MED437
KING SAUD UNIVERSITY

ANATOMY
Team 437

Autonomic Nervous System

Fourth Lecture

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Revised by

- Text in BLUE was found only in the boys' slides
- Text in PINK was found only in the girls' slides
- **Text in RED is considered important**
- Text in GREY is considered extra notes

هذا العمل لا يغني عن المصدر الأساسي للمذاكرة

Please check our Editing File BEFORE studying this lecture

Objectives

- Define the Autonomic Nervous System.
- Describe the structure of Autonomic Nervous System
- Trace the Preganglionic and Postganglionic neurons in both Sympathetic and Parasympathetic Nervous System.
- Enumerate in brief the main effects of Sympathetic and Parasympathetic System.

Autonomic Nervous System

Nerve cells located in both Central & Peripheral nervous system that are:

Concerned with the innervation and control of involuntary structures such as; visceral organ, smooth & cardiac muscles and glands.

Function

- maintain homeostasis with the Endocrine system of the internal environment

Located:

- central and peripheral nervous systems.

Regulated (controlled) by

- Hypothalamus.

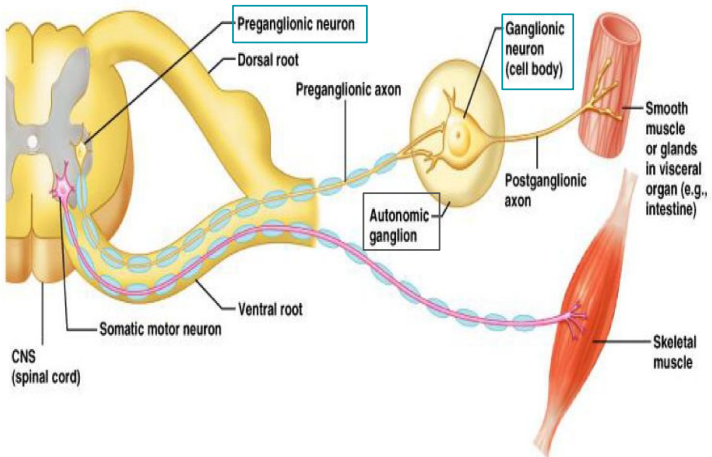
*Visceral organs: Referring to the viscera, the internal organs of the body, specifically those within the chest (as the heart or lungs) or abdomen (as the liver, pancreas or intestines).

*The hypothalamus: is located below the thalamus and is part of the limbic system. It forms the ventral part of the diencephalon.

Efferent pathway

Somatic Nervous System
"One Neuron"

Autonomic Nervous System
"2 Neurons".



Preganglionic

Cell bodies in brain and spinal cord

Their axons synapse with the postganglionic neurons

Postganglionic
Ganglionic neuron

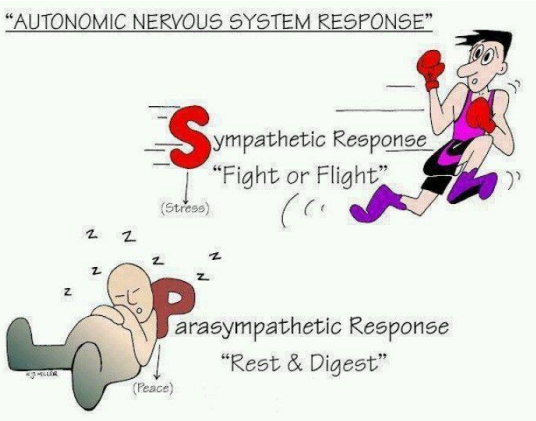
Cell bodies in the autonomic ganglia

Based on anatomical, physiological and pharmacological characteristics.
The AUTONOMIC NERVOUS SYSTEM is divided into :

Sympathetic	Parasympathetic
Activated during exercise, excitement and emergency. [Fight, Flight or Fright]	Concerned with conserving energy. [rest or digest]
 14–7 This man is making good use of the sympathetic part of us system.	 Figure 14–8 There is nothing like a good, large meal and a comfortable armchair to facilitate the activities of the parasympathetic part of the autonomic nervous system.

