AUTONOMIC NERVOUS SYSTEM

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OBJECTIVES

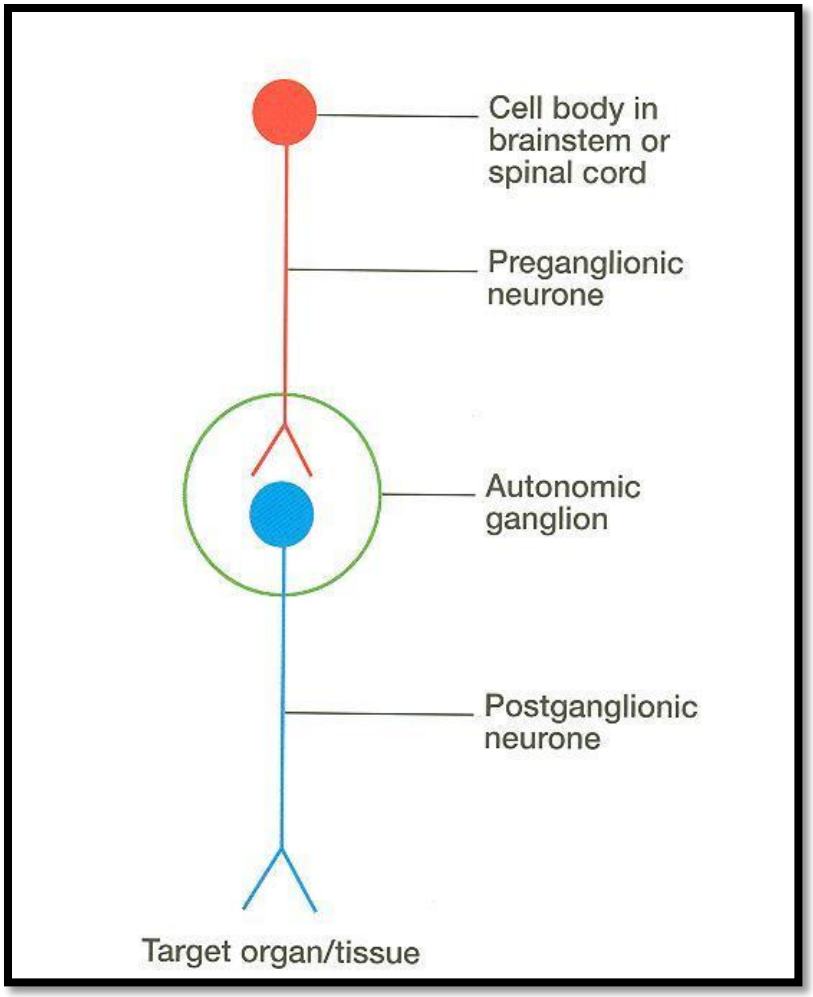
At the end of the lecture, students should:

- ***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*

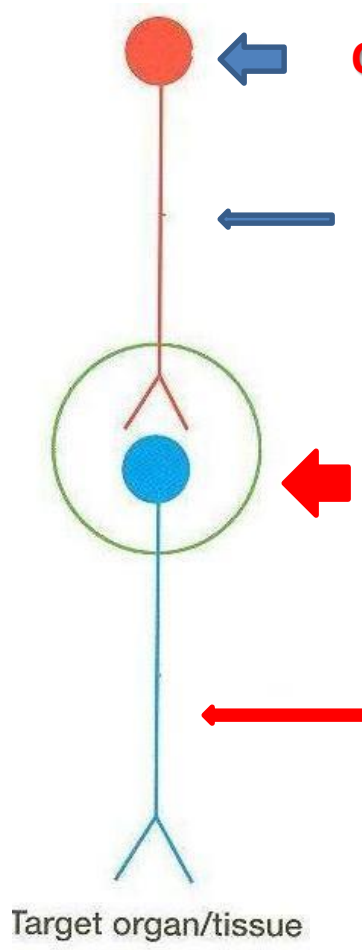
DEFINITION

- Nerve cells located in **both central & peripheral nervous system** that are concerned with **innervation of involuntary structures:** viscera, smooth & cardiac muscles, glands.
- ***Function:*** maintains **homeostasis** of internal environment.
- ***Regulation:*** by hypothalamus.

