- A 60 years old having long standing uncontrolled DM presenting with postprandal fullness, nausea and upper abdomen discomfort. His barrium meal show dilated stomach but no organic outlet obstruction .

  Diagnosis..?

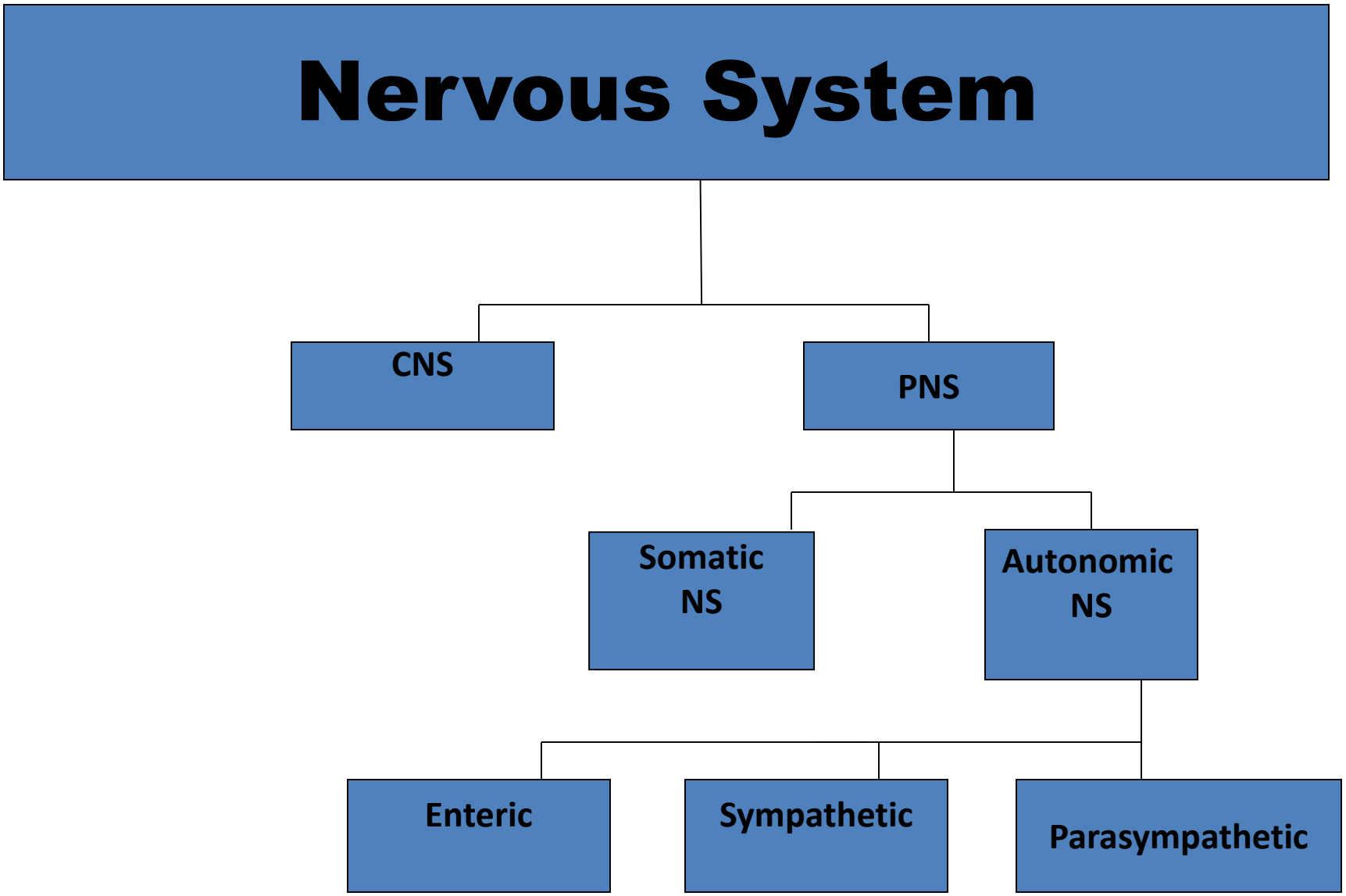
- A 30 years old women presented to neurology clinic with partial ptosis of Rt eye and dilated pupil not reacting to light.

diagnosis

Autonomic Nervous System

Outlines

- Introduction and overall function
- Organization of Autonomic Nervous System
- Autonomic Ganglia
- Sympathetic Nervous System
- Parasympathetic Nervous System


Nervous System
CNS
PNS
Somatic NS
Autonomic NS
Enteric
Sympathetic
Parasympathetic

Introduction

The portion of the nervous system that controls most visceral functions of the body

helps control ***B.P, GI motility, GI secretion, Urinary bladder emptying, sweating, body temperature , etc***

Functions of ANS

- arterial pressure
- gastrointestinal motility & secretion
- urinary bladder emptying
- sweating
- body temperature
- Pupillary dilation and constriction

