

THE



SYSTEM

Anatomy

Sheet

Slide

Handout

Number: **9**

Subject: **Nerves of the GIT**

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Price:

Note: Figures that are taken from the Dr's slides are numbered as (1,2,3,etc..) and they are required . But figures arranged alphabetically as (A,B,C,..) are not required , but hopefully going to enhance your understanding .

In this lecture we will be discussing the nerves of the posterior abdominal wall .

We have been through this subject before throughout the digestive system in the form of Celiac plexus of nerves, Superior and Inferior mesenteric plexuses of nerves ,Splanchnic nerves in addition to the Superior and Inferior hypogastric nerves .

Many students ask about the details of the nerves and may feel a bit confused and lost , but this lecture , hopefully, will clear the picture and make concept of GI and its related nerves much easier , since it is going to be about the nervous system , especially the peripheral nerves that going to be discussed slowly .

Introduction

→ We have something called the spinal nerves and they are divided according to the segment of the spinal cord they originate from , thus the Cervical region has 8 pairs of spinal nerves , the Thoracic region has 12 pairs , the Lumbar has 5 pairs , the Sacral has 5 pairs and the Coccyx has one pair only . (31 spinal nerves in total).

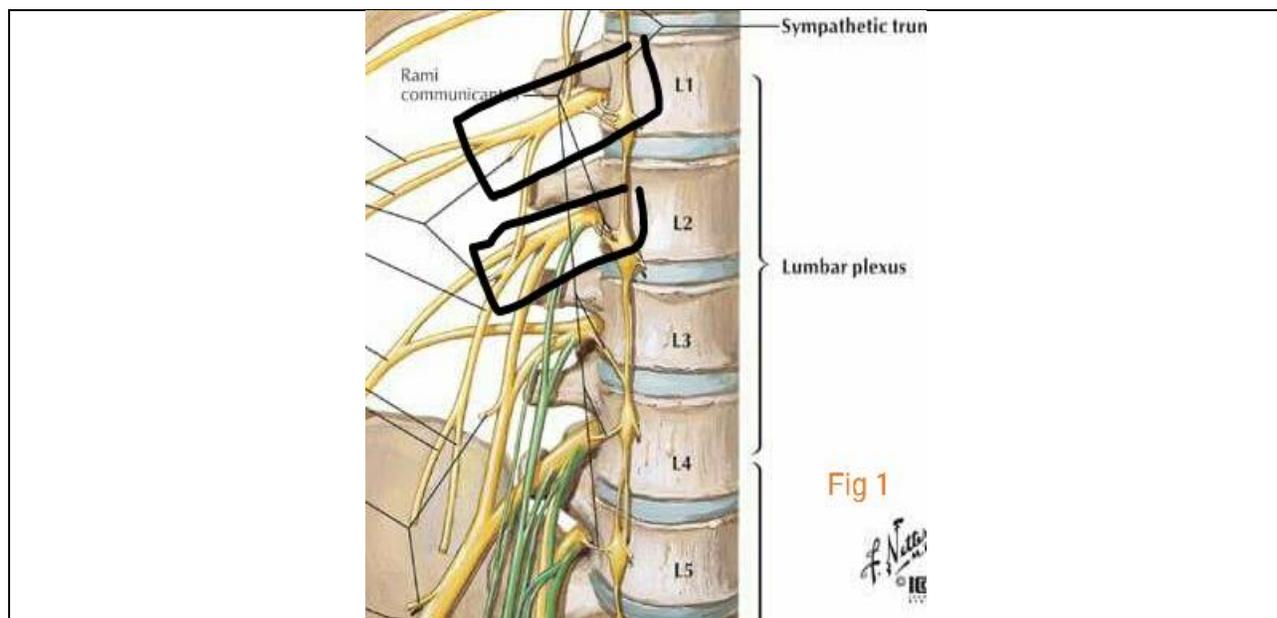
The Lumbar Plexus

It is known that the Lumbar plexus mainly supplies the lower limb , it is composed of anterior rami and posterior rami.

Figure 1 :

Notice the sympathetic chain starting from L1 and going through L2 ,L3,L4 and L5.

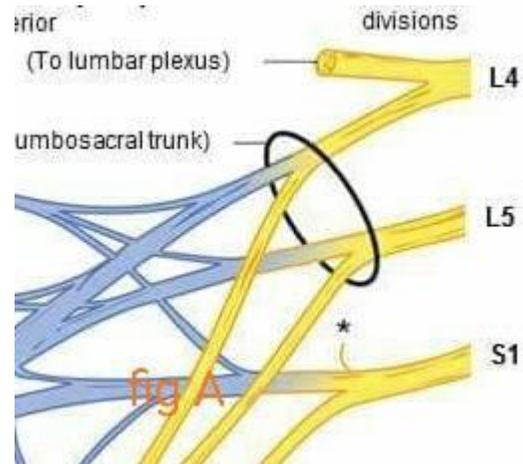
Also note the nerves in the black boxes , these are the spinal nerves , and all of them are called Lumbar Spinal Nerves , that divide into anterior and posterior divisions(rami) .



The posterior divisions supply the posterior wall while the anterior (ventral) divisions , which are longer, supply the lateral sides in addition to both limbs (upper and lower).

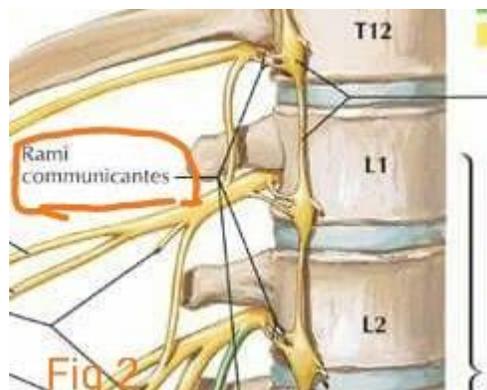
Going back to the brachial plexuses , recall that it is composed of the anterior rami of C5,C6,C7,C8,T1 .

Now the Lumbar plexus is composed of the anterior primary rami of L1,L2,L3,L4. The fourth root (L4) gives the lumbar and also gives a branch that supplies the sacral , while the fifth root L5 goes to the sacral plexus only , see figure A .



To sum up , we have lumbar and sacral plexuses of nerves , the former supplies mainly the lower limb , the latter supplies the pelvis .

The Anterior rami have communications with the sympathetic fibers know as Rami Communicants. **Figure 2** below



The sympathetic fibers come from the sympathetic chain .

What is the Sympathetic chain ?

Starts from the neck to the thorax, abdomen and ending in the pelvis , thus we have a sympathetic chain for every region , for example a sympathetic chain in the neck , another one in the thorax , etc . Its main function is to give a connection with the spinal nerves .

Nerves Originating from the Lumbar plexus in brief :

Root Value	Nerves
L1	1- The Iliohypogastric nerve 2- The Ilioinguinal nerve
L1-L2	The Genitofemoral nerve
L2-L3	The Lateral Coetaneous Nerve Of The Thigh
L2,L3,L4	1-The Femoral Nerve 2- The Obturator Nerve

Now each nerve will be discussed in details (its root and distribution)

1- The Ilioinguinal Nerve:

Root value : L1

Distribution: To the skin of the scrotum , groin , and in females:it supplies skin over Labia Majora .

