بسم الله الرحمن الرحيم

# Autonomic Nervous System

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# OBJECTIVES

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

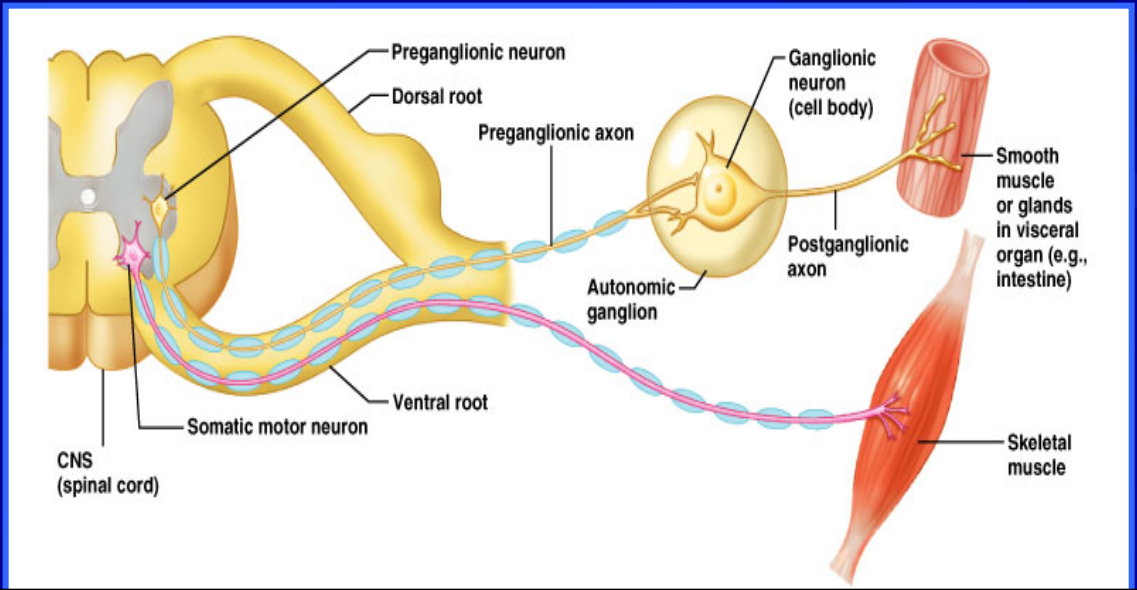
- ***Define the autonomic nervous system.***
- ***Describe the structure of autonomic nervous system***
- ***Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system.***
- ***Enumerate in brief the main effects of sympathetic & parasympathetic system***

# Autonomic Nervous System

- Concerned with the innervation and control of Involuntary structures: visceral organs, smooth & cardiac muscles and glands
- Function: maintain homeostasis of the internal environment along with the Endocrine system
- Located: both in the central and peripheral nervous systems.
- Regulated (controlled) by Hypothalamus.

# Autonomic Nervous System

- Unlike the somatic nervous system, the **Efferent** pathway of the autonomic nervous system is made up of two neurons called as **preganglionic** and **postganglionic** neurons
- The cell bodies of the **preganglionic** neurons are located in the **brain and spinal cord**. Their axons synapse with the **postganglionic** neurons whose cell bodies are located in the **autonomic ganglia**



- Based on the anatomical, physiological and pharmacological characteristics, the autonomic nervous system is divided into:
  - **Sympathetic**: Activated during **exercise**, **excitement**, **and emergencies**. **"fight, flight**, or **fright"**
  - **Parasympathetic**: Concerned with **conserving energy**. **"rest and digest"**

14–7 This man is making good use of the sympathetic part of his autonomic us system.

