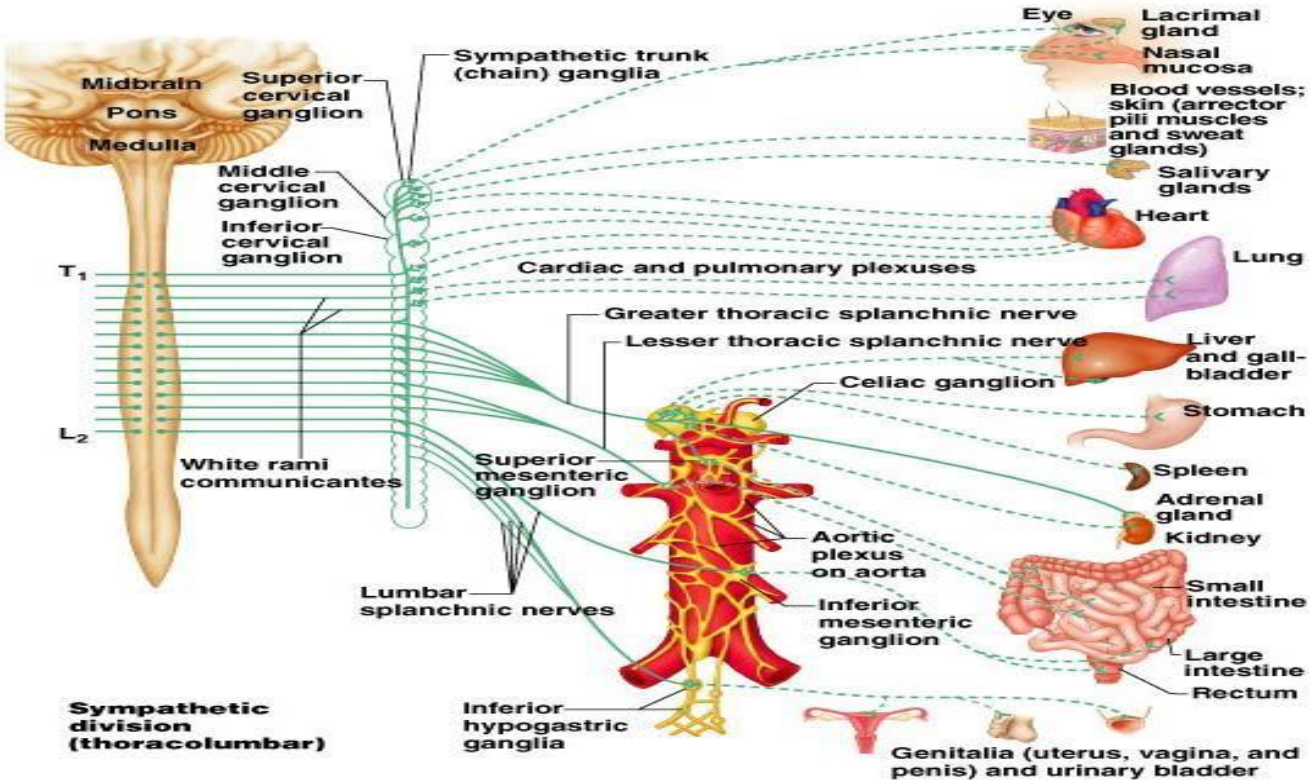
➢ Thoracic sympathetic chain:



- ✓ Site: 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 vertebrae
- ✓ Ganglia: (10 -12),1st sometimes fuses with the I.C.S.G →stellate ganglia
- ✓ Branches:

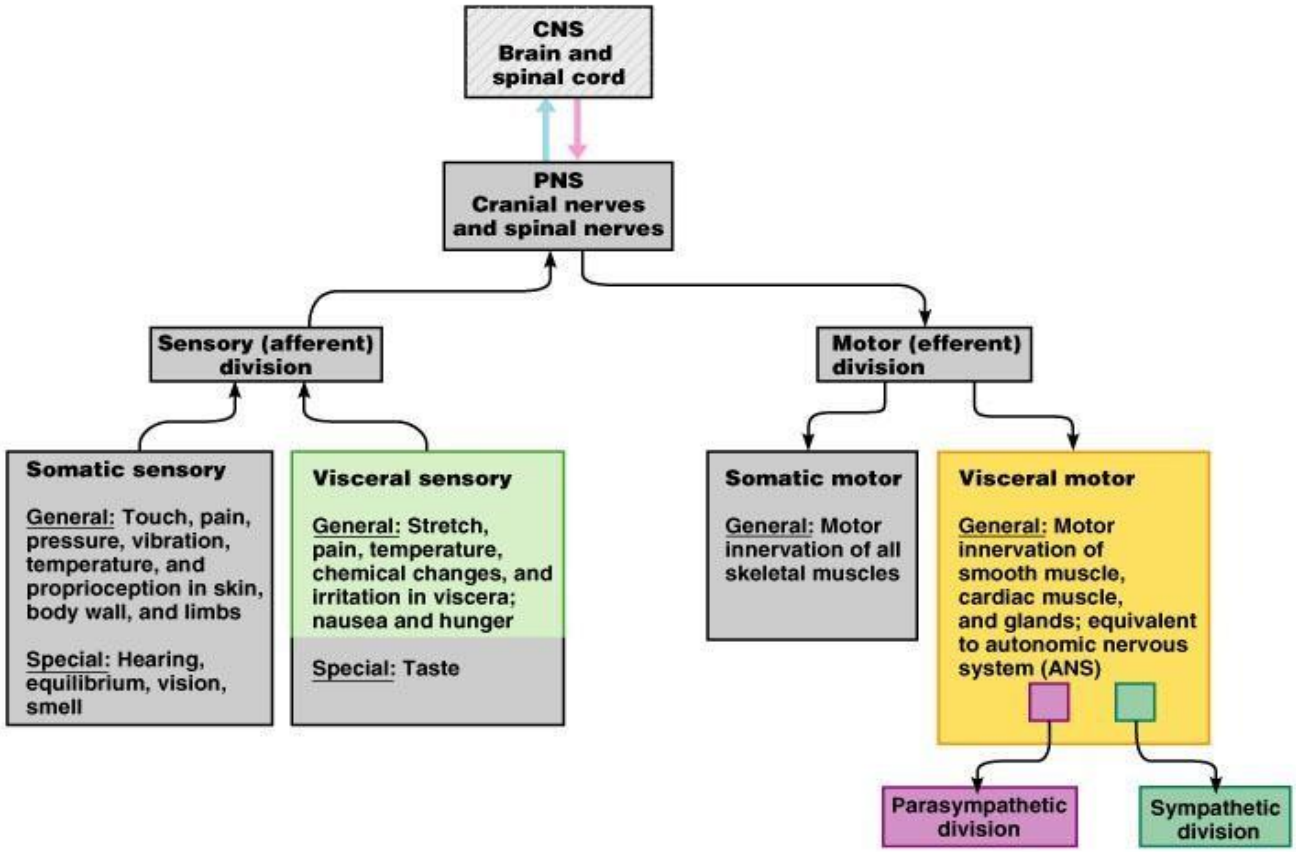
I. Gray & white rami communicants
II. 2nd ,3rd & 4th ganglia (cardiac & pulmonary)
III. The upper five ganglia give aortic oesophageal branches
IV. Greater, lesser and lowest splanchnic nerves

SYMPATHETIC CHAIN

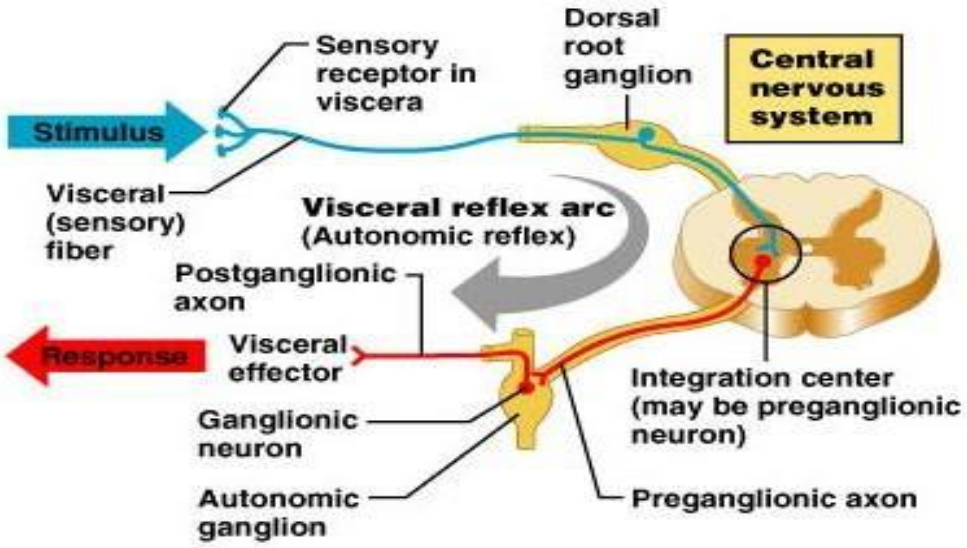


Side Note ;- we will study about them in details in CNS next year >> NOT Required ☺ .

VISCERAL SENSORY AND AUTONOMIC NEURONS PARTICIPATE IN VISCERAL REFLEX



- ✓ Many are spinal reflexes such as defecation and micturition reflexes
- ✓ Some only involve peripheral neurons: spinal cord not involved (not shown)*
- ✓ *e.g" .enteric "nervous system 3 :neuron reflex arcs entirely within the wall of the gut.



GOOD LUCK..

V2

- Page 7

- the anterior division form the Obturator nerve .
  - ✓ **Anterior** NOT posterior
- the posterior division form the Femoral nerve.
  - ✓ **posterior** NOT Anterior
  - page 11
- the vagus nerves are the ones responsible of parasympathetic innervation of the foregut and the midgut, including the liver, gallbladder, spleen, stomach, Small intestine, cecum, ascending colon and proximal two third of the transverse colon.
  - ✓ **proximal** NOT distal

V3