STRUCTURE OF AUTONOMIC NERVOUS SYSTEM



SYMPATHETIC NERVOUS SYSTEM



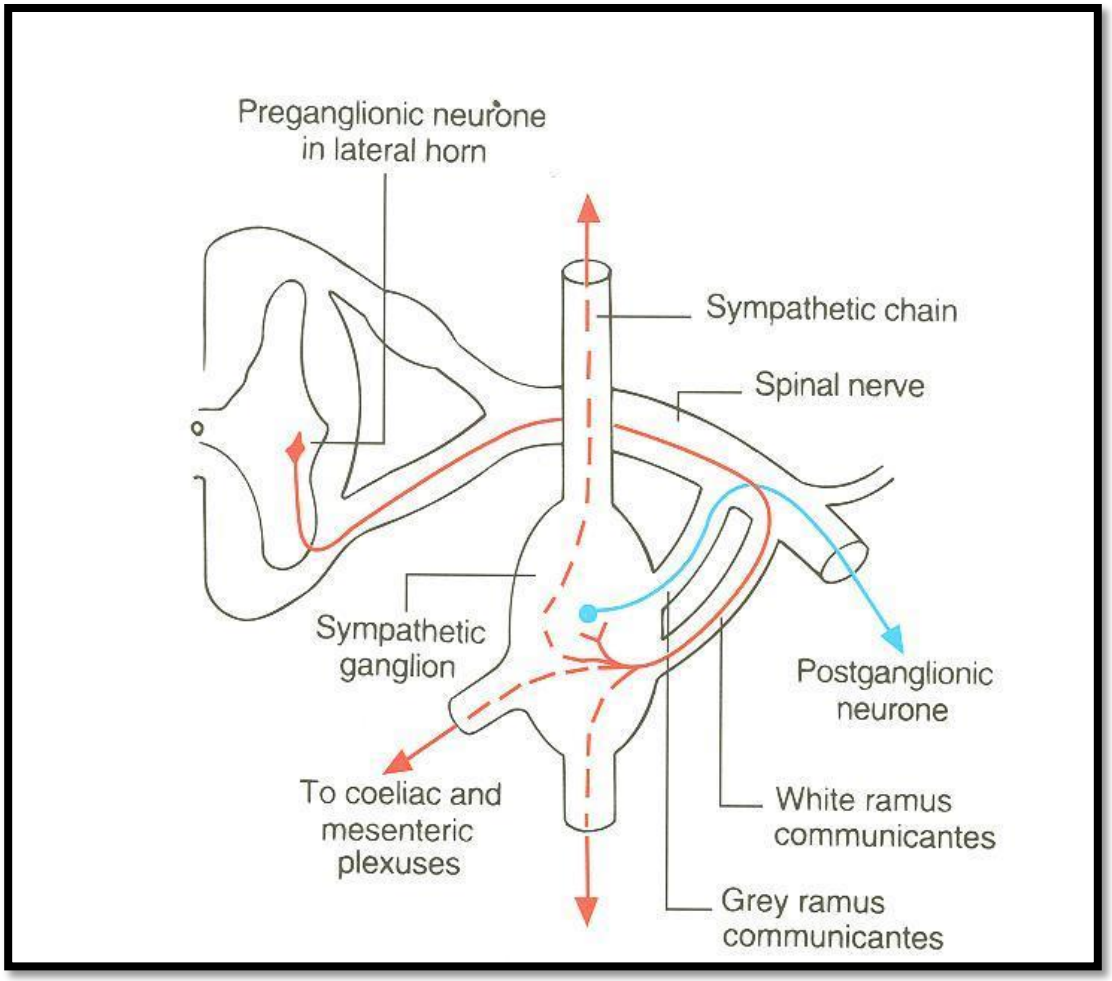
Cells of lateral horn of spinal cord (T1 – L3)