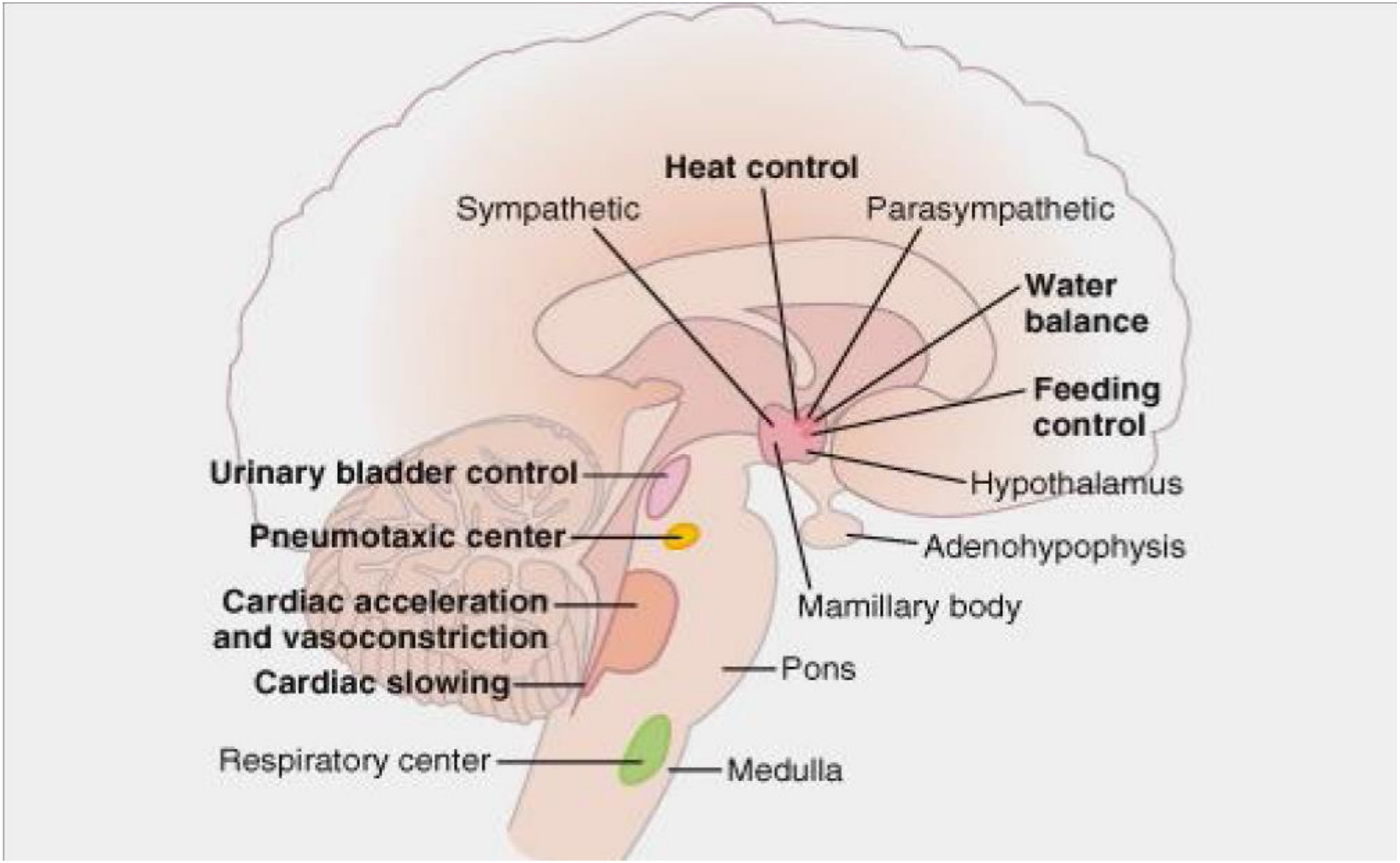
Organization of ANS

ANS is activated mainly by centers located in **spinal cord, brainstem and hypothalamus**

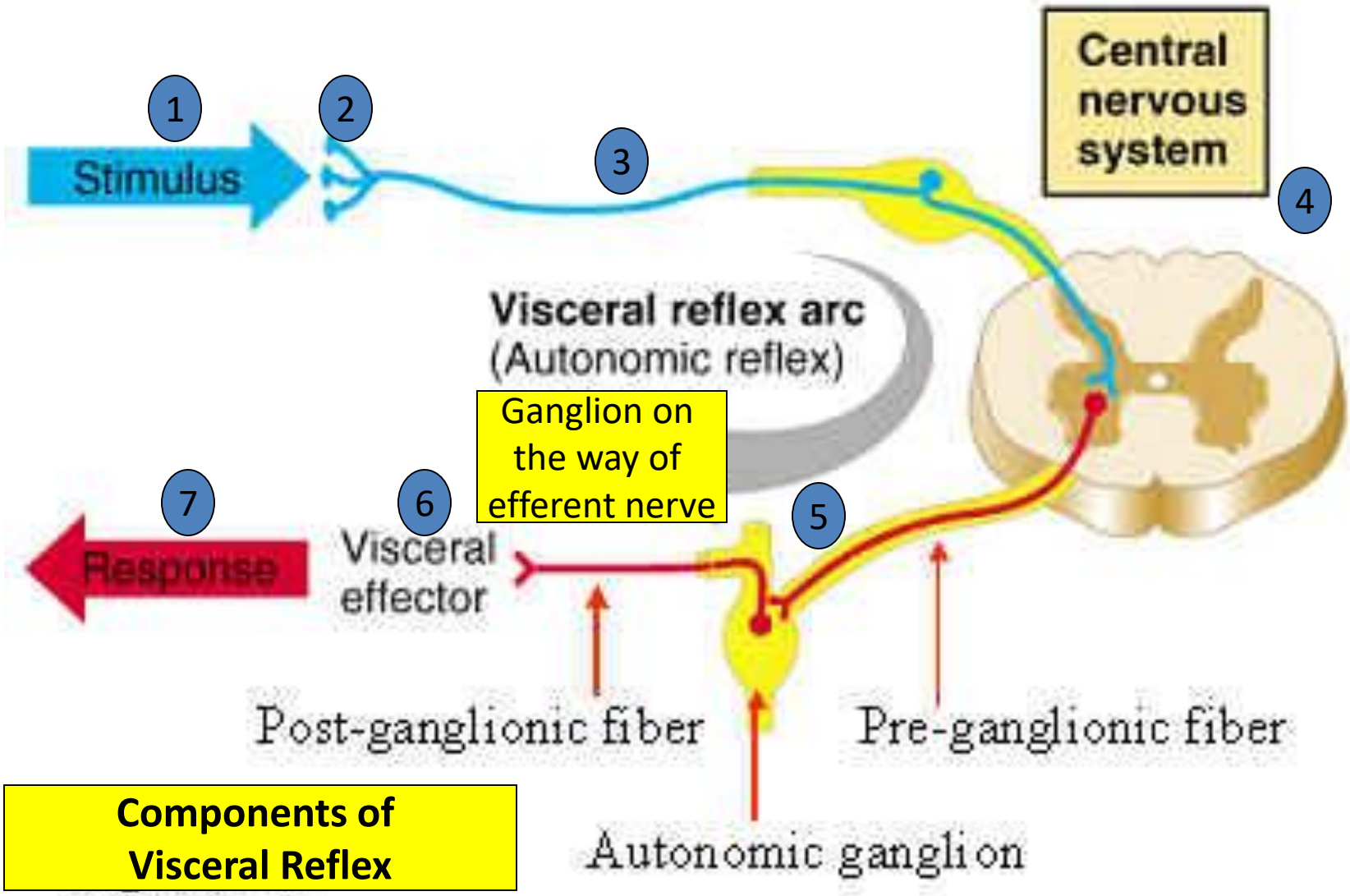
Higher signals from cerebral cortex and limbic cortex can influence it as well

