Editing File

Lecture 4:

Autonomic Nervous System

- Main text
- Red : Important
- Pink : in girls slides only
- Blue : in boys slides only
- Green : Doctors Notes
- Grey : Extra info

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Objectives

At the end of the lecture , students should be able to:

- Define the **autonomic** nervous system.
- Describe the **structure** of autonomic nervous system.
- Trace the **preganglionic** & **postganglionic** neurons in both sympathetic & parasympathetic nervous system.
- Enumerate in brief the **main effects** of sympathetic & parasympathetic system.

Nervous system

Peripheral nervous system (PNS)

- Sensory division
  - Visceral sensory division
  - Somatic sensory division
    for example (skin)
- Motor division
  - Visceral motor division (**Autonomic nervous system**)
    for example (glands)
    - **Sympathetic**
    - **Parasympathetic**
  - Somatic motor division
    for example (muscles)

Central nervous system (CNS)

- Brain

- Spinal cord

We will talk about this part

Autonomic nervous system

The Autonomic nervous system is concerned with the innervation and control of Involuntary structures such as visceral organs , smooth muscles , cardiac muscles and glands .

Visceral organs : referring to the viscera , the internal organs of the body , specifically those within the chest (as the heart or lungs) or abdomen (as the liver , pancreas or intestines).

Function	Maintain homeostasis of the internal environment along with the Endocrine system
Location	Central nervous system and peripheral nervous system
Regulation	Controlled by hypothalamus . Note: hypothalamus controls both of Autonomic system and Endocrine system

Note: The autonomic system and endocrine system both maintain homeostasis of the internal environment.

Autonomic nervous system

Unlike the somatic nervous system , the **Efferent pathway** of the autonomic nervous system is made up of **two neurons** cells classified as:

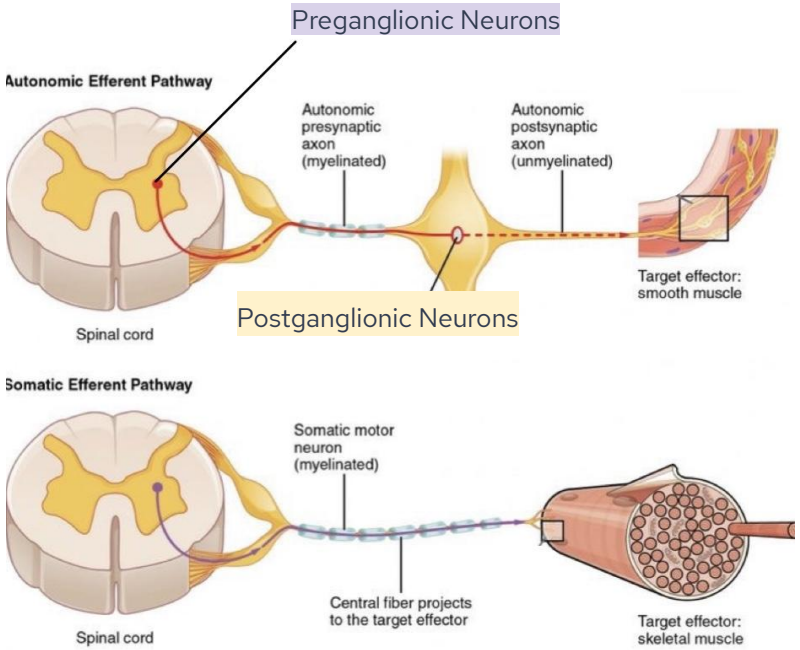
Preganglionic

The cell bodies are located in the brain and spinal cord (Inside CNS)

Postganglionic

The cell bodies are Located in the autonomic ganglia (Outside CNS)