Short axon

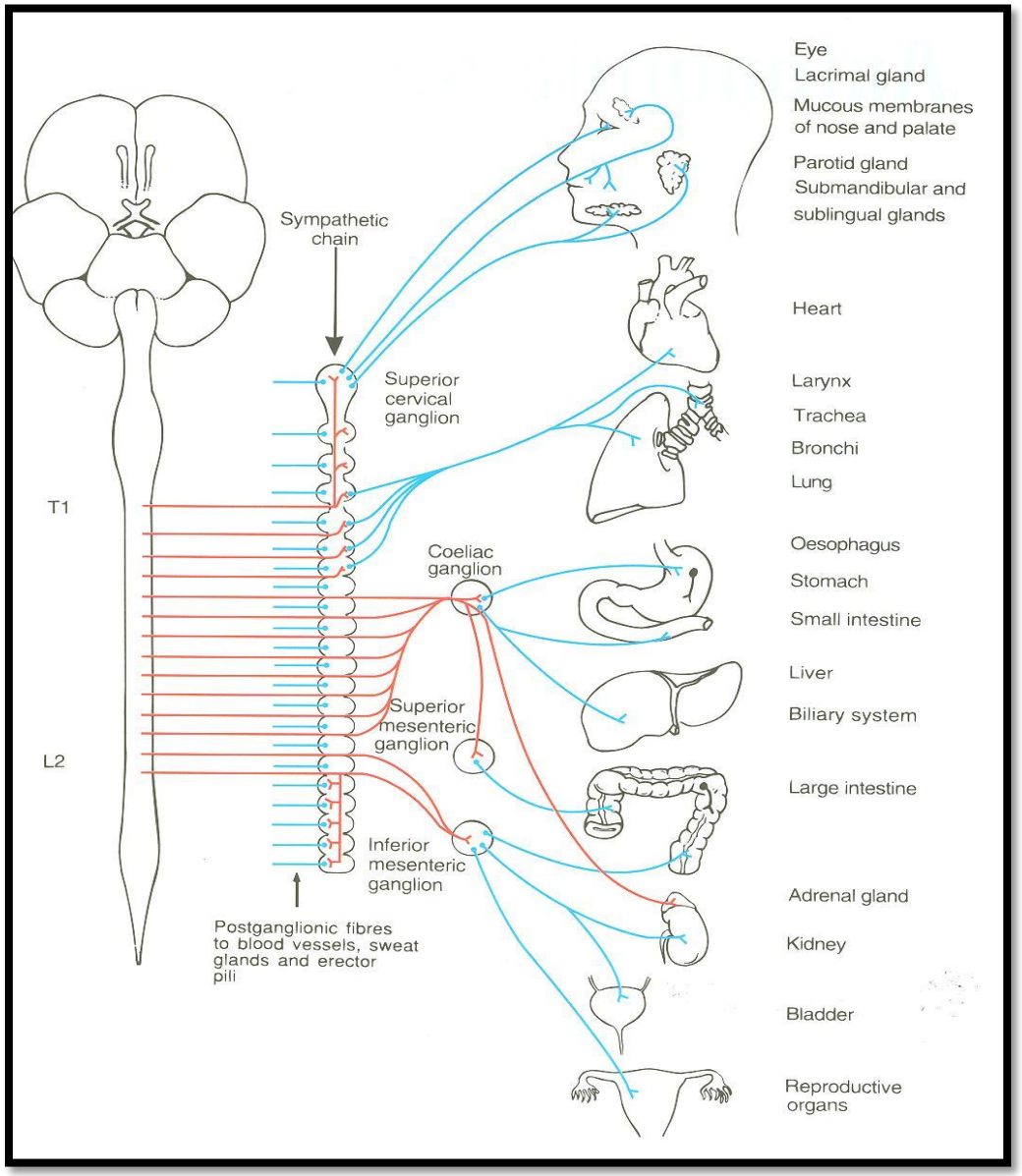
- Cells of sympathetic chain
- Cells of plexuses surrounding abdominal aorta (Coeliac, superior & inferior mesenteric)