Operates through **visceral reflexes**

Control Centres in Brain and Spinal Cord

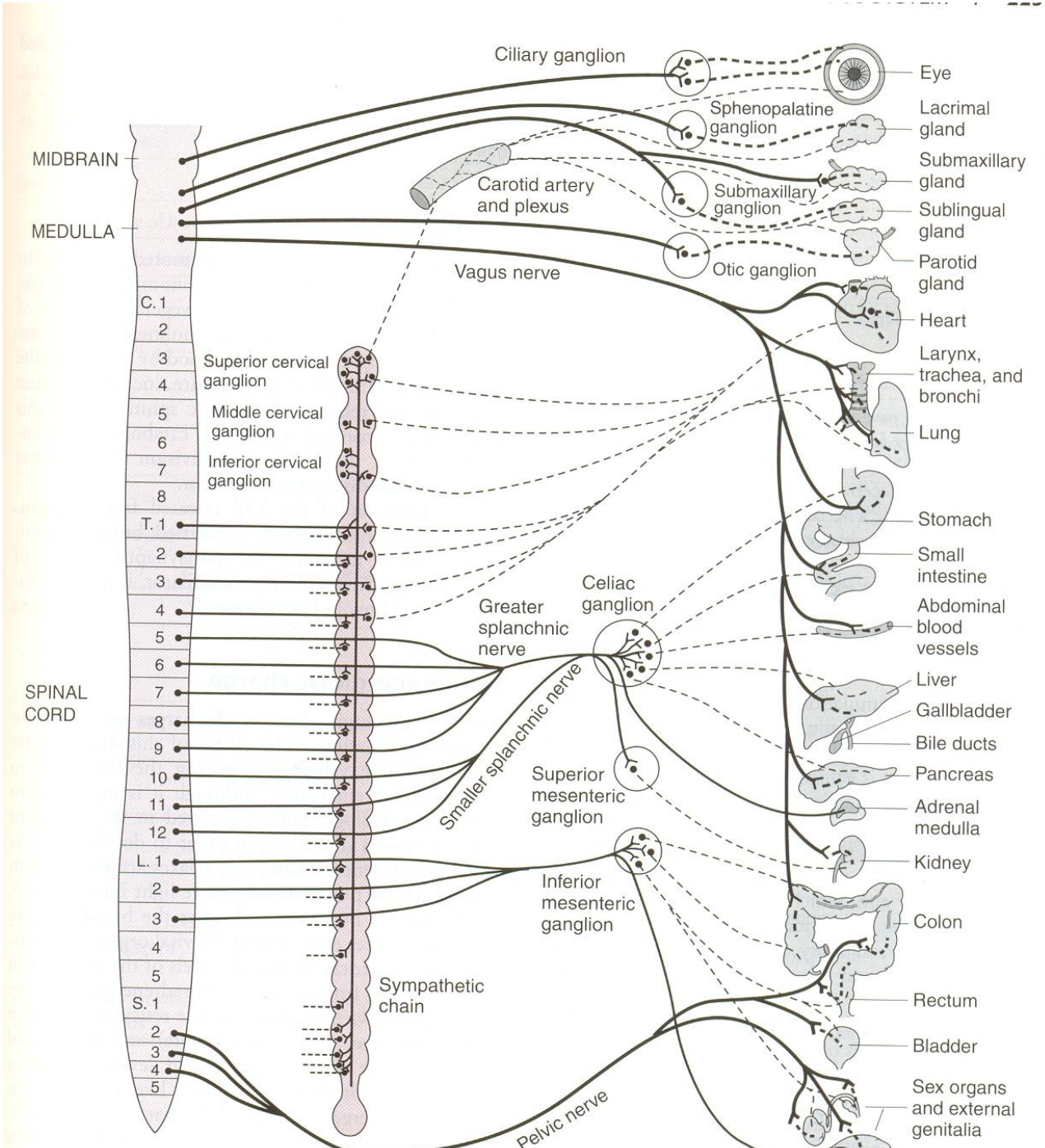


Visceral Reflexes



Components of Visceral Reflex

Organization of Autonomic NS



Autonomic Ganglia

- The **site** where preganglionic nerve fibers synapse on postganglionic neurons
- Preganglionic fibers are **type B small**, **myelinated**
- Postganglionic fibers are **type C small**, **unmyelinated**
- Small interneurons and collateral branches in ganglia which serve as a relay station