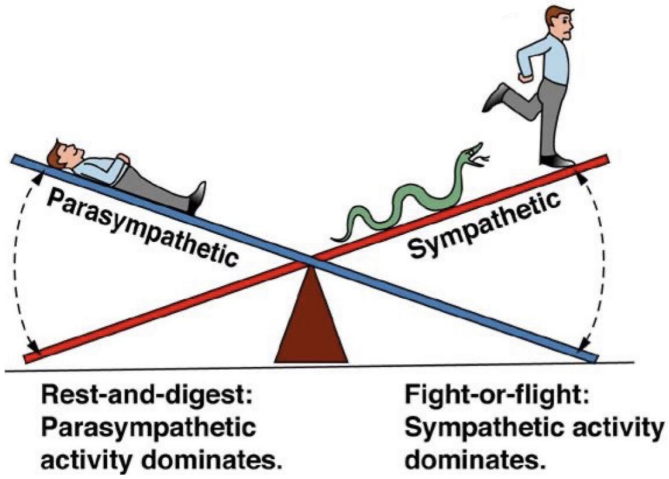
Preganglionic axons synapse with the postganglionic neurons.



Autonomic nervous system

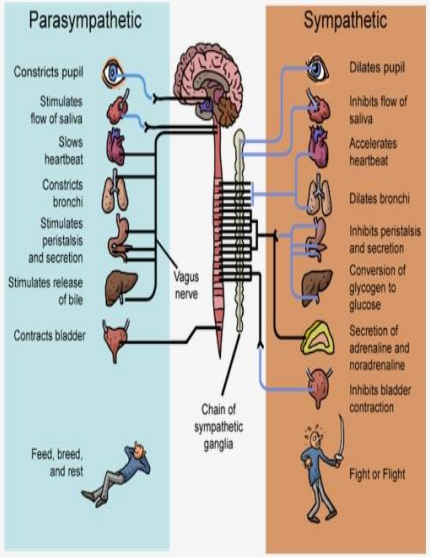
Based on the anatomical, physiological and pharmacological characteristics , the autonomic nervous system is divided into :

Sympathetic	Parasympathetic
Activated during exercise, excitement and emergencies. “Fight, or Flight”	Concerned with **conserving energy.** “Rest and digest”



Both divisions operate in conjunction with one another (have **antagonistic** control over the viscera) and aim at maintaining a stable internal environment

	Sympathetic effect	Parasympathetic effect
Iris of the eye(pupils)	Dilates pupil	Constricts pupil
Ciliary muscle of the eye	Relaxes	Contracts
Salivary Glands	Reduces secretion	Increases secretion
Lacrimal gland (الغدة الدمعية)	Reduces secretion	Increases secretion
Heart	Increases rate and force of contraction	Decreases rate and force of contraction
Bronchi	Dilates	Constricts
Gastrointestinal tract	Decreases motility	Increases motility
Sweat glands	Increases secretion	No effect
Erector pili muscles (attached to hair follicles)	Contracts	No effect