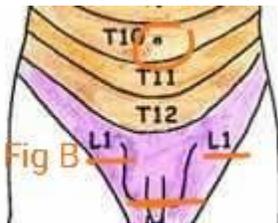
2- The Iliohypogastric Nerve :

Root Value : L1 (Lumbar spinal nerve number one)

*note that all nerves origin from the anterior ramus only , since the posterior rami supply the back and we are not concerned with them, so to be more specific the origin is from the anterior ramus of the lumbar spinal nerve number one.

Distributions :

- ➔ It has motor and sensory distributions .
- ➔ Sensory : to the skin of the lower part of the anterior abdominal wall. And something you should know is that L1 is located below the umbilicus and above the symphysis pubis . **See Figure B**



- ➔ Motor : remember in the third lecture we discussed anterior abdominal wall muscles and we said that they are all innervated nerves from L1 except for The Rectus Abdominus muscle which is supplied by intercostal nerves.

3- The Genitofemoral Nerve :

Root Value: L1,L2

Distribution: It is divided into a femoral and a Genital branch , the former is sensory over the middle and upper part of the skin of the thigh , and the latter is motor for the Cremasteric Muscle of the scrotum thus responsible for the *Cremasteric Reflex*.

The Cremasteric Reflex :

If the upper medial part of the thigh was stimulated , the pulses will go through the femoral branch of the Genitofemoral nerve to L1,L2. And the response is going to be through the motor branch (the genital branch) of the Genitofemoral nerve to the Cremasteric Muscle thus causing its contraction , a contraction that pulls the testis upwards , and that is simple the Cremasteric Reflex .

4- The Lateral Coetaneous Nerve Of The Thigh:

Root Value : L2 , L3

Distribution : Supplies the skin over the lateral side of the thigh , goes towards the anterior superior iliac spin (ASIS) and it descends into the inguinal ligament . **See Figure 4**

5- The Femoral Nerve

6-The Obturator Nerve

Root value : L2,L3,L4 (the both originate from the very same segment)

Distribution: *The femoral* supplies muscles of the lower limb especially the anterior compartment of the thigh , and the skin on medial side of the leg.

The Obturator goes through the Obturator canal towards the medial compartment of the thigh (the compartment that contains adductor muscles and Gracillis Muscle)

*But what is the difference between them ?

The anterior primary rami itself give anterior and posterior divisions, the anterior division forms the Obturator nerve , and the posterior division forms the femoral nerve . **See Figure 3**

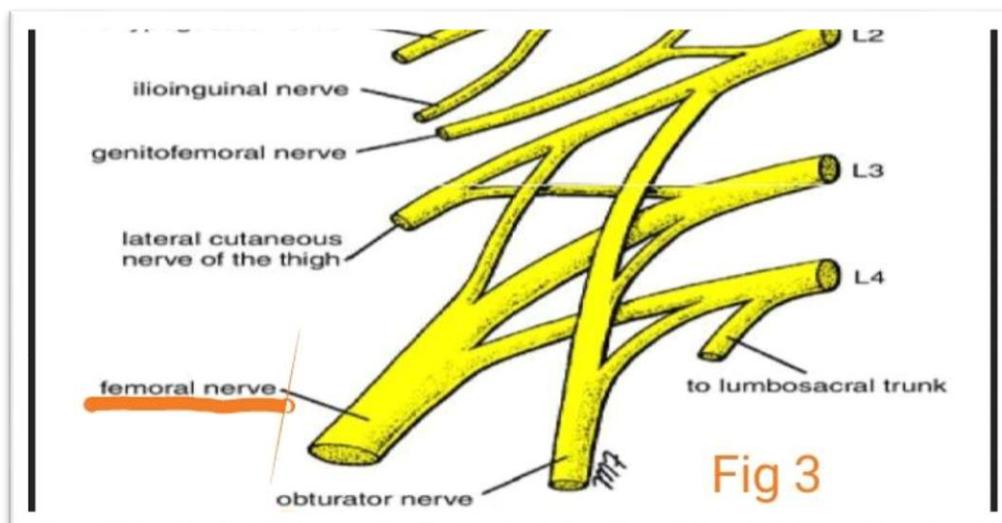


Figure 4 is important as the doctor spent some time explaining the nerves using it (more details in the next page)

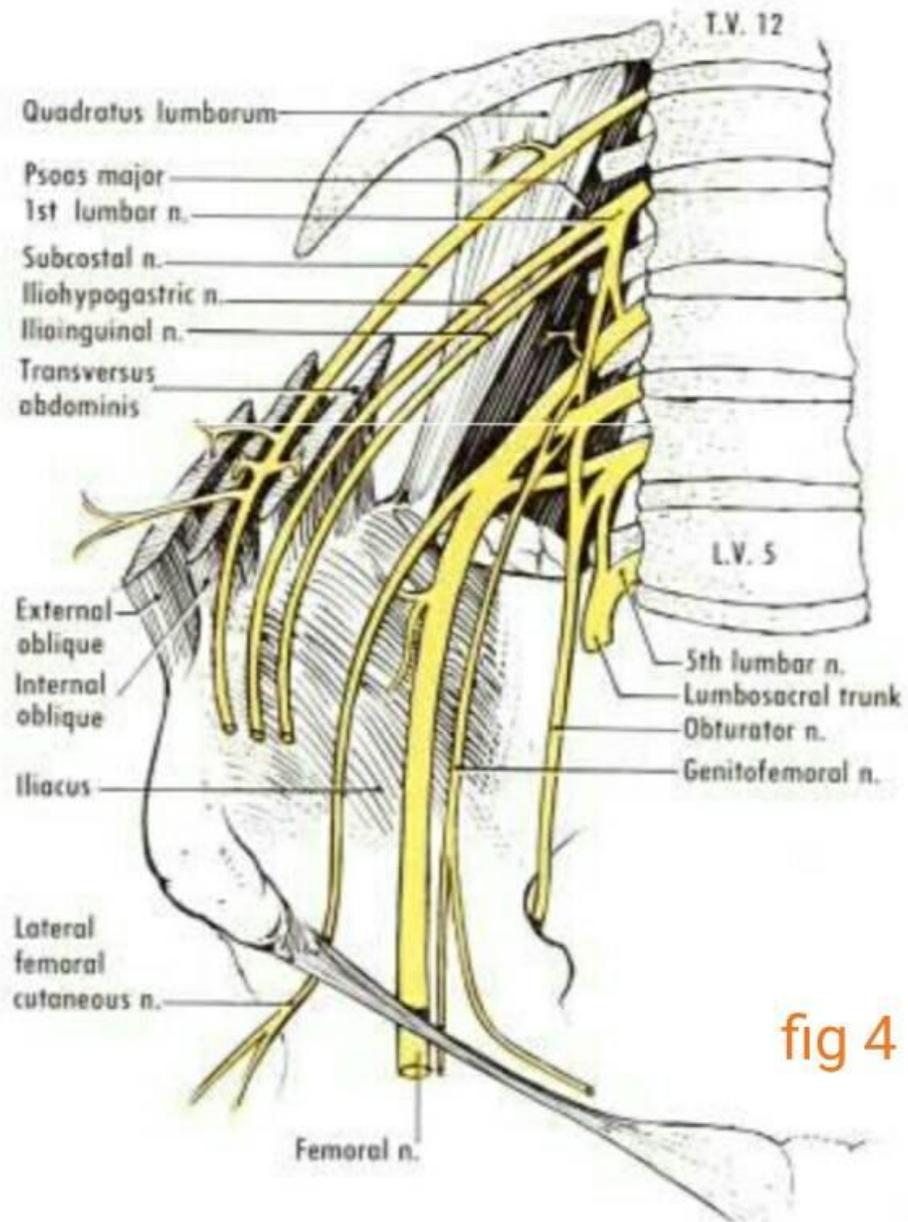


fig 4

In Figure 4 you can see :

- ➔ The subcostal nerve : its root value is T12 and the is why its subcostal since it is originally an intercostal nerve (Thoracic nerve) , the name subcostal exactly comes from the fact that the nerve is located below the last rib thus **Subcostal**.
- ➔ The Iliohypogastric nerve
- ➔ The Ilioinguinal nerve
- ➔ Lateral Cutaneous Nerve Of the Thigh : L2,L3 , Next to ASIS , goes into the inguinal ligament .
- ➔ Femoral Nerve : From posterior divisions of anterior primary ramus of L2,L3,L4.
- ➔ Obturator Nerve : From anterior divisions of anterior primary ramus of L2,L3,L4.