Types of Autonomic Ganglia

- 3 groups

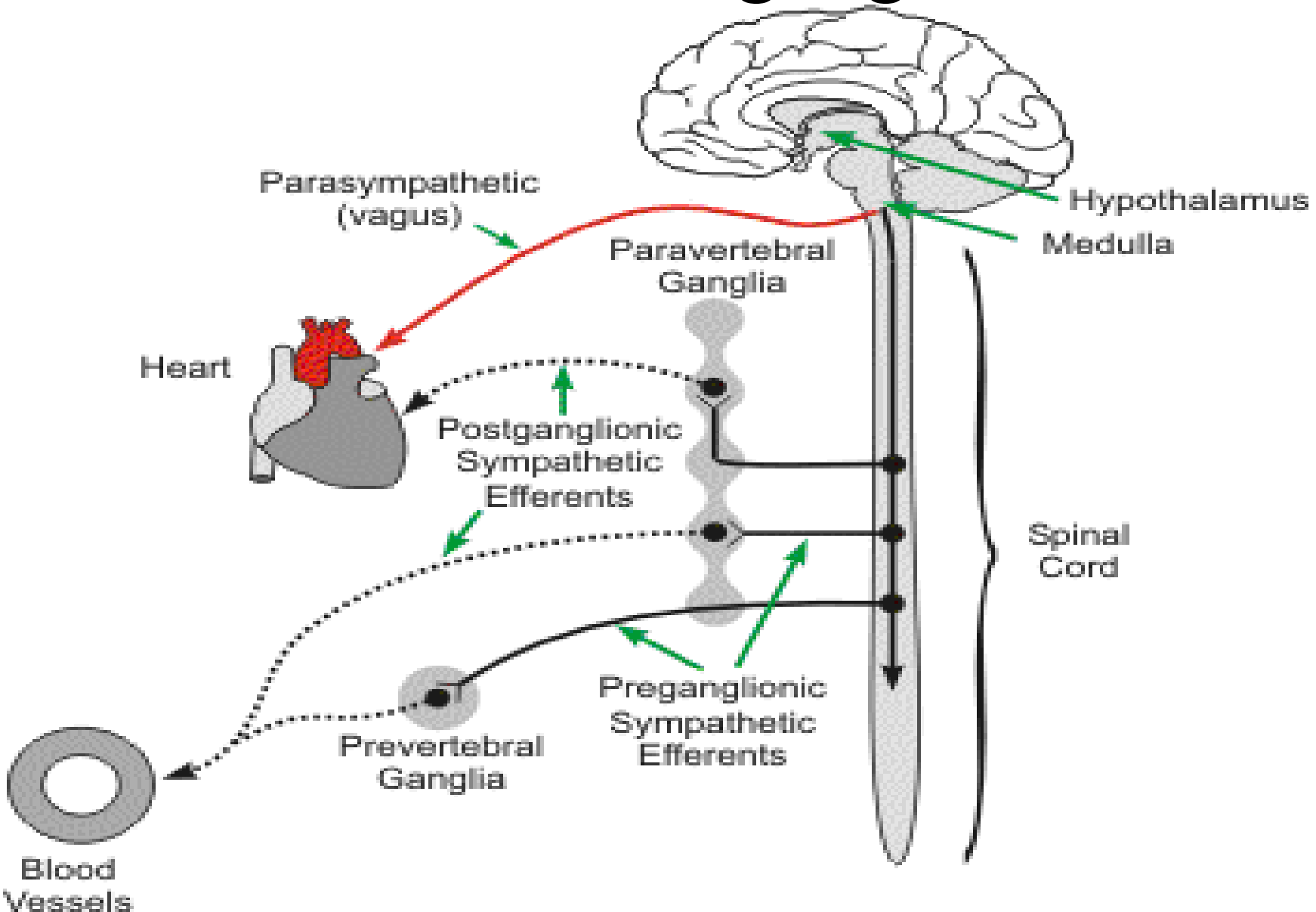
1) Paravertebral or Sympathetic occur in 2 chains