Long axon

SYMPATHETIC NERVOUS SYSTEM



SYMPATHETIC NERVOUS SYSTEM



SYMPATHETIC NERVOUS SYSTEM

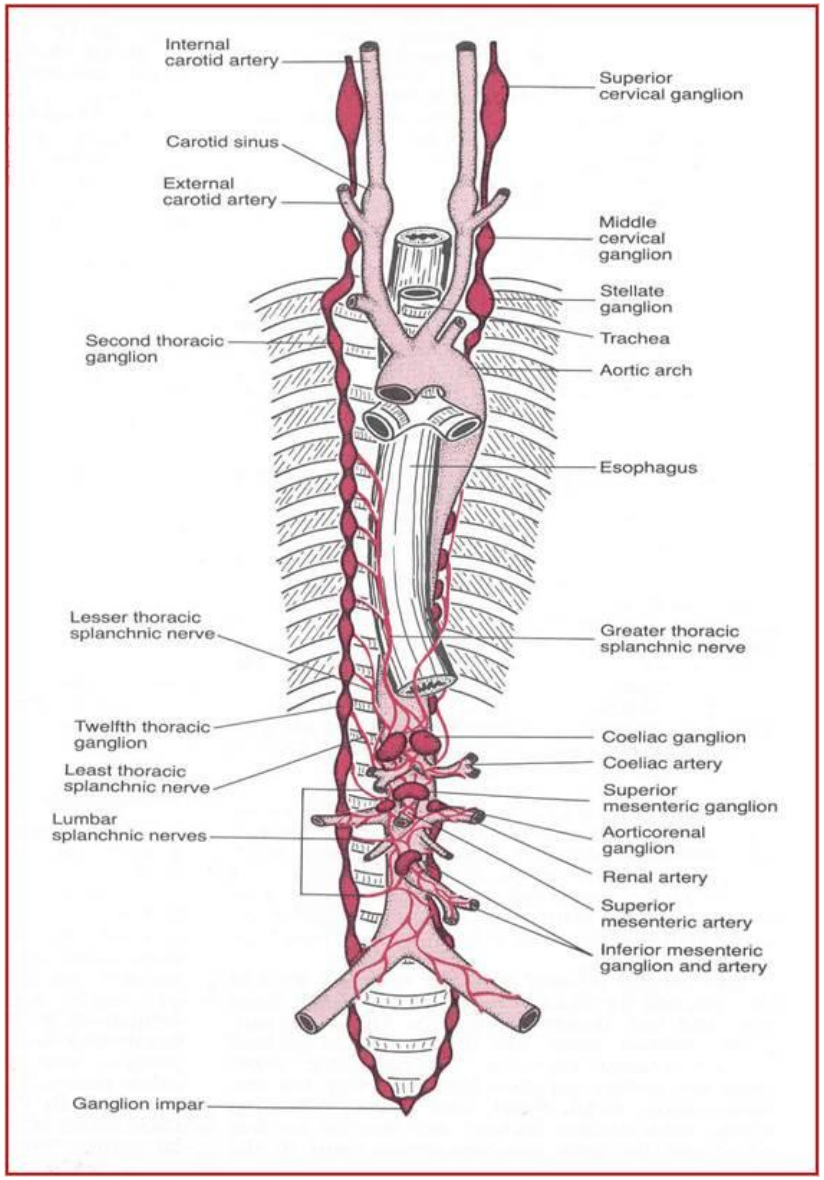
- **Preganglionic sympathetic neurons: cells of the lateral horn of spinal cord in all thoracic + upper 3 lumbar segments.**
- **Preganglionic axons leave the spinal cord, join corresponding spinal nerves & reach the sympathetic chain (via the white ramus communicans). They either:**