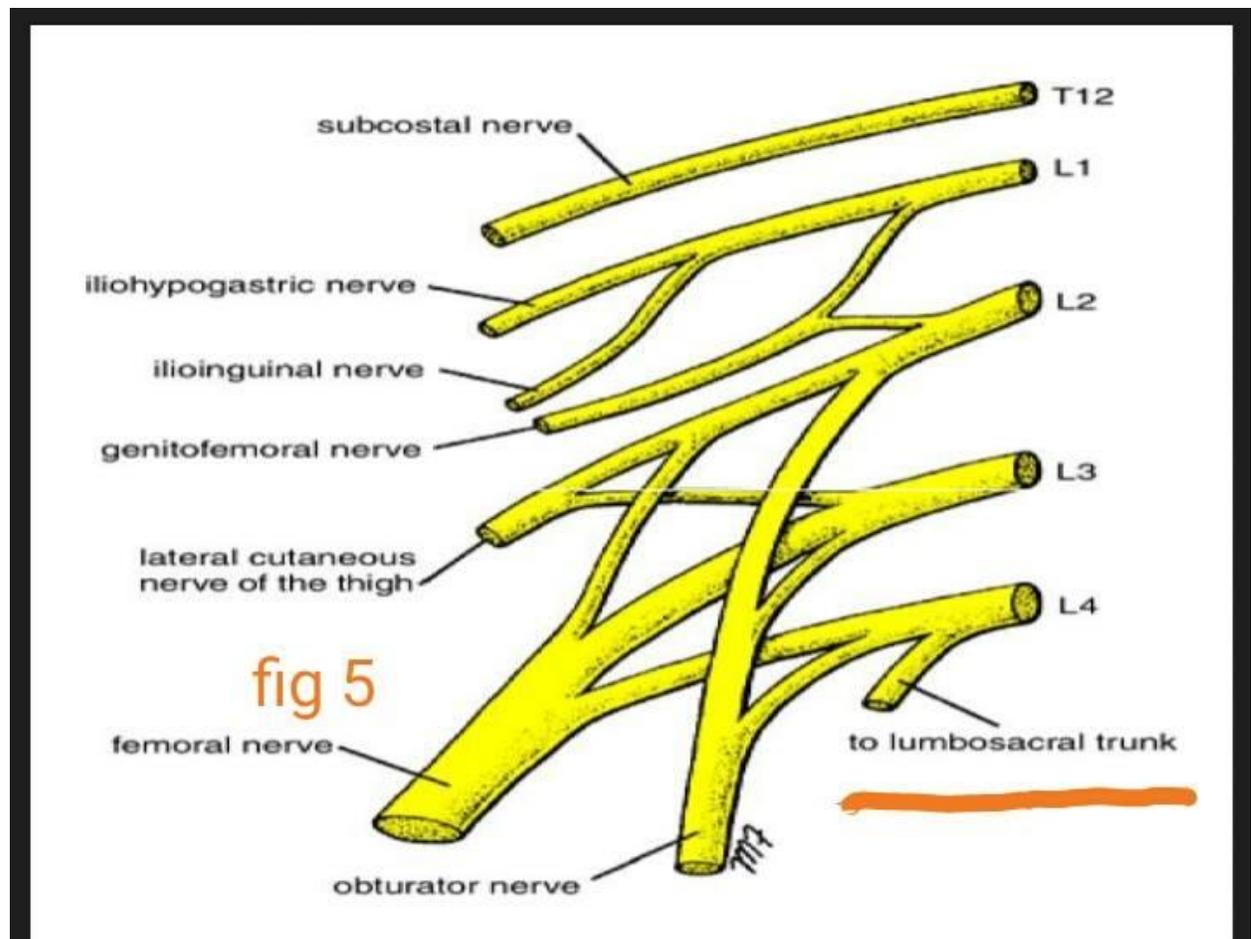


Figure 5 in the previous page shows:

- ➔ the roots of each nerve clearly .
- ➔ The Lumbosacral Plexus : it is formed by nerves from the lumbar ,sacral and coccygeal plexuses . we are concerned with the Lumbar participations which are L4&L5 . L4 gives a branch to the plexus but L5 participates completely in the plexus , now these two parts of lumbar plexus descend down to the ala of the sacrum ,meet the sacral participants (firsrt one is S1) to form the Lumbosacral plexus.

The sympathetic trunk in the abdominal part

In Figure 6 , this is the spinal cord in the spinal canal inside the vertebrae , it starts from the base of the skull and continues until it terminates between L1 and L2 , but the spinal nerves they continue until the coccyx , as one pair of coccygeal nerves .

The sympathetic chains are located on the sides of the vertebral column and contain ganglia called the (sympathetic ganglia),the chains' function is to give sympathetic fibers to the spinal nerves . **check figure 7**

The nerve that is coming out of the spinal cord through the spinal nerve, and reach the ganglion to synapse is called the white ramus , thus it is going **into** the ganglia .Consequently called a preganglionic fiber , these contain afferent (sensory) fibers and are heading to the ganglia.