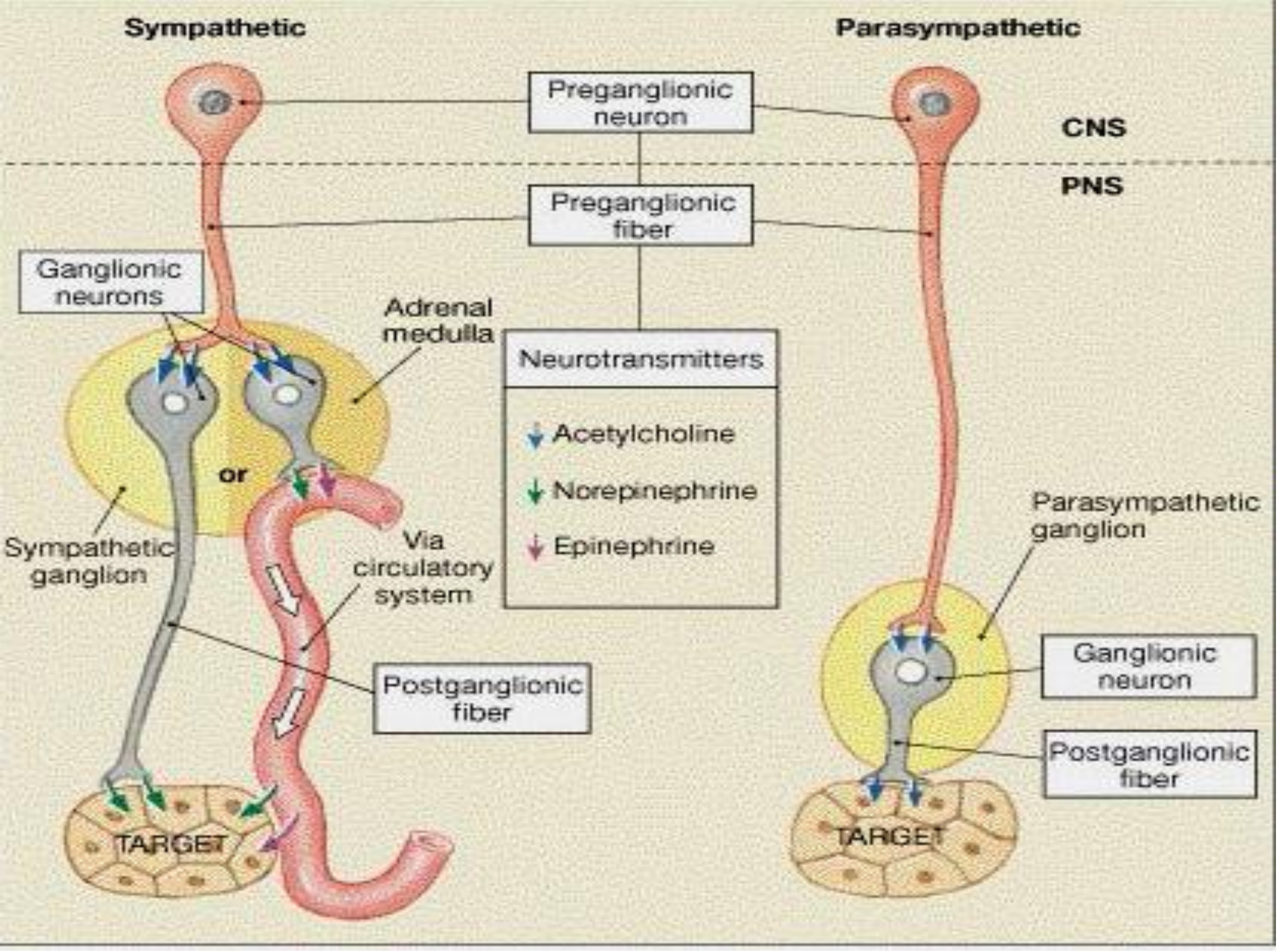
(from T1 to L2)

2) Prevertebral Ganglia in front of vertebral column, close to large arteries (mesenteric and celiac)

3) Terminal Ganglia lie close to or within viscera (sphenopalatine, submaxillary and otic)

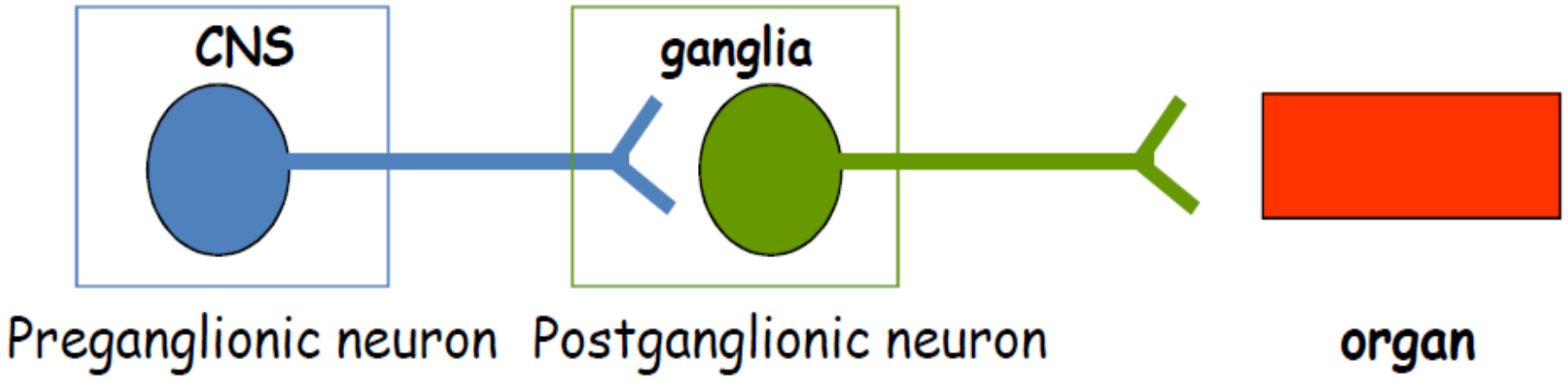
Autonomic ganglia




Sympathetic
Parasympathetic
Preganglionic neuron
CNS
PNS
Preganglionic fiber
Ganglionic neurons
Adrenal medulla
Neurotransmitters
Acetylcholine
Norepinephrine
Epinephrine
or
Sympathetic ganglion
Via circulatory system
Postganglionic fiber
TARGET
Parasympathetic ganglion
Ganglionic neuron
Postganglionic fiber
TARGET

Anatomy

- **Preganglionic neurons : cell bodies in brain or spinal cord**
- **Postganglionic neurons : axons directly to the effector organ**



Autonomic Nerve Fibers in the Skeletal Nerves

Preganglionic fibers are **small, myelinated** and **type B fibers**

Postganglionic fibers are **small**, **unmyelinated**, **type C fibers**

8% of fibers in a skeletal nerve are SYMPATHETIC

Physiologic Anatomy of Sympathetic Nervous System

1. **2 paravertebral sympathetic chains of ganglia** are interconnected with the spinal nerves on the side of the vertebral column
2. **Prevertebral ganglia** (the celiac and hypogastric)
3. **Nerves** extending from the ganglia to the different internal organs