1. **Synapse with cells of paravertebral ganglia located in sympathetic chain (postganglionic neurons are cells of paravertebral ganglia: postganglionic axons leave the sympathetic chain & join again the spinal nerve (via grey ramus communicans) to supply *structures in head & thorax + blood vessels & sweat glands* .**

SYMPATHETIC NERVOUS SYSTEM

2. Leave the sympathetic chain **(without synapse)** to reach coeliac & mesenteric plexuses (around branches of abdominal aorta) to synapse with their cells. **Postganglionic neurons are cells of coeliac & mesenteric plexuses.** **Postganglionic axons** supply ***abdominal & pelvic viscera.***

PARAVERTEBRAL GANGLIA

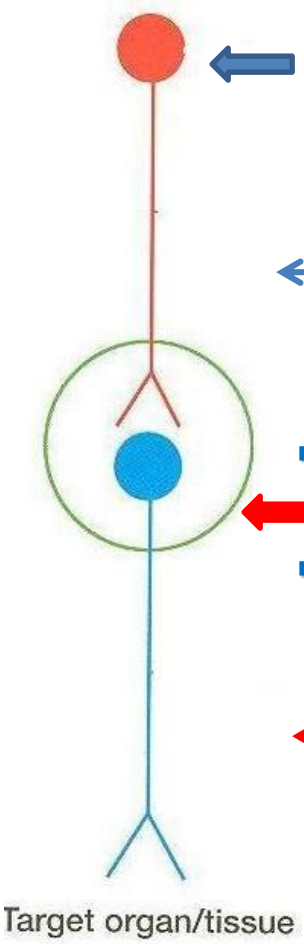


- They are interconnected to form 2 sympathetic chains, one on each side of vertebral column.
- Number of ganglia:

1. Three ganglia in cervical part of chain
2. Eleven to twelve ganglia in thoracic part
3. Four in lumbar & sacral parts.

- The chains end into a common ‘ganglion impar’ in front of coccyx

PARASYMPATHETIC NERVOUS SYSTEM



- Cranial: cells in brain stem: nuclei of 3rd, 7th 9th & 10th
- Sacral: cells in S2 – S4 segments of spinal cord