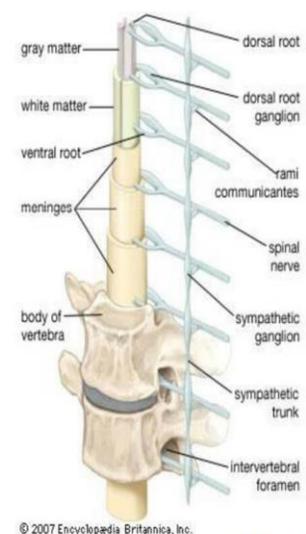
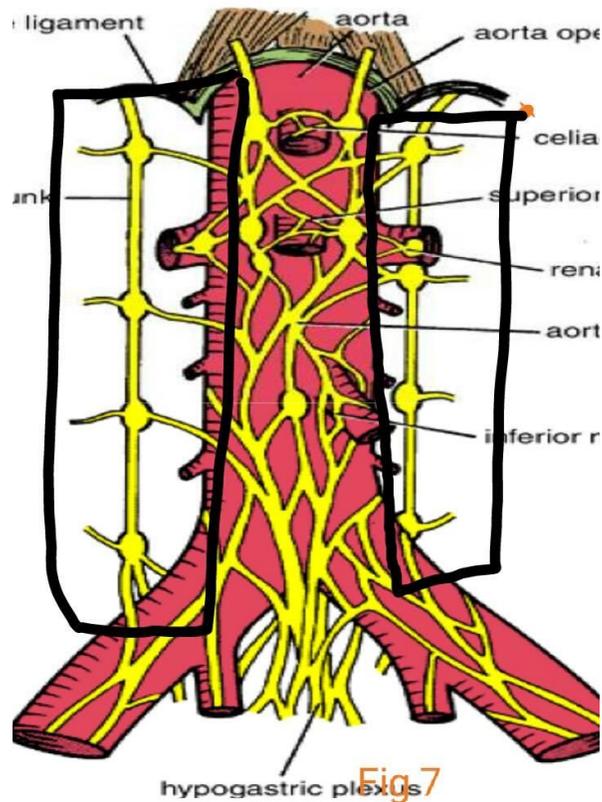
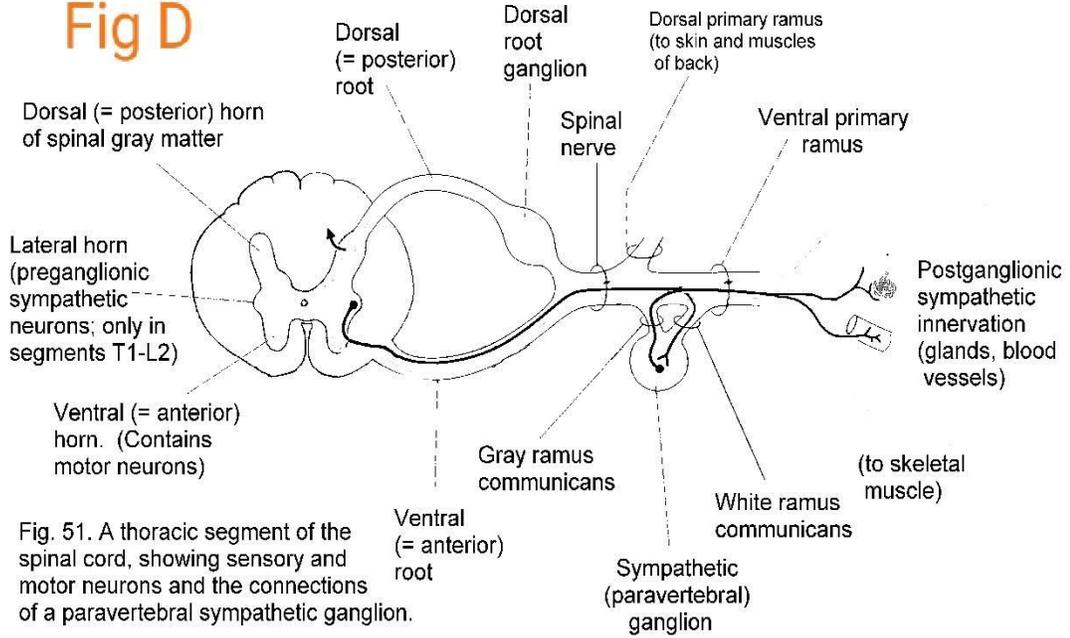


Fig 6

The one that is coming **out** of the ganglion , it is postganglionic ,also sympathetic and heading to blood vessels ,sweat glands and errector pilli mucle of the skin, is called the gray ramus . **Check figure D**

Fig D



In the abdomen we have both right and left sympathetic trunks , the right is found behind the the right border of the inferior vena cava (behind its edge) , it is hiding there thus not visible . On the other hand , the left is found next to the left border of the aorta , visible on the edge of it .**Figure 8 shows the visible left trunk on the border of the aorta , the right one is visible since the IVC is not shown in the figure but is supposed to be covering it .**

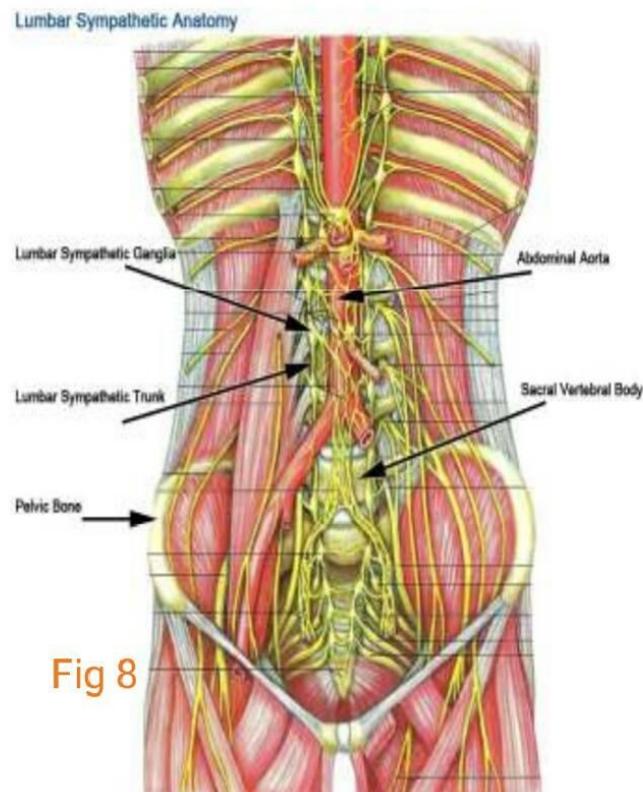


Fig 8

How many ganglia do we have in the abdomen (called abdominal sympathetic ganglia)?

They are four to five in number .

Origin of the sympathetic trunk

Introduction:

→ We already know that the ANS is mainly composed of sympathetic and parasympathetic nerves , and always if one of them is functioning in a certain time on a certain organ the other is not , let us take the heart and blood vessels for example.

If the sympathetic component acted on the heart , tachycardia (an increase in heart rate) occurs , and at that time the parasympathetic component is not functioning at all . And if the parasympathetic started functioning , the opposite happens which is bradycardia .

In blood vessels the same concept is applied , with sympathetic fibers causing vasoconstriction thus increasing of blood pressure , and the parasympathetic fibers cause vasodilatation thus lowering blood pressure .

→ Neural anatomy in brief :

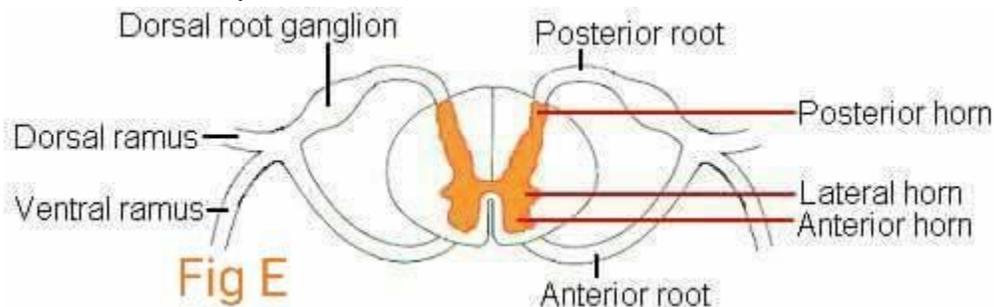


Figure E shows a cross section in the spinal cord , the dark area (butterfly-shaped) , is called the gray matter and is compose of horns , Anterior or ventral , posterior or dorsal , and a lateral horn .

The lateral horn is exclusive and only present in thoracic and upper lumbar segments of the spinal cord , but the ventral and dorsal horns are common in all segments.

Origin of the sympathetic trunk

Now, the origin of the sympathetic trunk is from the **lateral horn** of spinal nerves from the segments T1-T12 in addition to the first two lumbar segments L1, L2. Thus, the origin is called a thoracolumbar origin (all the thoracic segments + two lumbar).