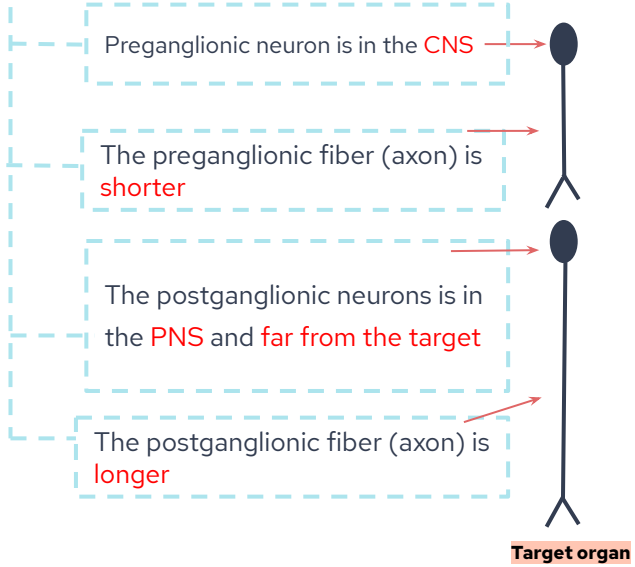


Sympathetic inhibit gland secretion **except** for **Sweat gland**

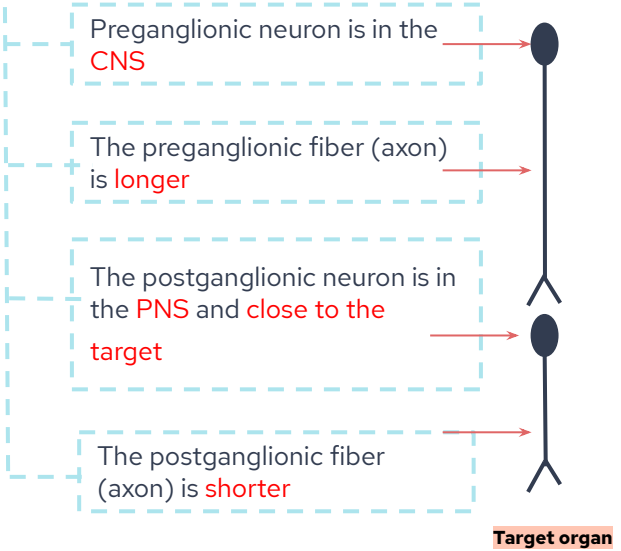
Autonomic nervous system

A helpful video

Sympathetic



Parasympathetic



Note 438: the cause of preganglionic (white) and postganglionic (grey) fibers having different colors is the myelin sheath that the preganglionic fibers (white) are sheeted with. Myelin helps isolate preganglionic fibers for faster transportation. (تخليه معزول اكثر ويوصل أسرع)

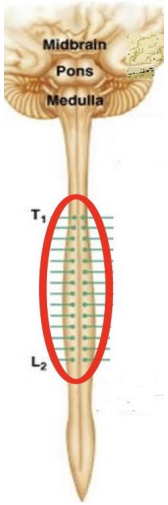
Sympathetic division

1-Preganglionic Neurons:

Located in the lateral gray horn of T1-L2 segments of spinal cord

(ThoracoLumbar outflow)

Outflow: the passage of impulses outwardly from the central nervous system



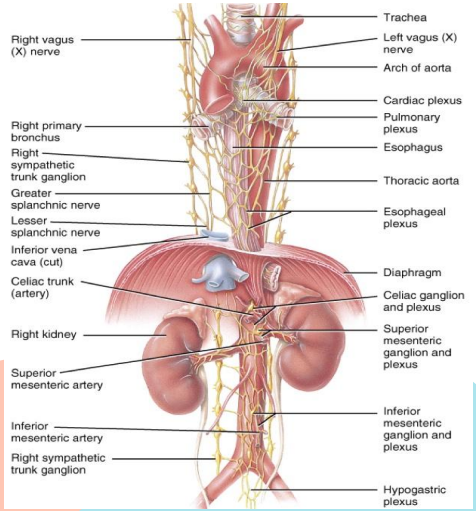
IMPORTANT NOTE (439): Sympathetic neurons only found in spinal cord

2-Postganglionic ganglia:

Located nearer to the central nervous system as:

1- Prevertebral is the celiac and mesenteric (in front of vertebral)

2- Paravertebral forming sympathetic chain (next to parallel)



Paravertebral Ganglia

Series of Ganglia parallel to the vertebrae.

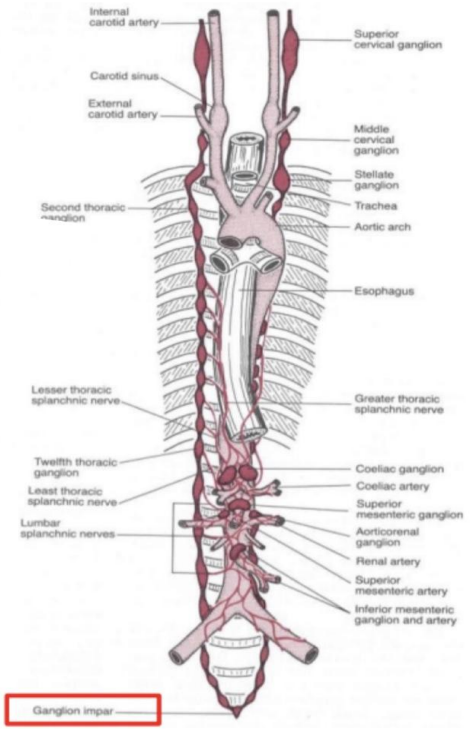
They are interconnected to form **2 sympathetic chains** , one on each side of vertebral column.