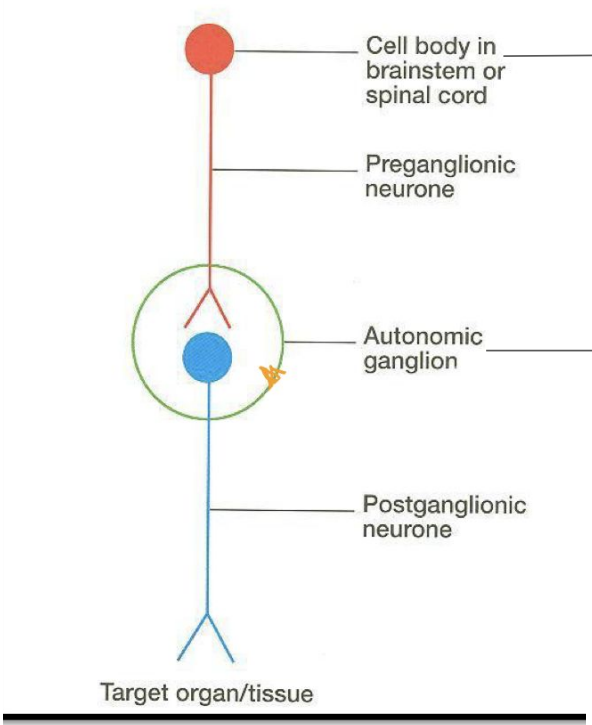
Both divisions operate in conjunction(بالتزامن) with one another [have antagonistic control over the viscera] to maintain a stable internal environment.

The two parts supply all structures in the body [under autonomic control]
In normal situations; two systems are in balance



**Sympathetic and Parasympathetic have counter (antagonistic) control,
E.g. In the salivary gland,
Sympathetic: reduce secretion of saliva.
Parasympathetic: increase secretion of saliva.

STRUCTURE OF AUTONOMIC NERVOUS SYSTEM



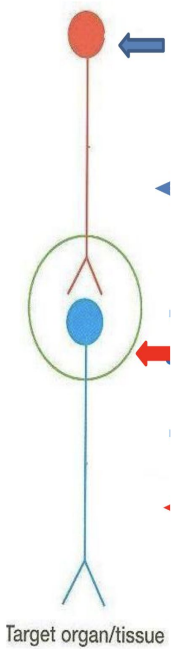
In the Central Nervous System

In the Peripheral Nervous System

Parasympathetic

Preganglionic neuron [**LONG axon**]

Postganglionic neuron [**SHORT axon**]



Cranial: cells in brain stem :nuclei of 3rd, 7th, 9th, and 10th

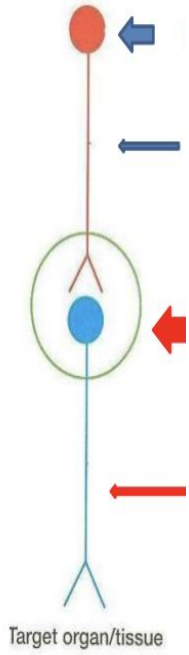
Sacral: cells in S2-S4 segments of spinal cord

Cranial : cells of ciliary, pterygopalatine, submandibular, Otic and peripheral ganglia

Sacral : cells of peripheral ganglia

***Nucleus: group of neurons INSIDE CNS**
***Ganglion: group of neurons OUTSIDE CNS**

Sympathetic



Cells of lateral horn of spinal cord [T1 - L3]
*No cells in the brain

Preganglionic neuron [**SHORT axon**]

-Cells of sympathetic chain
-Cells of plexuses surrounding abdominal aorta [Coeliac, superior, inferior mesenteric]

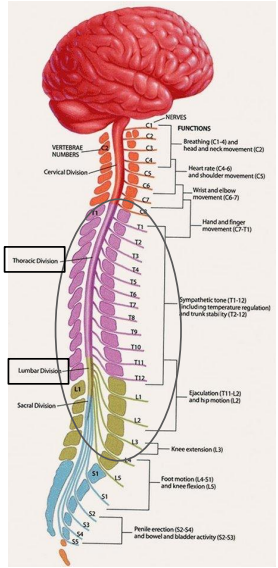
Postganglionic neuron [**LONG axon**]

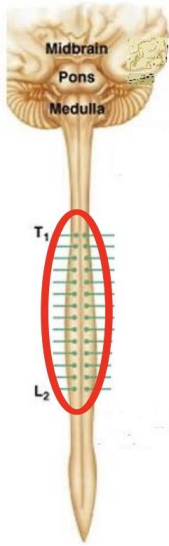
Sympathetic Division:

A)Preganglionic Neurons: Located in the lateral grey horn

of T1-L2 (or L3) segments of spinal cord (Thoracolumbar outflow)

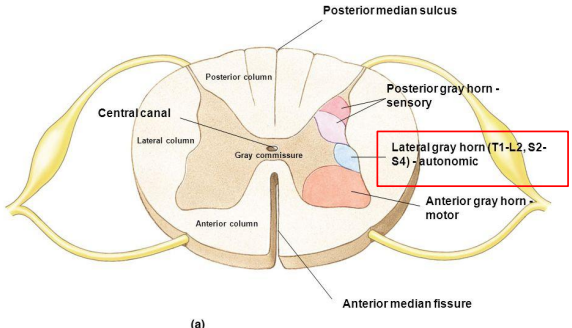
-outflow: the passage of impulses outwardly from the central nervous system-





* in the sympathetic division, there are preganglionic neurons only in the spinal cord.