Since the spinal cord is divided into 31 segments, according to spinal nerves, and the sympathetic trunk originates from the thoracic (12) and lumbar (2), the spinal nerves containing sympathetic fibers are 14 in number, these sympathetic fibers synapse in the sympathetic ganglia and are called preganglionic, white ramus.

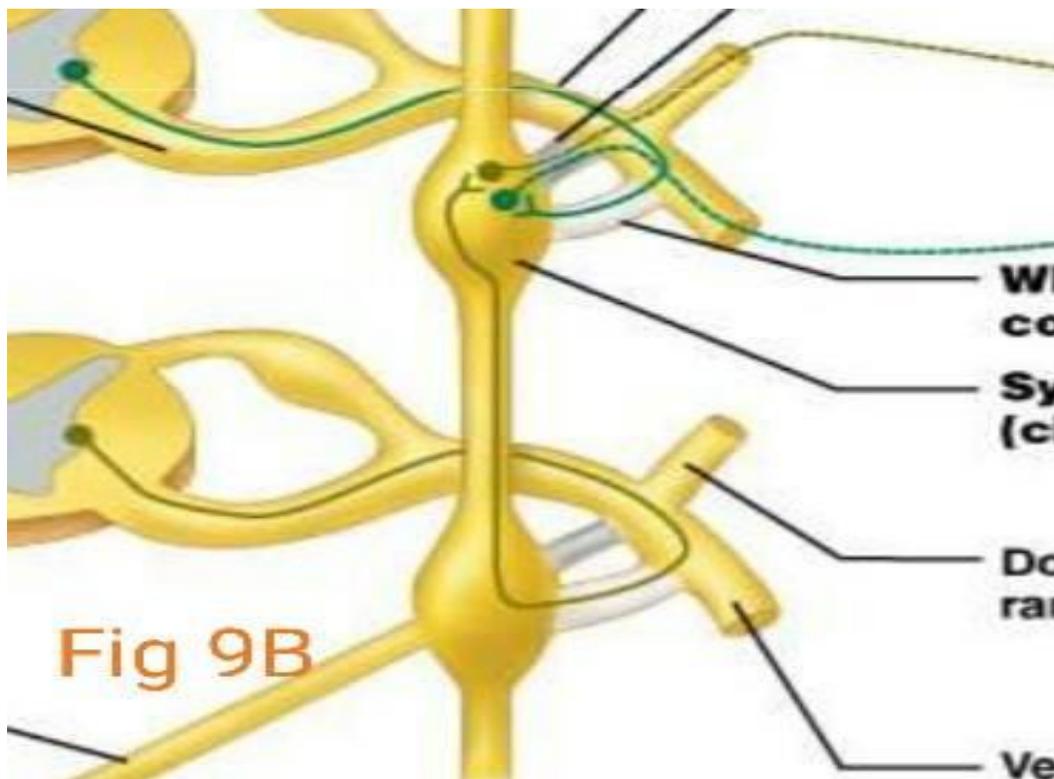
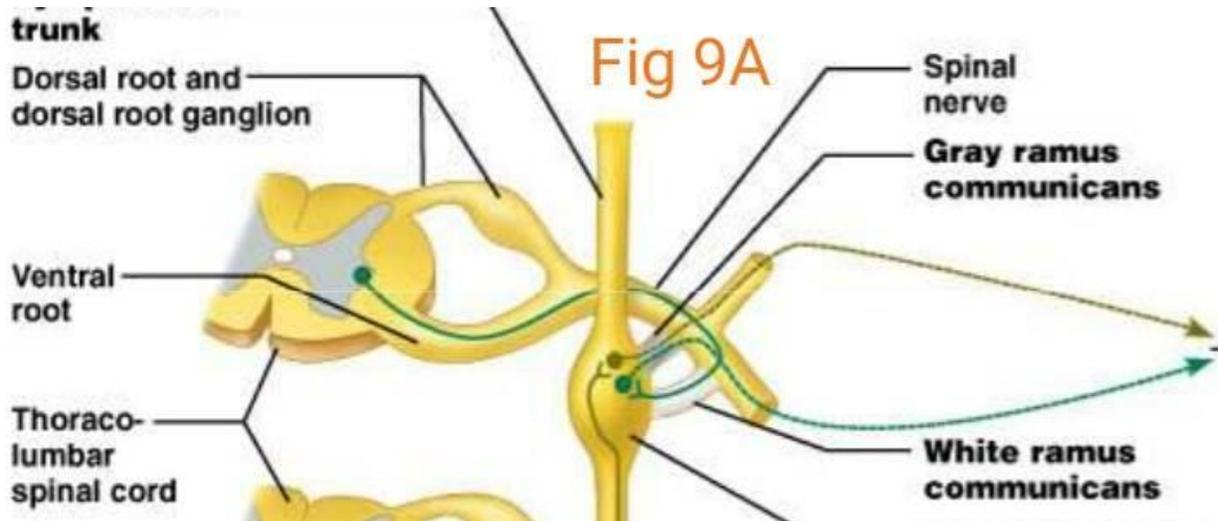
After leaving the ganglia they are called postganglionic sympathetic fibers (Grey ramus).

Only (T1-T12 + L1, L2) give sympathetic preganglionic (white rami), but postganglionic sympathetic fibers (gray rami) are present in the entire spinal cord thus exceeding the white rami in number. These postganglionic sympathetic fibers go to **blood vessels** (mainly) effecting their smooth muscles of the wall and permitting their contraction leading to vasoconstriction, **sweat glands** and **erector pili** muscle in the skin.

- ➔ The preganglionic fibers are out of the lateral horn of grey matter, go through the ventral root towards the spinal nerve, then they have multiple ways to synapse:
- ➔ A- synapse in a corresponding ganglion, meaning that the fiber is out of L1 to synapse in the ganglion number one, Check figure 9A
- ➔ B- Ascend upwards or descend downwards toward another ganglion. Check figure 9B.

Regardless of the type of synapsing, they are still called preganglionic fibers, and after the synapse takes place, we can call them postganglionic fibers.

→ Notice that the synapsing occurred in the sympathetic chain. We will discuss another location where synapse occurs, so keep this in your mind for now.