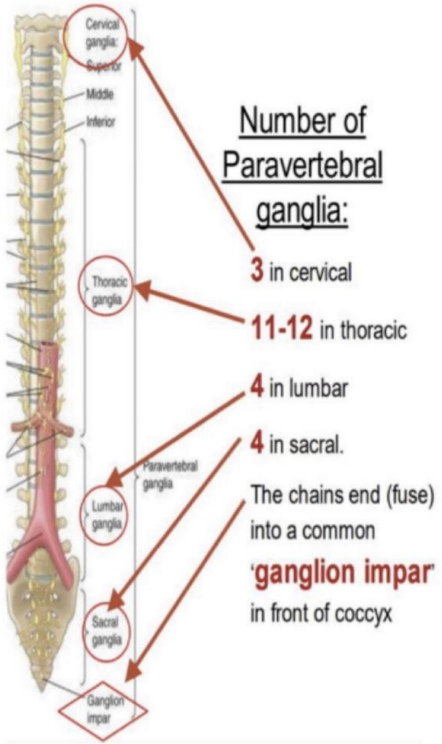
Number of ganglia:

3 in Cervical part of chain

11-12 in Thoracic part

4 in Lumbar & Sacral parts **each**

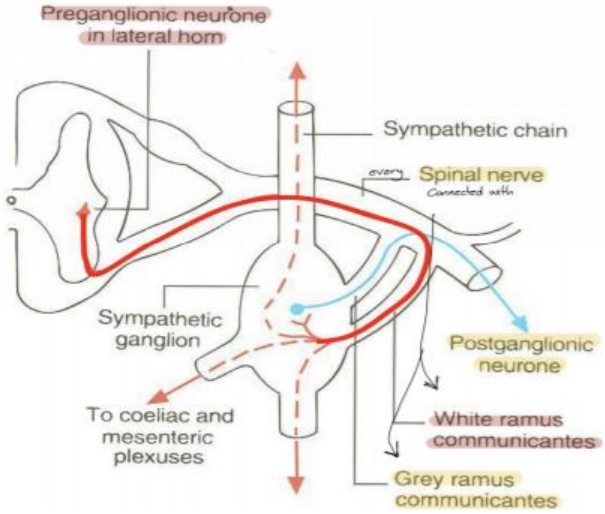




The chains end into a common **"Ganglion impar"** in front of coccyx.

Preganglionic fibers

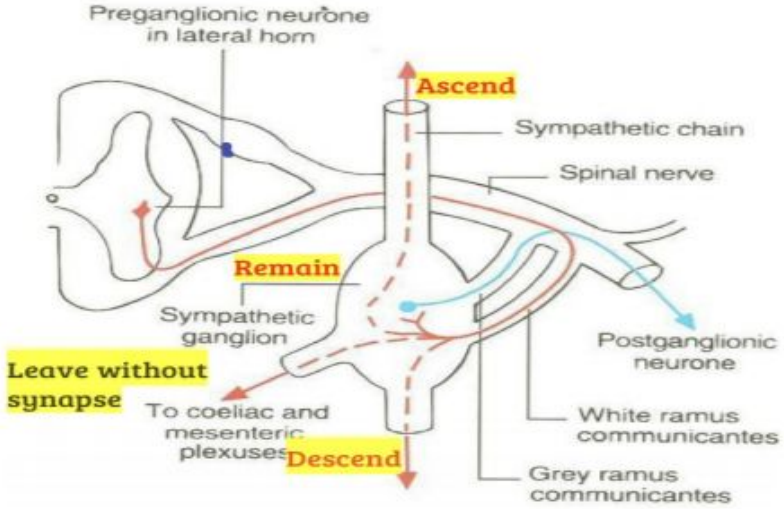
- Are the fibers between the preganglionic neuron and the postganglionic neuron.
- Run in the ventral roots of the spinal nerve
- Travel through the spinal nerve, and then join the sympathetic chain via the White Rami Communicantes (WRC)