***There are no preganglionic neurons in the brain.**

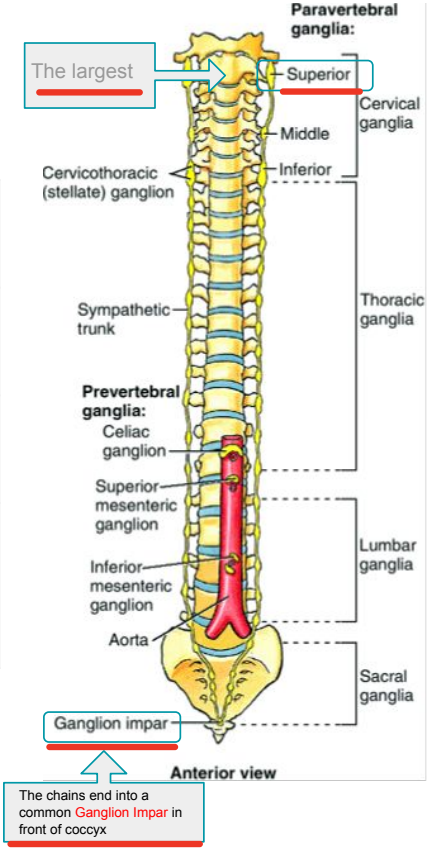


B) Postganglionic Ganglia:

Located near the central nervous system as:

Prevertebral	Paravertebral
- In front of the vertebrae.	- Next to the vertebrae. -
- Celiac & mesenteric (superior and Inferior) ganglia.	- Sympathetic chain ganglia.
- On the abdominal aorta.	- Two interconnected parallel sympathetic chains, one on each side of vertebral column.

Number of ganglia in the sympathetic chain(one on each side):
3 in the Cervical part of chain
11-12 in the Thoracic part
4 in Lumbar and 4 in Sacral parts



C) Fibers:

Preganglionic fibers	Postganglionic fibers
Run in the **ventral roots** of the spinal nerve	**From the sympathetic chain ganglia** enter again into the spinal nerve .
Travel through the corresponding **spinal nerve**, and then join the sympathetic chain via the **white rami communicans (WRC)** *Myelinated	enter into the spinal nerve through **Grey Rami Communicantes (GRC)** *unmyelinated
Within the sympathetic chain, these fibers may:	supply structures in head & thorax + blood vessels & sweat glands .
1- Ascend, descend or remain at the same level to synapse with neurons (postganglionic) of **paravertebral ganglia** located in sympathetic chain.	From the **cells of coeliac & mesenteric ganglia**(prevertebral) supply **abdominal & pelvic viscera.**
2- Leave the sympathetic chain (without synapse) to reach **coeliac & mesenteric ganglia** (around branches of abdominal aorta) to synapse with their neurons (postganglionic).	* nerve -> when 2 roots join each other