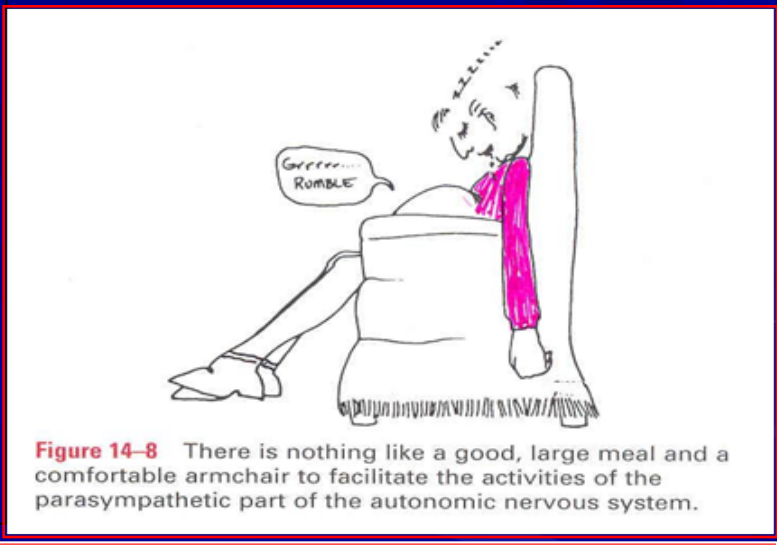
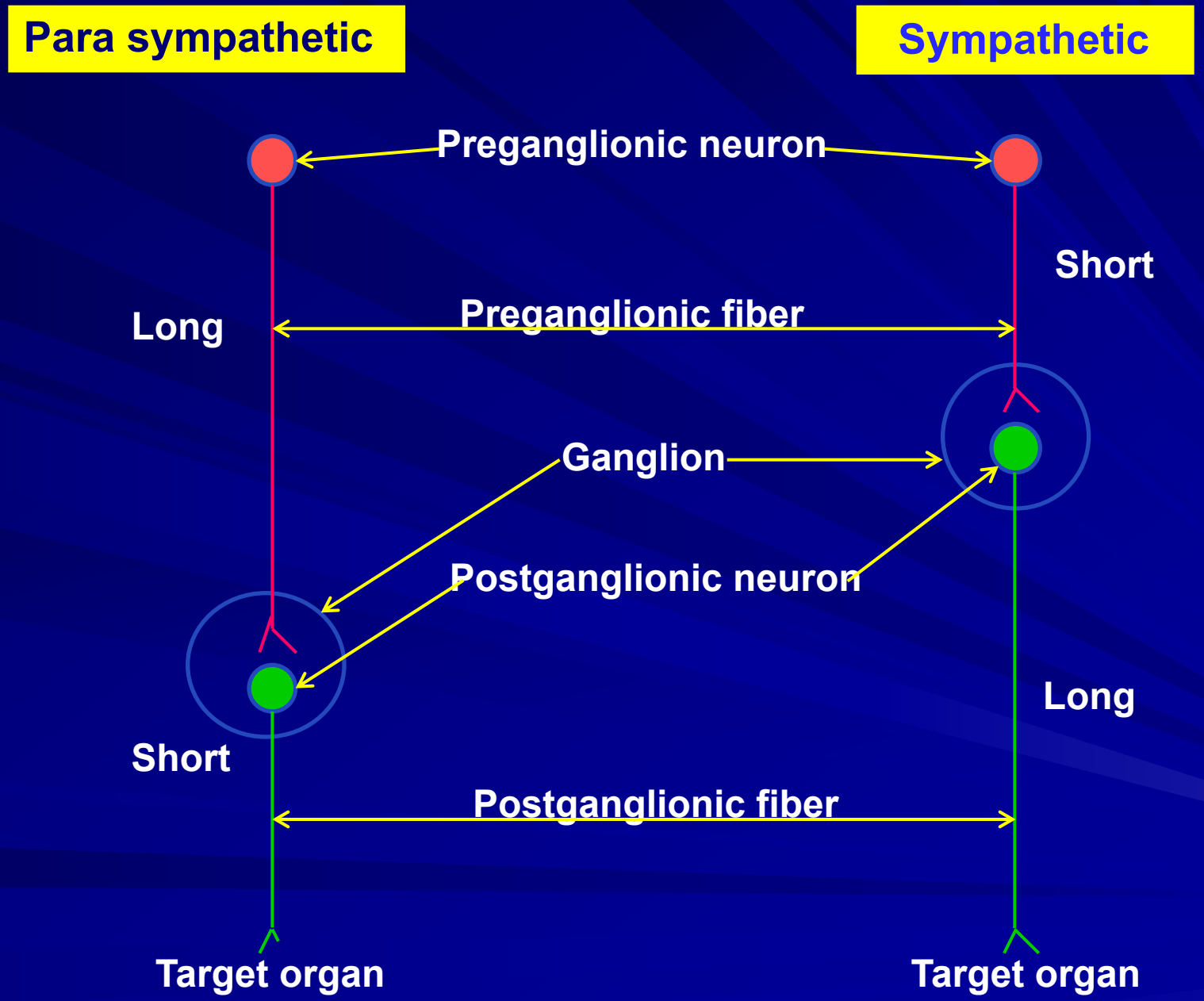