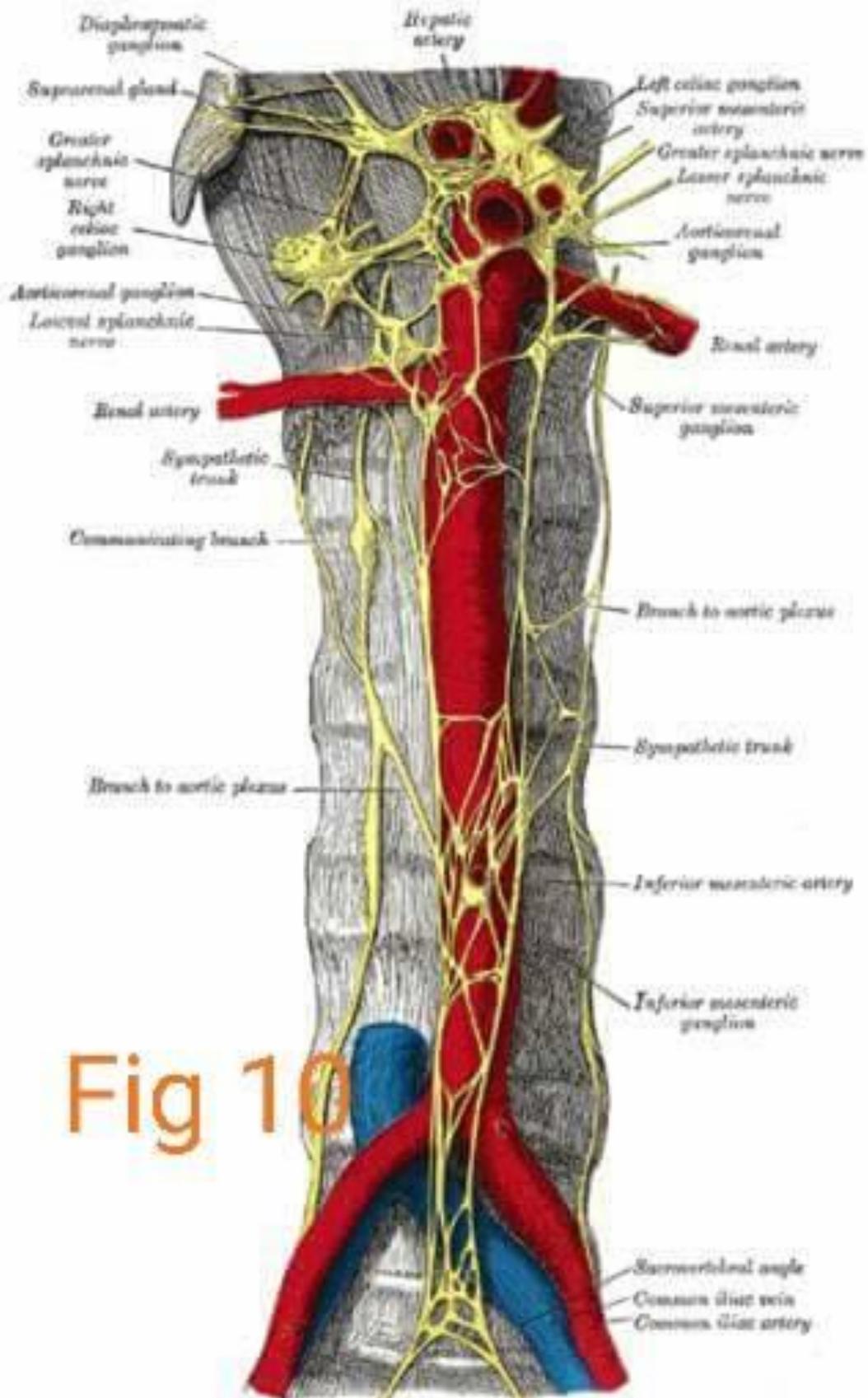


Fig 10

Figure 10 in the previous page is important since the doctor focused on it :

- ➔ It shows the sympathetic chains , right and left .
- ➔ Has ganglia through out the trunks
- ➔ The right trunk is located behind the IVC
- ➔ The left trunk is on the lateral side of the edge of aorta .
- ➔ Starts from the head to the chest then abdomen and descends down to the pelvis , **note that in the pelvis** , it is deep to the common illiac vessels , and on the sides of the IVC and abdominal aorta .

-
- ➔ The number of ganglia in the cervical (neck) region is three and they are called superior , middle and inferior cervical sympathetic ganglia .

S.C.S.G : superior cervical sympathetic ganglion

I.C.S.G : inferior cervical sympathetic ganglion

M.C.S.G : middle cervical sympathetic ganglion

spinal and cranial nerves go through them towards the head and neck regions , in addition to the chest region .

- ➔ The number of ganglia in the thoracic region is from 10-12 , in the lumbar 4 or 5 , in the sacral 4 or 5 and in the coccygeal region it is only one ganglion called the ganglion impar .
nerves go through them towards the abdomen and pelvis .

The Aortic plexus

Is the plexus present around the aorta , the word plexus means that it receives parasympathetic fibers coming from the vagus nerve , and sympathetic fibers from either L1 and L2 that are the only sympathetic segments in the abdomen, or from the chest through the splanchnic nerves.

The splanchnic nerves :

The word splanchnic means sympathetic fibers coming from the chest towards the abdomen and synapse around the celiac ganglia in the celiac trunk , or around the inferior , superior mesenteric ganglia present in the inferior mesenteric artery and superior mesenteric artery , respectively .(explanation of these ganglia starts from page 19 so do not confuse yourself).

1-the greater splanchnic nerve :

- Arise from ganglia (T5-T9) or T10.
- Pierces the cruss of the diaphragm.
- End in the celiac ganglia.
- Postganglionic fibers follow the branches of celiac artery (will be explained) artery to reach the smooth_muscle , gland of stomach , liver and lower end of the esophagus .

2- the lesser splanchnic nerve :

- Arise from the T9,T10 ganglia
- Pierces the cruss of diaphragm.
- End in the superior Mesenteric Ganglia.
- Postganglionic fibers are distributed with branches of Sup. Mesenteric artery and supply the smooth muscles, glands of small intestine, ascending colon until the lateral third of the transverse colon (end of midgut).

3-the lowest Splanchnic :

May be absent, if present arises from the last one or two thoracic ganglia

- Pierces the diaphragm to end in renal plexus (specifically to

The suprarenal gland since it needs sympathetic and parasympathetic fibers).

4- Lumber splanchnic branch

- Arise from L1& L2 ganglia
- *Ends in inferior mesenteric ganglia*
- Post. Ganglionic fibers go to sigmoid and pelvic colon, other post. Ganglionic fibers form the descending hypogastric plexus to supply bladder, rectum and genitalia
- **Branches from sacral part of the chain go to pelvic viscera.**

you might notice that the explanation of splanchnic nerves is not that much different from that written in the slides , since the doctor went through them rapidly .

Going back to the Aortic Plexus :

Aortic plexus is divided into : 1. **Celiac plexus** : found around the celiac trunk and its branches . 2. **Superior mesenteric plexus** : around the superior mesenteric artery and its branches . 3. **Inferior mesenteric plexus** : around the inferior mesenteric artery and its branches . 4. **Renal plexus** : around the renal vessels.

Check Figure F

The Celiac Plexus:

- ➔ We have something called celiac ganglia , these ganglia receive greater and lesser splanchnic nerves that are preganglionic ,from the chest , the postganglionic fibers emerge out of the ganglia and accompany the celiac artery and its branches to supply the organs as shown in **Figure F**.
- ➔ **Parasympathetic fibers are from the vagus nerve , they also accompany the celiac artery and its branches .**

The Renal plexus :

→ From its name we conclude that is located around the renal blood vessels and going mainly towards the suprarenal gland , above the kidney . It is smaller than the celiac plexus , the sympathetic fibers follow the arterial branches .

→ **Parasympathetic fibers from the vagus nerve .**

The doctor did not give that much detail about the renal plexus , probably because we will be discussing it later in its related system .