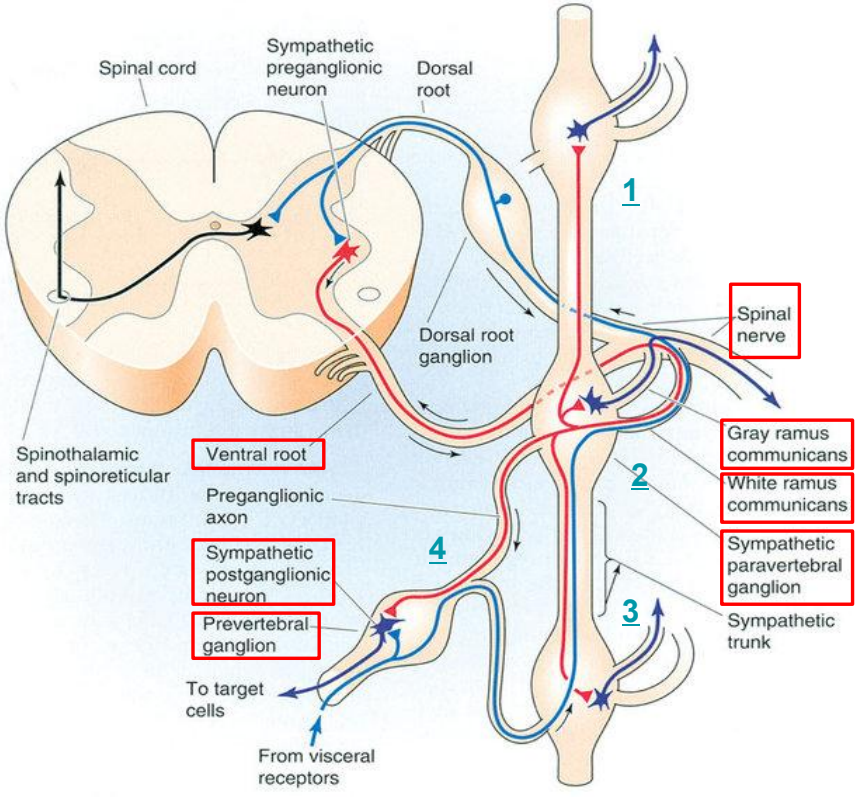
Nerve

W
R
C

Ganglion

G
R
C

Nerve



1- Ascend
2- Remain
3- Descend
4- Leave

For a better understanding of the previous slide

To Summarize:

Sympathetic Fibers Movement

Preganglionic Fiber

Run in **ventral root** of spinal cord

Travel through spinal nerve

Join the sympathetic chain via **WRC**

1/**Ascend**
2/**Remain at the same level** to synapse with neurons of paravertebral ganglia
3/**Descend**
4/**Leave the sympathetic chain** without synapse to make synapses with the neurons of coeliac & mesenteric ganglia

Postganglionic Fiber

From coeliac & mesenteric ganglia

Supply:
1/Abdomen viscera
2/pelvic viscera

From sympathetic chain ganglia

Enter **GRC**

Supply structure of:
1/sweat glands
2/blood vessels
3/thorax
4/head

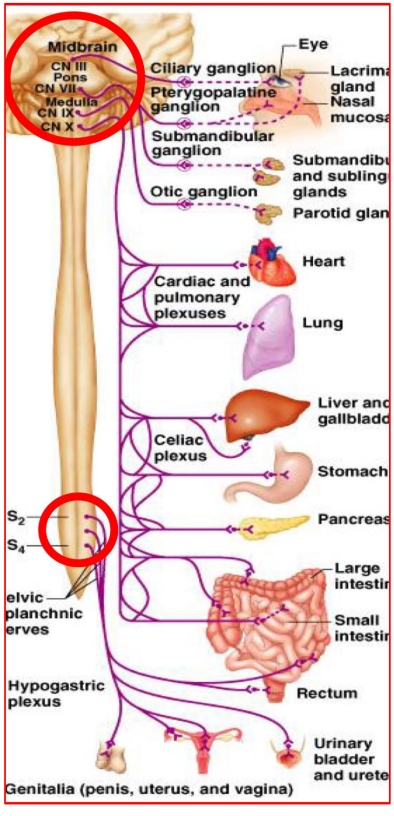
Parasympathetic division:

Preganglionic neurons:

Located in:

1. Nuclei of the 3rd, 7th , 9th & 10th cranial nerves, in the brain stem **(Cranial outflow)**
2. The **lateral gray horn of S_2-S_4** segments of spinal cord **(Sacral outflow)** "pelvic splanchnic nerves"

*Craniosacral outflow : part arise from brain & another from spinal cord.



Parasympathetic Division

Note: preganglionic fiber in parasympathetic is longer than the postganglionic fiber. Both secreted the same neurotransmitter which is the Ach but in different receptors.

Sacral outflow

Preganglionic

fibers

from sacral outflow are carried by **pelvic splanchnic nerves** to peripheral ganglia in pelvis where they synapse

Neurons

From the **lateral gray horn** of S_2-S_4 segments of spinal cord

Postganglionic fibers:

- innervate organs of the pelvis and lower abdomen

Cranial outflow

Preganglionic

Fibers

-Are carried by 3rd, 7th, 9th & 10th cranial nerves and terminate (synapse) in

- **ciliary** ganglion (3rd).
- **pterygopalatine, submandibular** ganglion (7th).
- **otic** ganglion (9th).
- **peripheral ganglia** (10th).