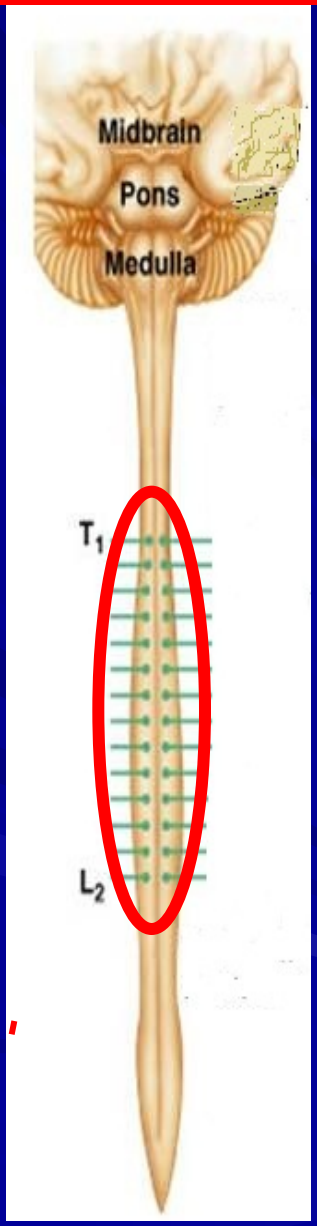

Figure 14–8 There is nothing like a good, large meal and a comfortable armchair to facilitate the activities of the parasympathetic part of the autonomic nervous system.

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


Para sympathetic
Sympathetic
Preganglionic neuron
Short
Long
Preganglionic fiber
Ganglion
Postganglionic neuron
Long
Short
Postganglionic fiber
Target organ
Target organ

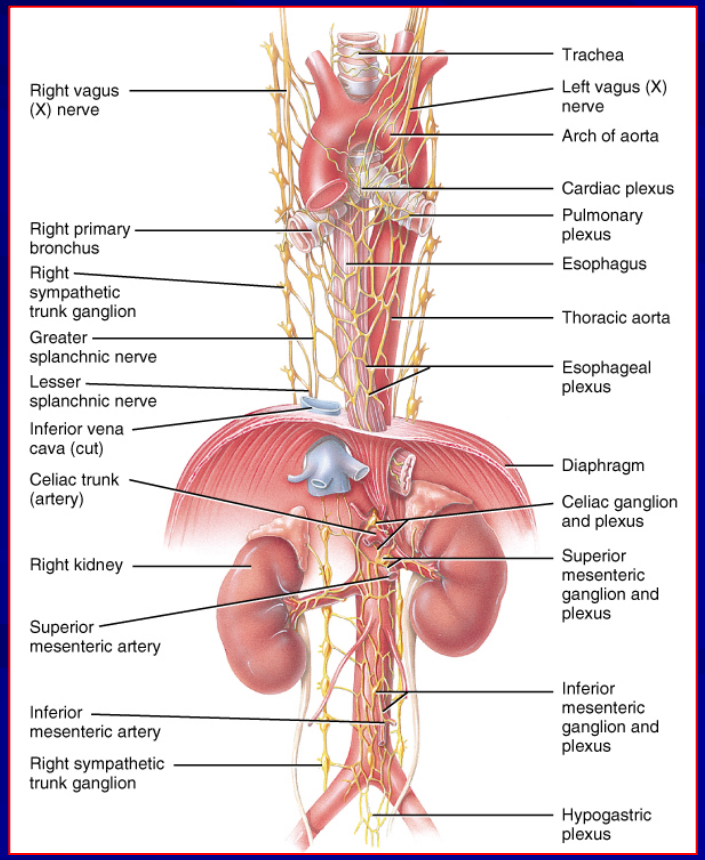
# Sympathetic Division

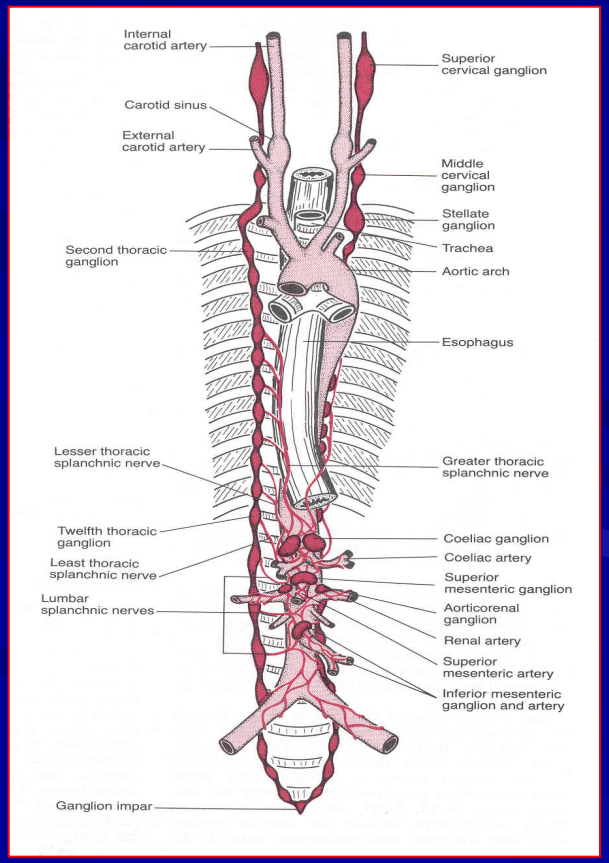
- **Preganglionic Neurons:** located in the **lateral gray horn** of $T_1$-$L_2$ segments of spinal cord (**Thoracolumbar outflow**)