Routes of Preganglionic fibers:

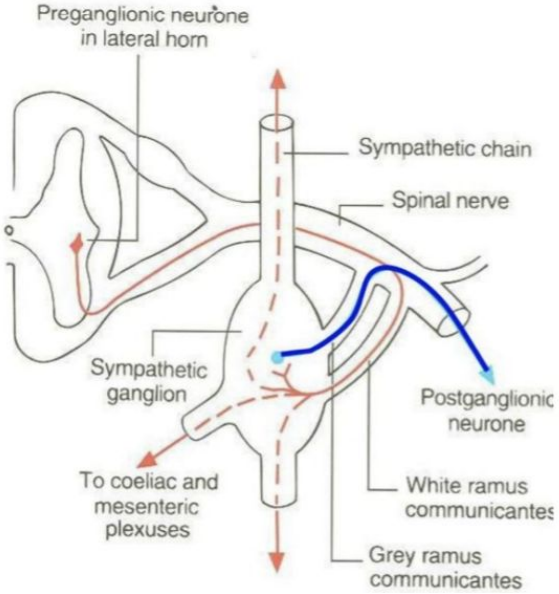
1. **Ascend, descend or remain at the same level** to synapse with neurons (postganglionic) of **paravertebral** ganglia located in sympathetic chain.

2. **Leave the sympathetic chain** (without synapse) to reach **prevertebral** ganglia (coeliac & mesenteric ganglia)(around branches of abdominal aorta) to synapse with their neurons (postganglionic).



Postganglionic fibers

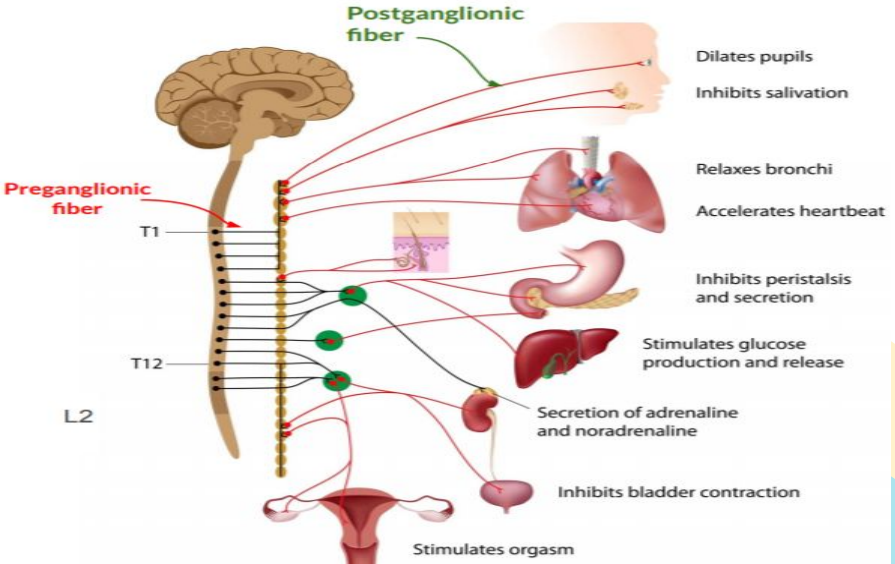
- Are the fibers between the prevertebral/paravertebral ganglions and their targeted organs.