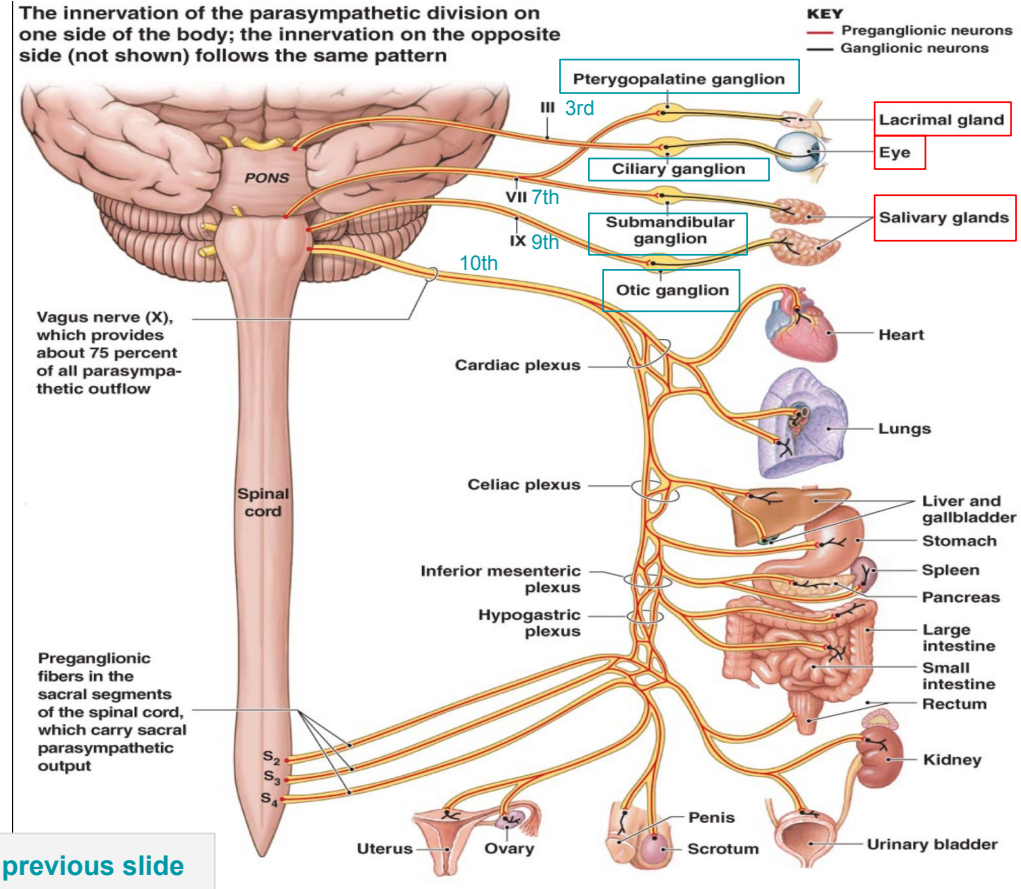
Neurons

- Located in the **3rd**, **7th**, **9th** & **10th** cranial nerves in the brain stem

Postganglionic fibers :

-innervate organs of the head, neck, thorax, and abdomen

**Memorize each nerve and its ganglion,and the part of the body it supplies.(only the ones in the boxes)



For a better understanding of the previous slide

*Don't memorize the functions! just know that the Sympathetic and Parasympathetic have a counter effect.

And the Sweat Gland & Erector pili muscles are only under the sympathetic effect.

Autonomic nervous system

Structure	Sympathetic effect	Parasympathetic effect
Iris of eye	Dilates pupil	Constricts pupil
Ciliary muscle of eye	Relaxes	Contracts
Salivary glands	Reduces secretion	Increases secretion
Lacrimal gland	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	
Erector pili muscles	Contracts	

Questions

1.Which of these maintain homeostasis of the internal environment?

A-Endocrine system

B-Autonomic nervous system

C-Both

2.Postganglionic neurons synapses with?

A-Preganglionic neuron

B- Target organs

3.Both autonomic and somatic nervous systems made of one neuron

A) T
B) F

4.The cell bodies of preganglionic neurons are located in

A-Spinal cord

B-Brain

C-A and B

D- Peripheral nervous system

5. Both sympathetic and parasympathetic work …… , and have ……. control over the viscera.

6.In parasympathetic, the preganglionic fibers are …….and the postganglionic fibers are ……

A-Long,short

B-Short, long

Answers

1.C

2.B

3.B (autonomic has two)

4.C

5. Together, antagonistic

6.A

Team Members

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Abdulaziz Ibrahim Aldrgam
Akram alfandi
saud Abdulaziz alghufaily
Mohammed Alquwayfili
ali alammari
Sultan alfuhaid
Zeyad Alkhenizan
Fahad alshughaithry
saad aloqile
Abduljabbar Alyamni

Mohammed Alomar
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Abdulelah alqarni
Fahad alshugaithry
Mohammed Alomar
Yazeed Aldossari