# Post Ganglionic Ganglia

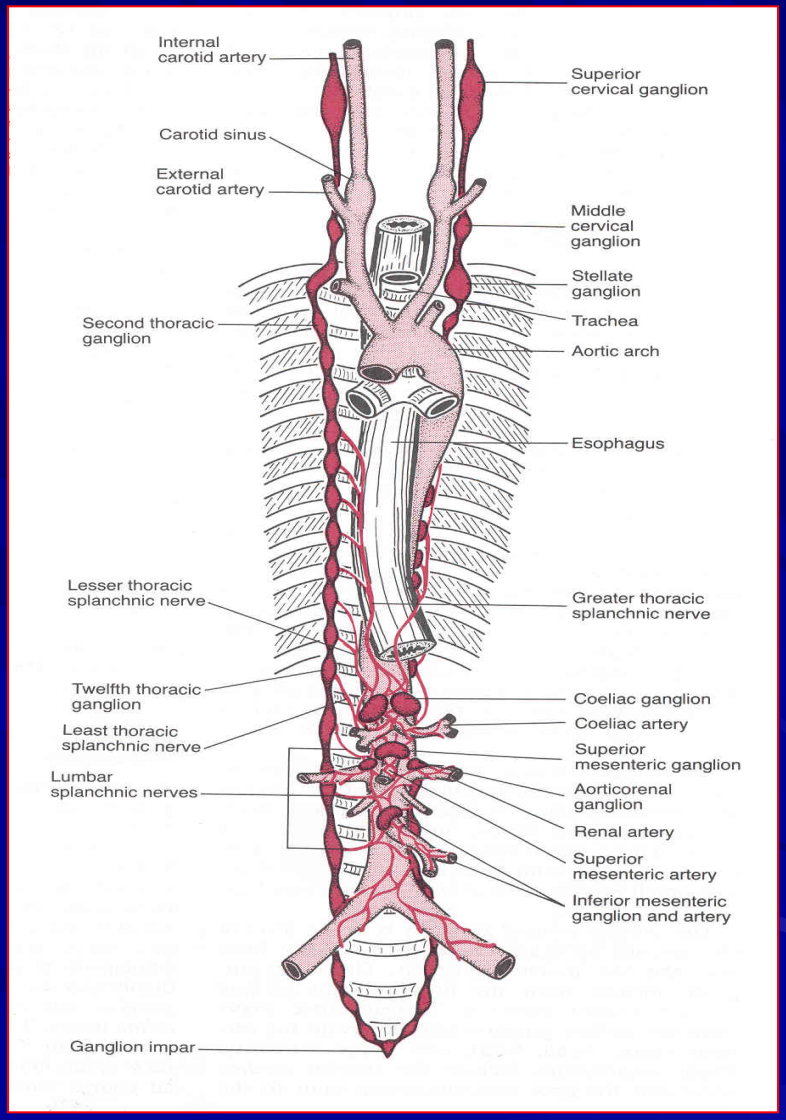
- **Located nearer the central nervous system as:**
  - **Prevertebral: celiac & mesenteric**
  - **Paravertebral forming sympathetic chain**