Sympathetic nerve fibers originate in

T-1 to L-2 → sympathetic chain → tissues and organs that are stimulated by them

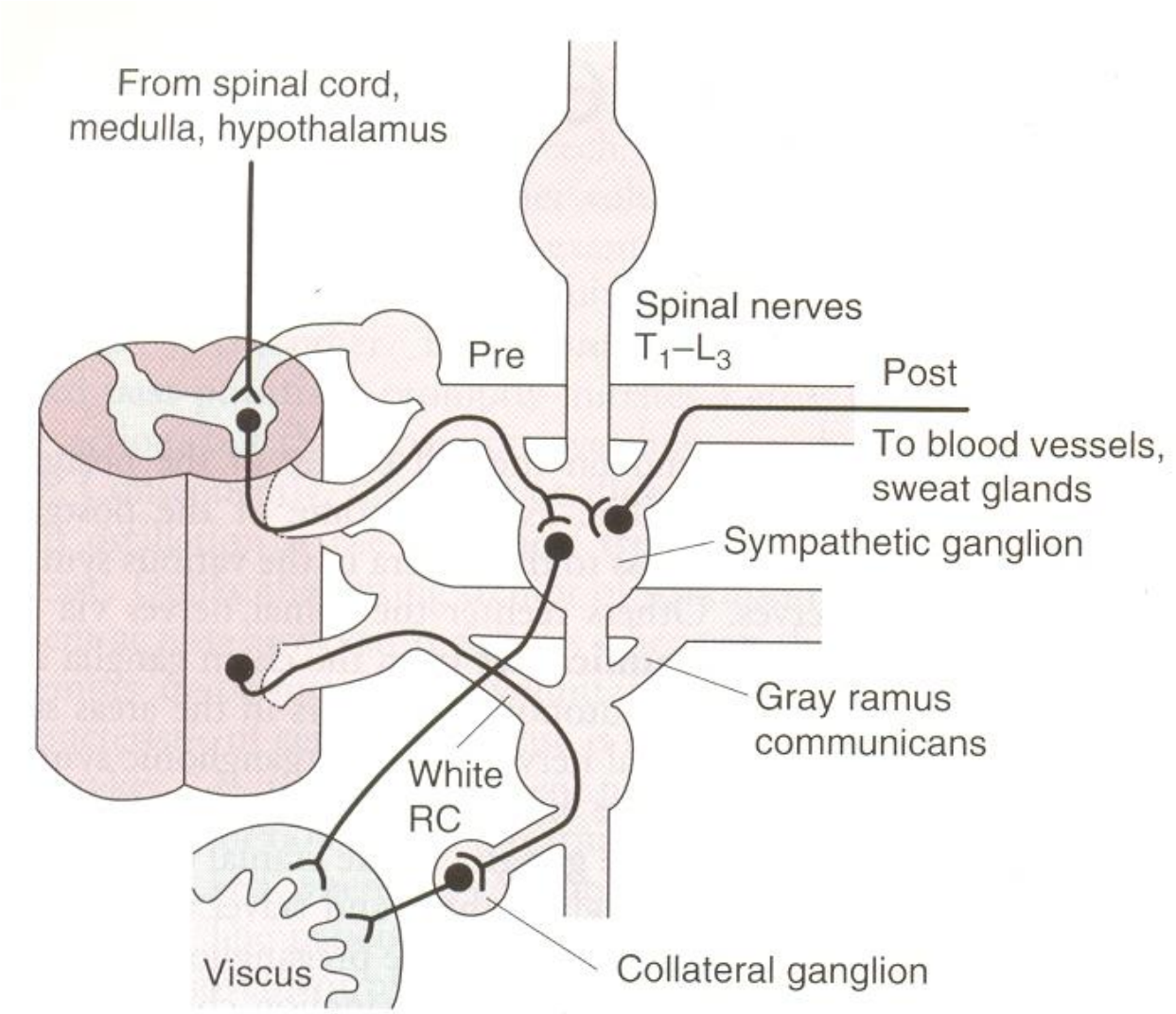
Sympathetic nervous system

- PREGANGLIONIC nerves
  thoracic and lumbar spinal cord levels
  axons are **short and myelinated**