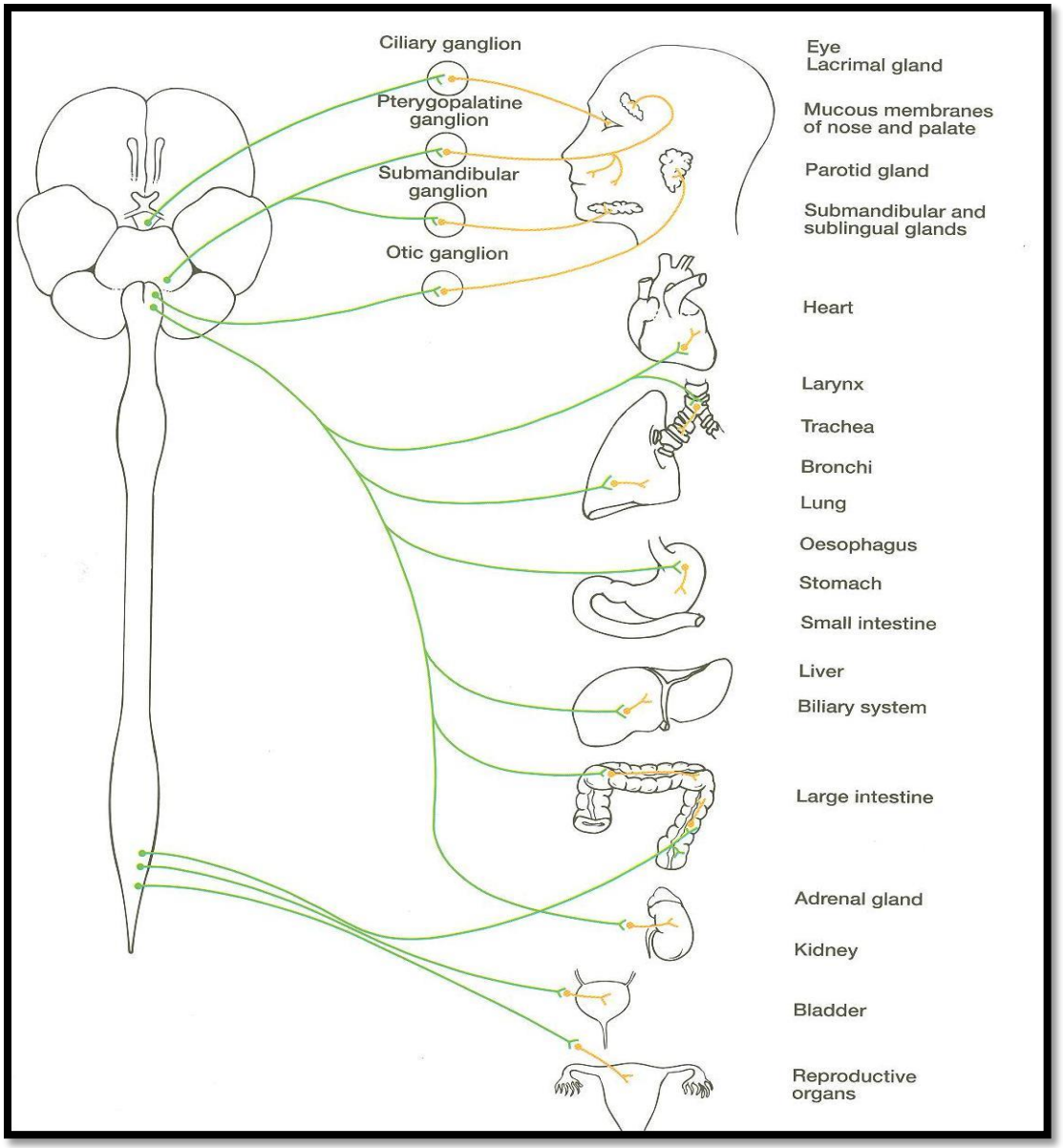
Long axon

- Cranial: cells of ciliary, pterygopalatine, submandibular, otic & peripheral ganglia
- Sacral: cells of peripheral ganglia

Short axon

Nucleus: group of neurons inside CNS
Ganglion: group of neurons outside CNS

PARASYMPATHETIC NERVOUS SYSTEM



PARASYMPATHETIC NERVOUS SYSTEM

- **Preganglionic parasympathetic neurons:**

1. **Cells located in brain stem: Preganglionic axons leave the brain stem, join 3rd, 7th, 9th & 10th cranial nerves & reach ciliary, pterygopalatine, submandibular, otic & peripheral ganglia (Postganglionic neurons are cells of those ganglia). Postganglionic axons supply *structures in head, thorax & abdomen.***
2. **Cells located in 2nd, 3rd & 4th sacral segments of spinal cord. Preganglionic axons leave the spinal cord, join corresponding sacral spinal nerves to reach peripheral ganglia in pelvis where they synapse. Postganglionic neurons are cells of peripheral ganglia. Postganglionic axons supply *pelvic viscera.***

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	

QUESTION 1

- At which one of the following sites are located preganglionic neurons of the sympathetic nervous system ?

1. Brain stem
2. Thoracic segments of spinal cord ⬅
3. Sacral segments of spinal cord
4. Sympathetic chain

QUESTION 2

- Regarding the parasympathetic nervous system, which one of the following statements is correct?

1. Its preganglionic axons are short.
2. It supplies sweat glands.
3. Its preganglionic neurons are located in the sacral segments of spinal cord. ⬅
4. Its postganglionic neurons are located in the coeliac & mesenteric plexuses.


THANK YOU