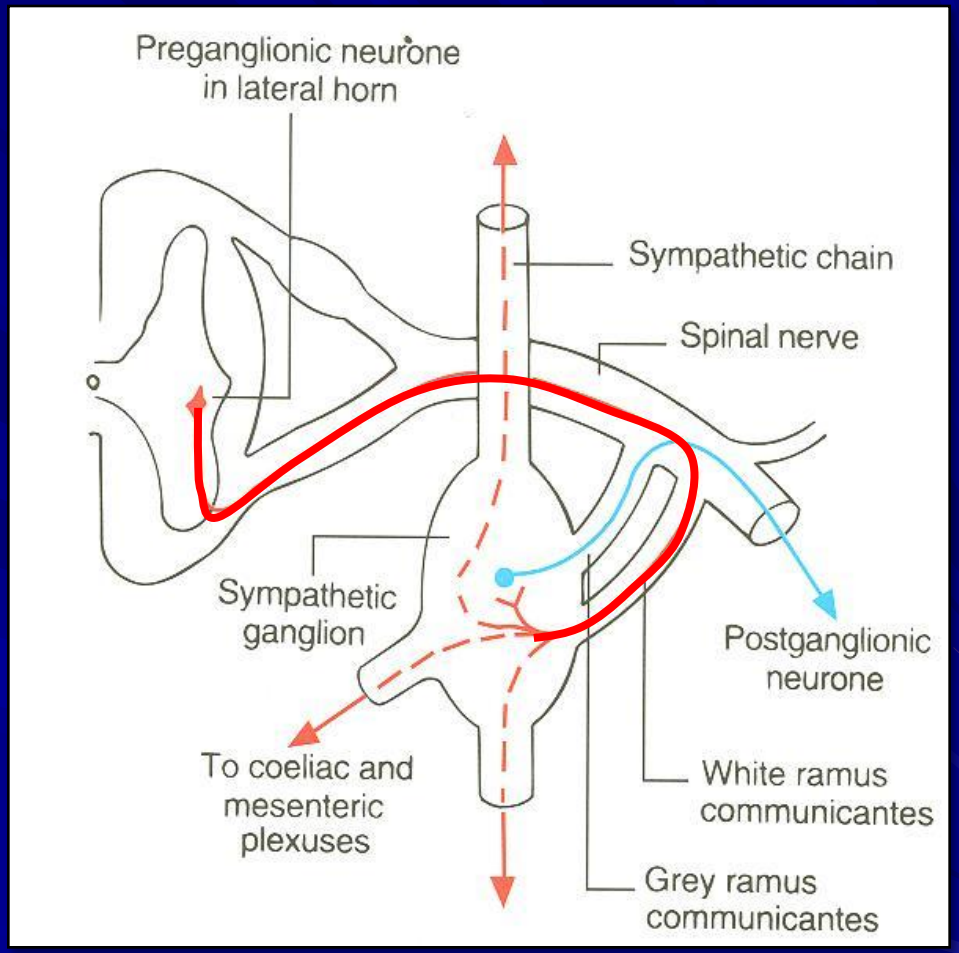
# Paravertebral Ganglia

- They are interconnected to form 2 **sympathetic chains**, one on each side of vertebral column.
- Number of ganglia:
  - **Three** in **cervical** part of chain
  - **Eleven to twelve** in thoracic part
  - **Four** in **lumbar & sacral** parts each.
- The chains end into a common **'ganglion impar'** in front of coccyx



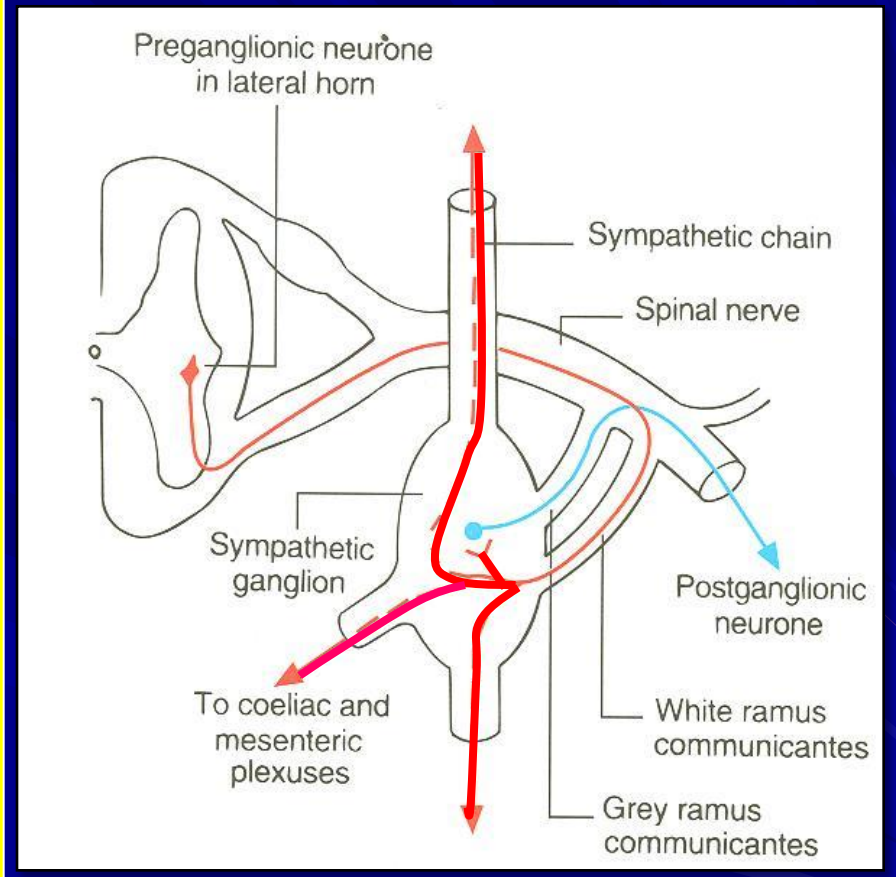
# Preganglionic fibers

- Run in the **ventral roots** of the spinal nerve
- Travel through the **spinal nerve**, and then join the sympathetic chain via the **White Rami Communicans.** (WRC)