Routes of Postganglionic fibers:

1. Fibers from the sympathetic chain enter again into the spinal nerve through Grey Rami Communicantes (GRC), to supply **structures in the head, thorax + blood vessels and sweat glands.**

2. Fibers from the cells of coeliac & mesenteric ganglia supply **abdominal & pelvic viscera.**



Parasympathetic division

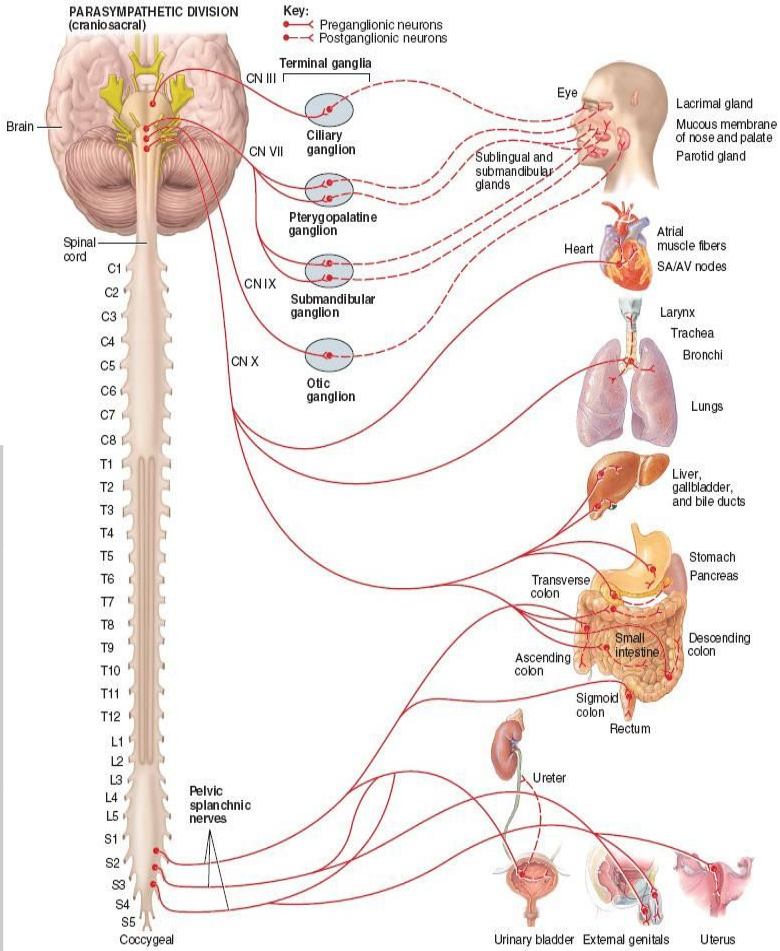
Note: Postganglionic neurons are cells of those underlined

Preganglionic neurons

The Nuclei of the 3rd, 7th, 9th & 10th cranial nerves, in the brain stem **(Cranial outflow)**

The lateral gray horn of S2-S4 segment of spinal cord **(Sacral outflow)**

Fibers	Cranial outflow	Sacral outflow
Preganglionic	carried by 3rd, 7th, 9th & 10th cranial nerves to **ciliary, pterygopalatine, submandibular, otic & peripheral ganglia**	carried by pelvic **splanchnic nerves** to **peripheral ganglia** in pelvis where they synapse.
Postganglionic	target the organs of the head, neck, thorax, and abdomen	target the organs of the pelvis and lower abdomen



MCQs:

1- Which of the following aims at maintaining homeostasis?			
A-Endocrine system	B-Autonomic system	C-somatic system	D-A&B
2- The cell bodies of *all* preganglionic neurons are located in :			
A-Central nervous system	B- Spinal cord	C- Peripheral nervous system	D- T1-L2 segment of Spinal cord
3-The parasympathetic division is activated during:			
A-Exercise	B-fear	C- conserving energy	D-excitement
4-Which of the following is a sympathetic effect?			
A-Constricts pupil	B-Dilates bronchi	C- Increases secretion of saliva	D-Decreases heart rate
5- The preganglionic fibers of the sacral outflow synapse with:			
A-paravertebral ganglia	B-Peripheral ganglia	C-Head and neck	D-coeliac & mesenteric ganglia

Answers	
1	D
2	A
3	C
4	B
5	B

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