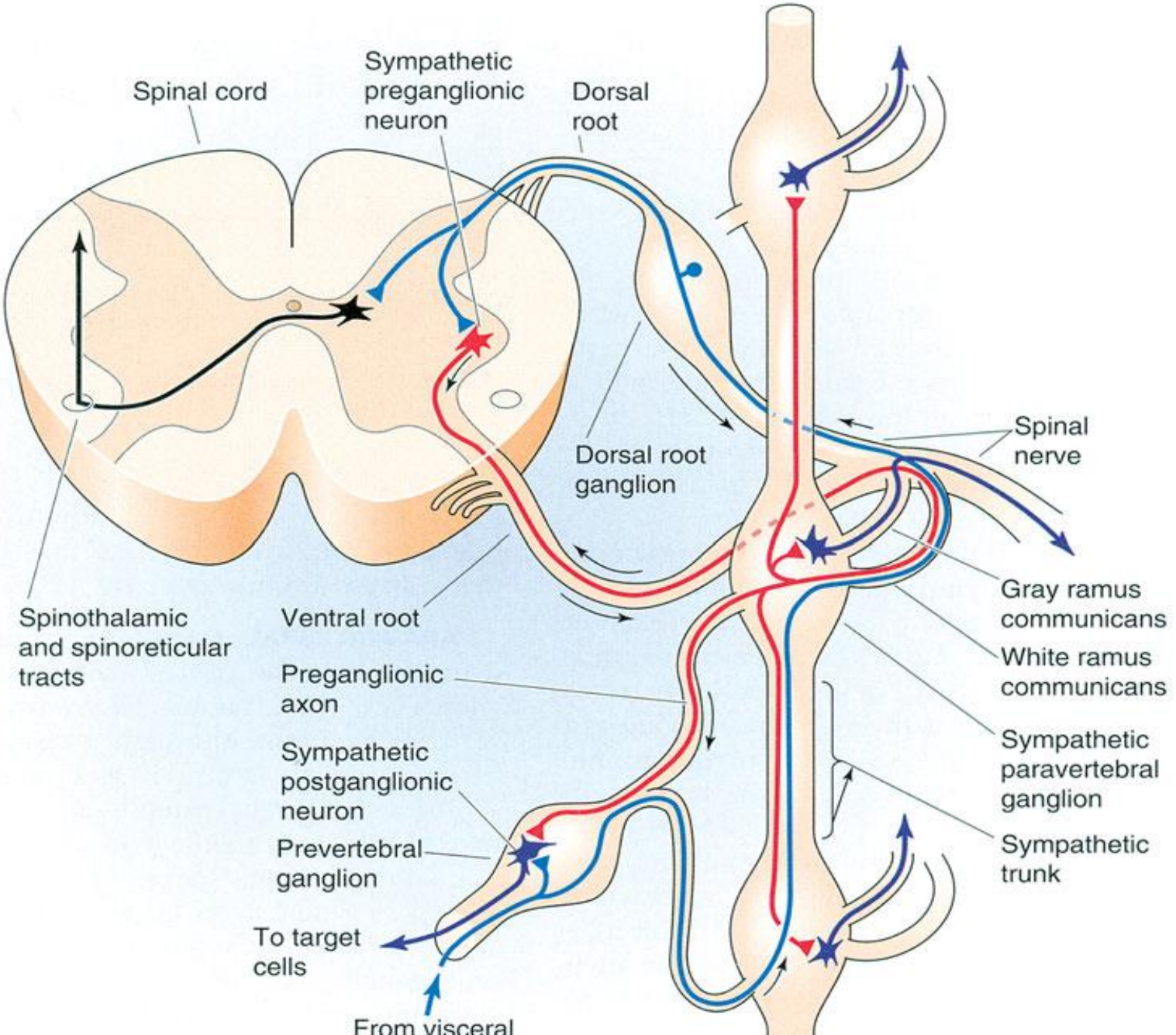
- POSTGANGLIONIC nerves
  axons are **long and unmyelinated**

  Ganglia are located near the spinal cord

Sympathetic Division



SYMPATHETIC DIVISION


Spinal cord
Sympathetic preganglionic neuron
Dorsal root
Spinal nerve
Dorsal root ganglion
Spinothalamic and spinoreticular tracts
Ventral root
Gray ramus communicans
White ramus communicans
Preganglionic axon
Sympathetic postganglionic neuron
Sympathetic paravertebral ganglion
Prevertebral ganglion
Sympathetic trunk
To target cells
From visceral

Preganglionic and Postganglionic Sympathetic neurons

are different from skeletal motor nerves

Each sympathetic pathway is composed of 2 neurons, a ***preganglionic neuron*** *and a* ***postganglionic neuron***

The cell body of each preganglionic neuron lies in the ***intermediolateral horn*** *of the* spinal cord;

its fiber passes, through an ***anterior root*** *of the cord into the corresponding spinal nerve.*

Pre and postganglionic symp….

1) It can synapse with postganglionic sympathetic neurons **in the ganglion that it enters;**

2) It can pass **upward or downward** in the chain and synapse in one of the other ganglia of the chain; or

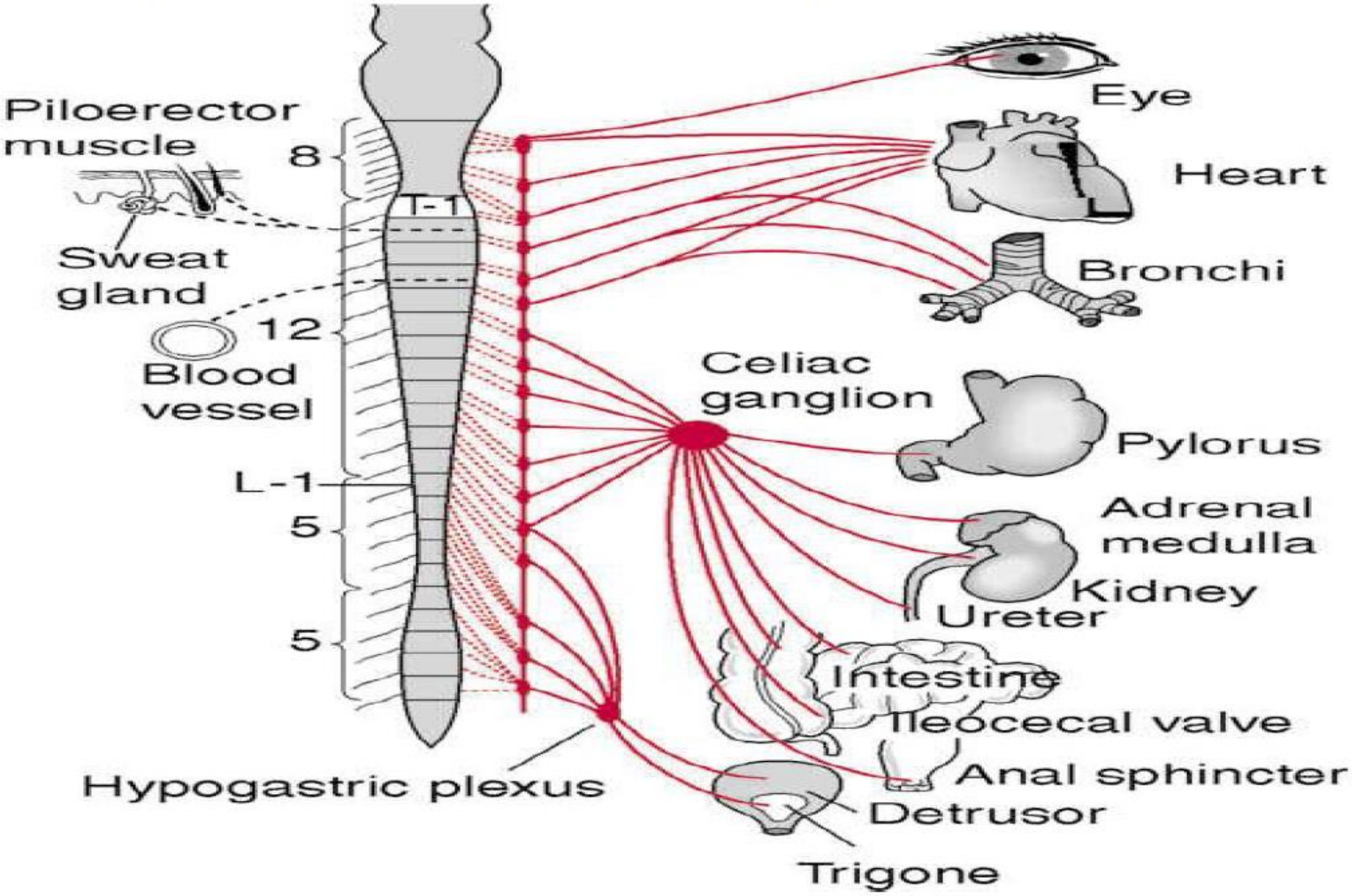
3) it can pass up and down the chain and then through one of the *sympathetic nerves radiating outward from the* chain, finally synapsing in a **peripheral sympathetic ganglion.**