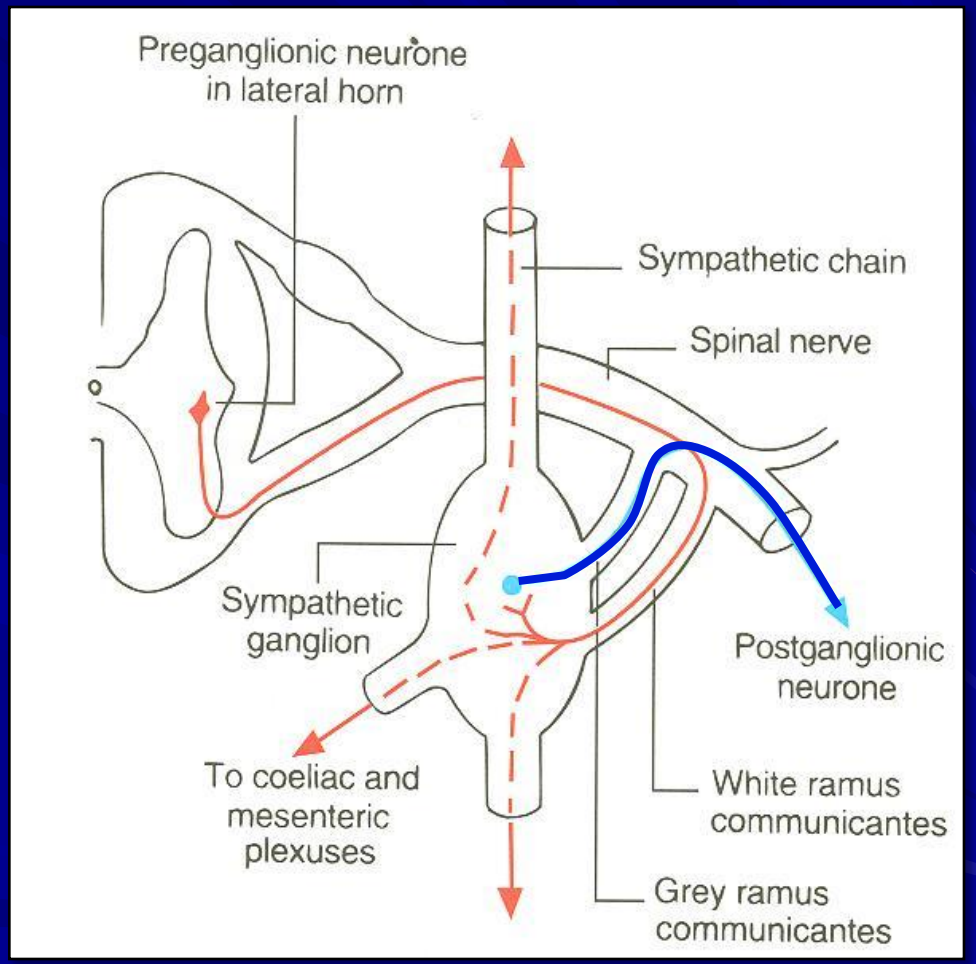
- **Within the sympathetic chain, these fibers may:**

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 coeliac & mesenteric ganglia (around branches of abdominal aorta) to synapse with their neurons (postganglionic).**



# Postganglionic fibers

- **From the sympathetic chain ganglia** enter again into the spinal nerve through **Grey Rami Communicantes (GRC)** to supply *structures in head & thorax + blood vessels & sweat glands*
- **From the cells of coeliac & mesenteric ganglia** supply *abdominal & pelvic viscera.*