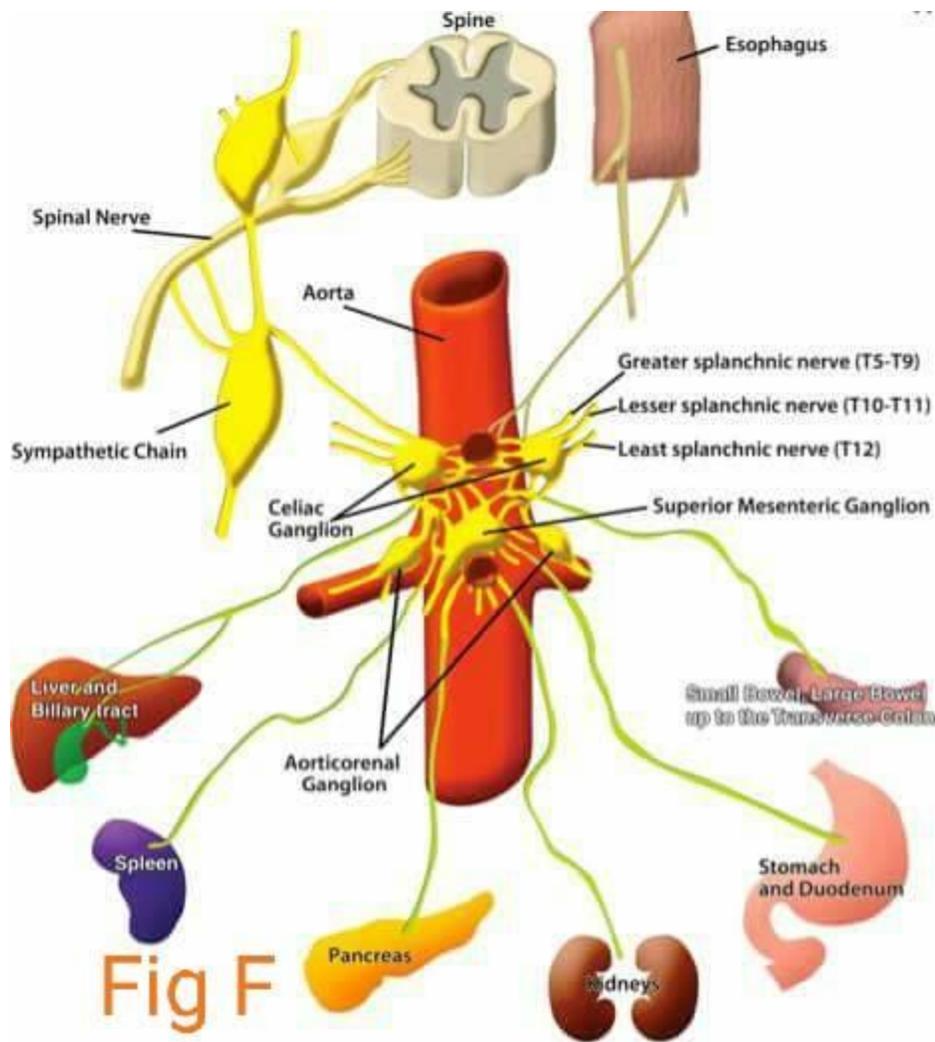
Superior and Inferior mesenteric plexuses :

→ They are both very similar except for the fact that the inferior which supplies the hindgut receives parasympathetic fibers from the sacral nerve (S2,S3,S4) , while the superior which supplies the midgut receives it from the vagal nerve .

These ganglia (Celiac , inferior mesenteric and superior mesenteric)are called preaortic ganglia , since they are located in front of the abdominal aorta , though totally different from the sympathetic chain , their fibers are also sympathetic , just like it . *Thus we conclude that we have two sources of sympathetic fibers :*

→ The sympathetic chain

→ The Aortic plexus



Remember when we talked about the synapse occurring in the sympathetic chain? Now it is the time to talk about the other location outside the sympathetic chain, called prevertebral ganglia. Please refer to Figure 11 in the next page.

If the synapse was not in the sympathetic chain, the fibers synapse in the preaortic (prevertebral ganglia).

As you see in the figure, the preganglionic nerves are splanchnic nerves; they synapse in the prevertebral ganglia, then emerge as postganglionic nerves going to the foregut and midgut.

Called preaortic since they are anterior to the aorta and prevertebral since they are also anterior to the vertebrae.

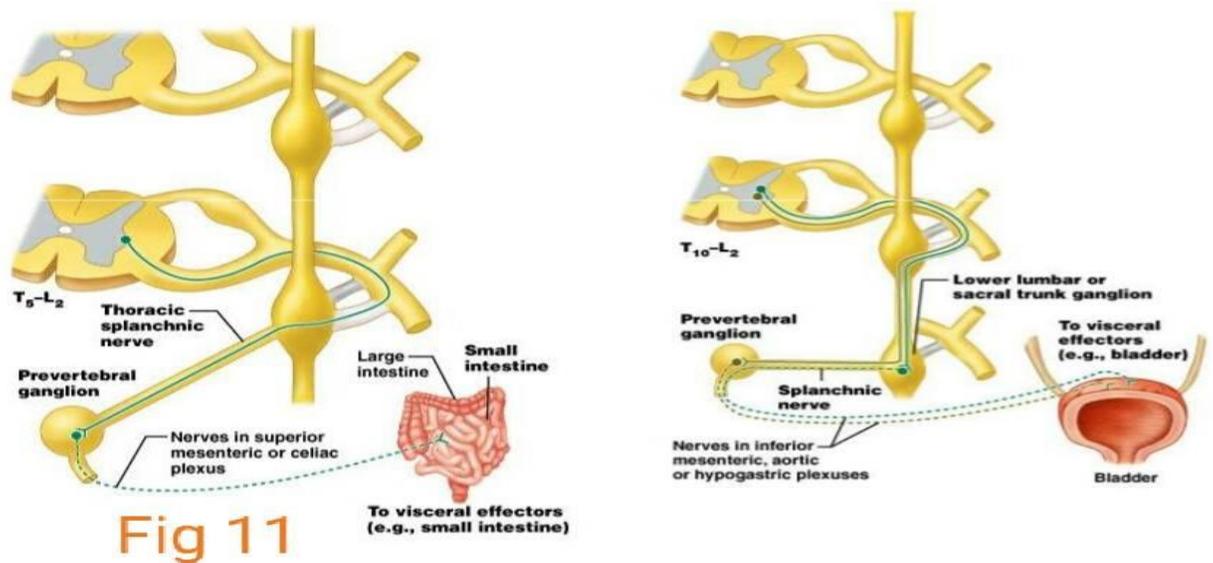


Figure 11 (sorry if it is not that clear , kindly refer to slide 19)

- ➔ The left side is explained in the previous page .
- ➔ In the hindgut the story is a bit different , since the parasympathetic fibers are recieved from the sacral plexus , notice that the synapse did not take place in a corresponding vertebral ganglion , but instead , the sympathetic fiber descended downward to synapse in a lower ganglion and finally emerged as nerves going to the urinary bladder **called Inferior mesenteric or hypogastric plexus of nerves .**

Now go back to page 15 Figure 10 and read these related notes :

Look to the top of the figure

- ➔ You can see the celiac artery and superior mesenteric arteries and each is surrounded by two ganglia called preaortic ganglia , each 2 are connected by a large network of fibers , these ganglia are sympathetic thus replacing the sympathetic chain present on both sides of the vertebral column , and note on the upper right how the splanchnic nerves synapsed with them .

Before moving to another important concept , go back to page 13 Figure E , and make sure you are able to distinguish between the following parts since the doctor repeated them twice :

→ the grey matter and its horns , sympathetic fibers emerge from the lateral horn.

→ The dorsal root ganglia on the dorsal (posterior root)

→ The ventral root

→ The spinal nerve and its anterior and posterior divisions

→ The gray and white rami

there is a note mentioned in the slides but not in the lecture , but is good to know , which is that the white rami are white since they are myelinated (recall that the myeline sheath is composed of fat tissue) , and the gray rami appear gray since they are unmyelinated .