# Parasympathetic Division

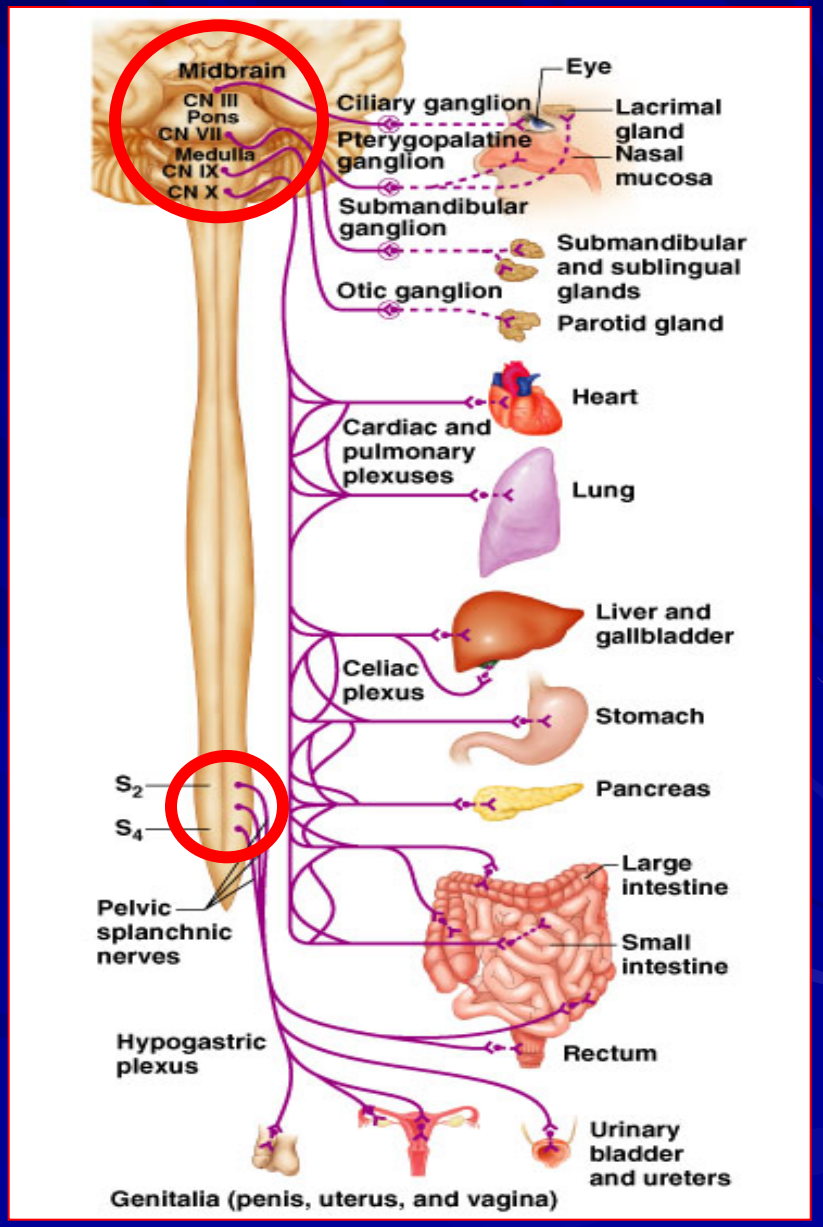
## Preganglionic neurons

**Located in:**

- Nuclei of the $3^{rd}$, $7^{th}$, $9^{th}$ & $10^{th}$ cranial nerves, in the brain stem (Cranial outflow)

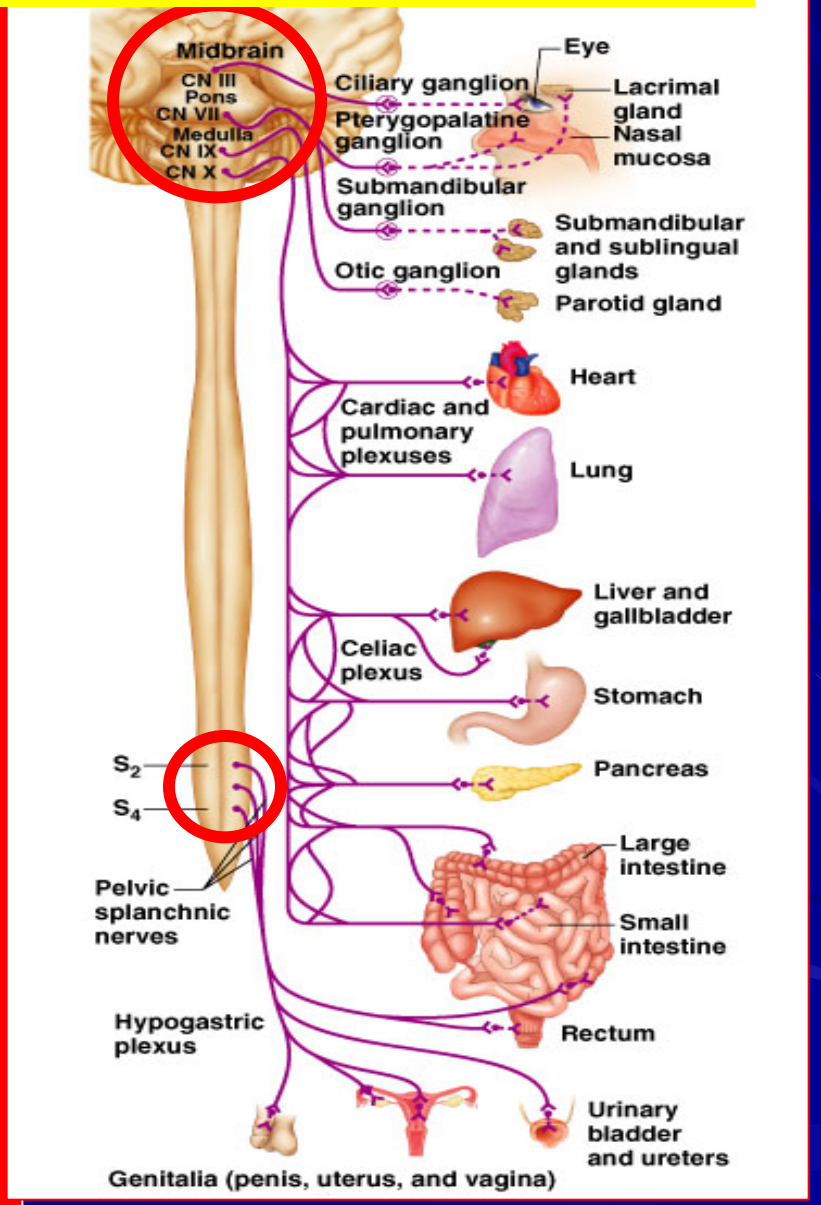
&

- The lateral gray horn of $S_2$-$S_4$ segments of spinal cord (Sacral outflow)



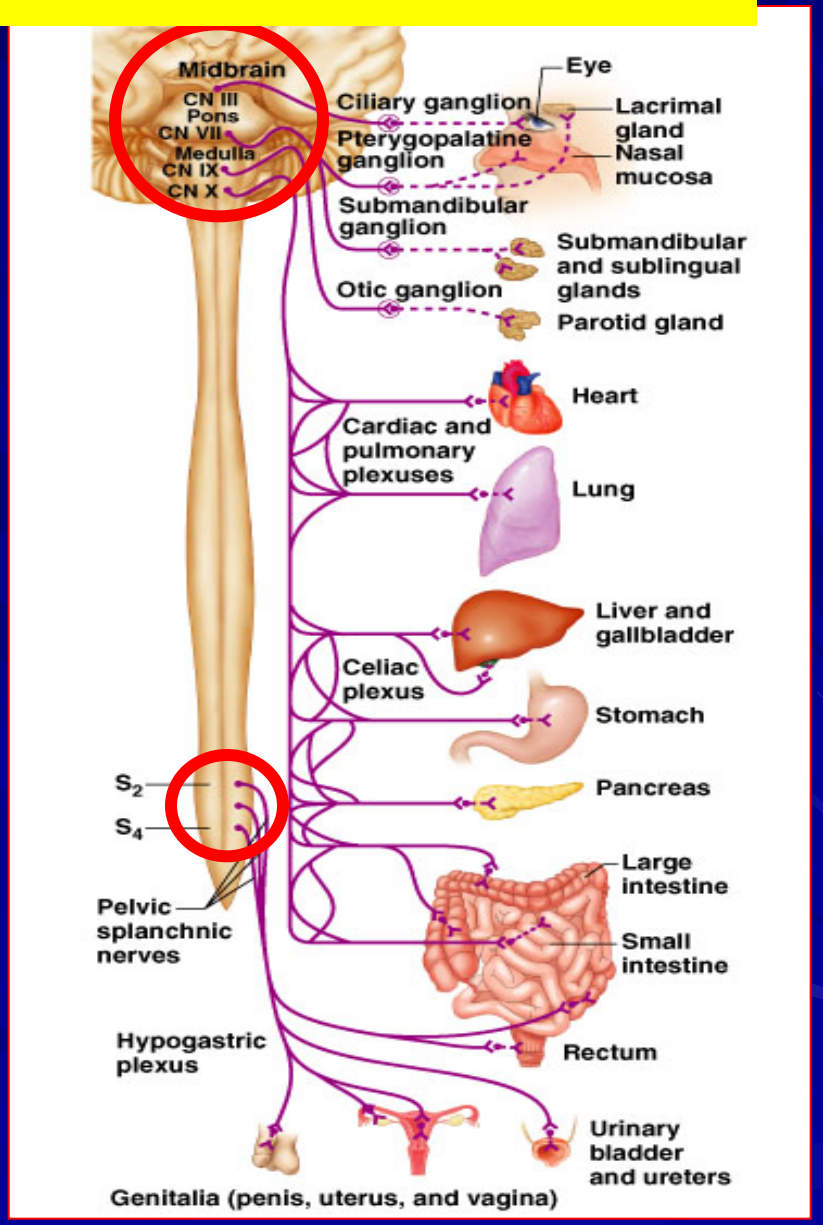
# Cranial Outflow

- **Preganglionic fibers** from ***cranial outflow*** are carried by 3rd, 7th, 9th & 10th cranial nerves and terminate in ciliary, pterygopalatine, submandibular, otic & peripheral ganglia
- **Postganglionic fibers** innervate organs of the head, neck, thorax, and abdomen



# Sacral Outflow

- **Preganglionic fibers** from ***sacral outflow*** are carried by **pelvic splanchnic nerves** to peripheral ganglia in pelvis where they synapse.
- **Postganglionic fibers** innervate organs of the pelvis and lower abdomen



## 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 | |

# Thank U & Good Luck