The Visecral Nerves (Important)

→ Going to visecra ,accompany internal and external carotid arteries , take from S.C.S.G and by following the blood vessels they reach their target , recall the parotid and submandibular glands , and the lacrimal gland .

→ Around the pharynx we have pharyngeal branches also from S.C.S.G

→ Pulmonary and cardiac nerves both take from the thoracic and cervical ganglia (*in the slides it is mentioned that that only the cardiac nerves take from the cervical in addition to the thoracic ganglia , but the doctor said that they both do take from them.*)

→ Splanchnic nerves : coming from the chest to the abdomen.

The thoracic sympathetic chain :

Check figure 12 (slide 26)

We already said that we have a thoracic spinal chain :

- Has 10-12 ganglia
- If fused with I.C.S.G it is then called the *stellate ganglia*.
- Each ganglion has its gray and white rami going mainly to the heart and pulmonary system . Around the esophagus it forms the esophageal plexus , and a pulmonray and cardiac plexus around the trachae and the heart , respectively .
- Sends splanchnic nerves to the abdomen.

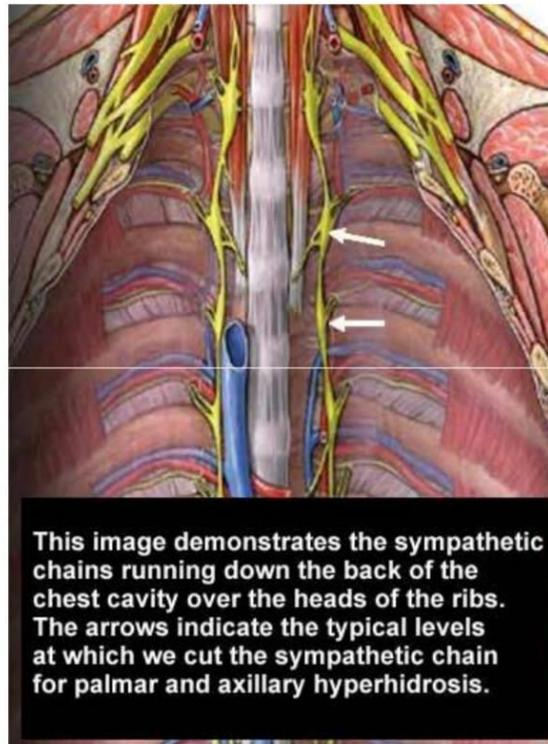


Fig 12

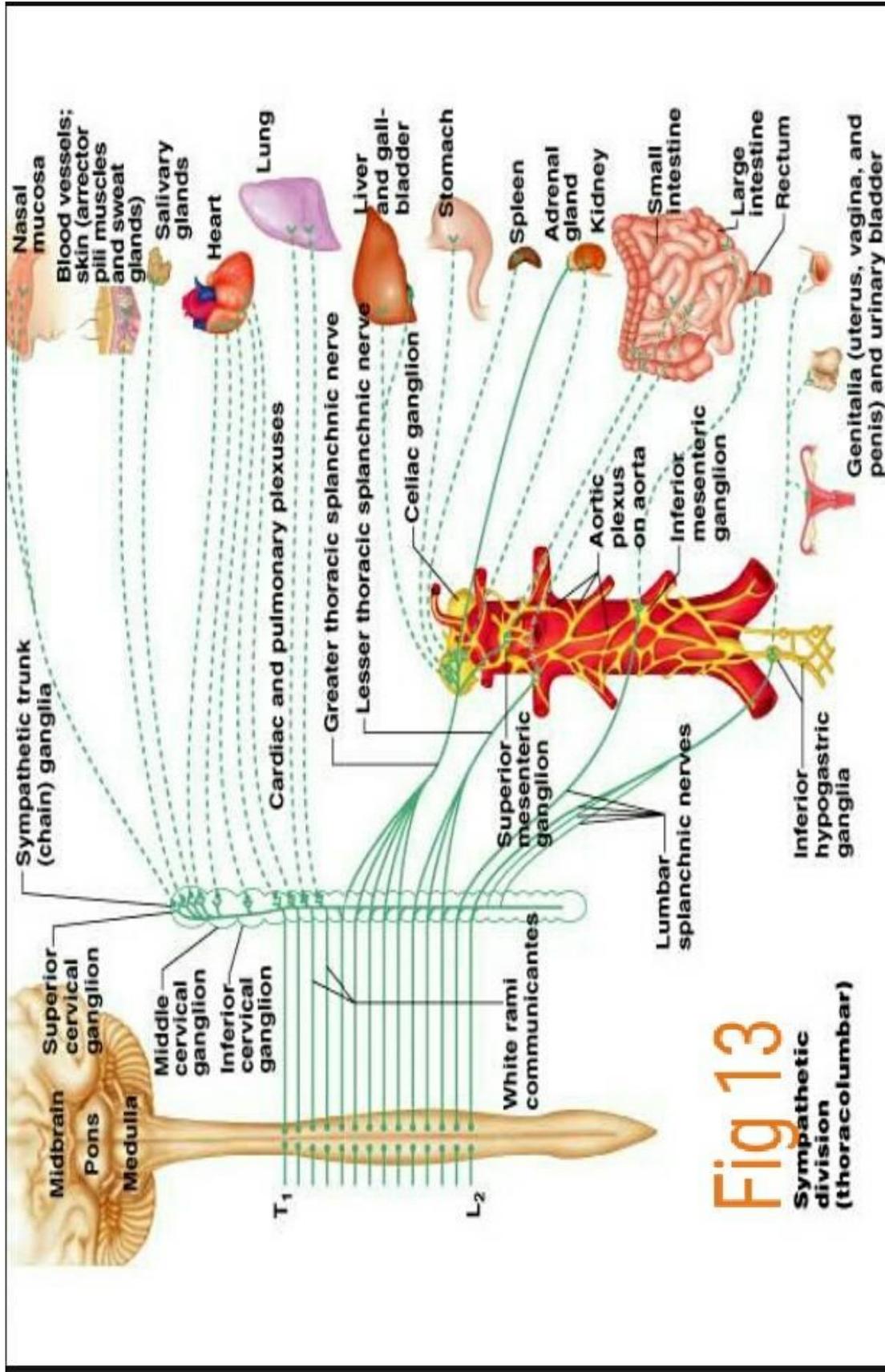


Fig 13
Sympathetic division (thoracolumbar)

Figure 13 above is such a great summary , and the doctor mentioned it :

- ➔ We have thoracic sympathetic fibers that start from T1-L2 out of the lateral horn of grey matter of the spinal cord , the line is the preganglionic fibers (white rami) and they are 14 in number .
- ➔ In the cervical region notice we have 3 ganglia , then thoracic , then abdominal , then pelvic .
- ➔ The splanchnic nerves go to the celiac , inferior and superior mesenteric ganglia and form the aortic plexus of nerves , and downwards we have the inferior hypogastric plexus of nerves .
- ➔ Notice that all organs in the body receive sympathetic and parasympathetic fibers .

The very last note is that the preganglionic fibers are short and the postganglionic are long in the sympathetic fibers . The exact opposite is in the parasympathetic with the short postganglionic present in the walls of the organ (synapse with myenteric plexus).

*the last slide is just a summary that will be discussed in the CNS later

The lecture is over ..

I hope you guys enjoyed studying this sheet , sorry for any mistake , wish you a life full of A's .. and please tell me your feedback about the sheet so I can improve in the next times !

Shout out to Ghada Qahtan & Raghad Jabbar