Special Nature of the Sympathetic Nerve Endings in Adrenal Medulla

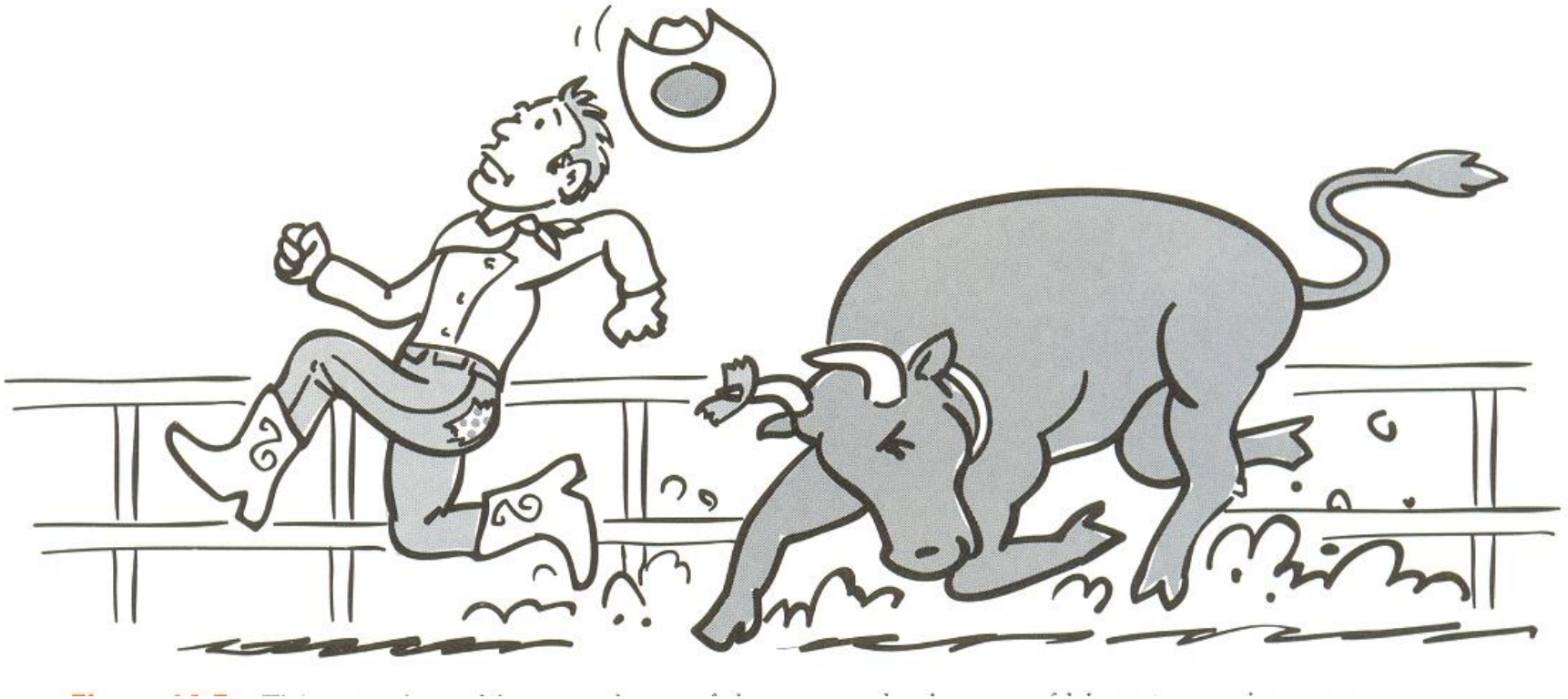
Preganglionic sympathetic nerve fibers pass ***without synapsing****, all the way from the* **intermediolateral horn** cells of the spinal cord→ **sympathetic chains** → **splanchnic** nerves → **adrenal medullae**

There they end directly on modified neuronal cells derived from nervous tissue that secrete ***epinephrine*** and ***norepinephrine*** *into the blood stream.*

Sympathetic nervous system. (T_1-L_2)



Sympathetic functions



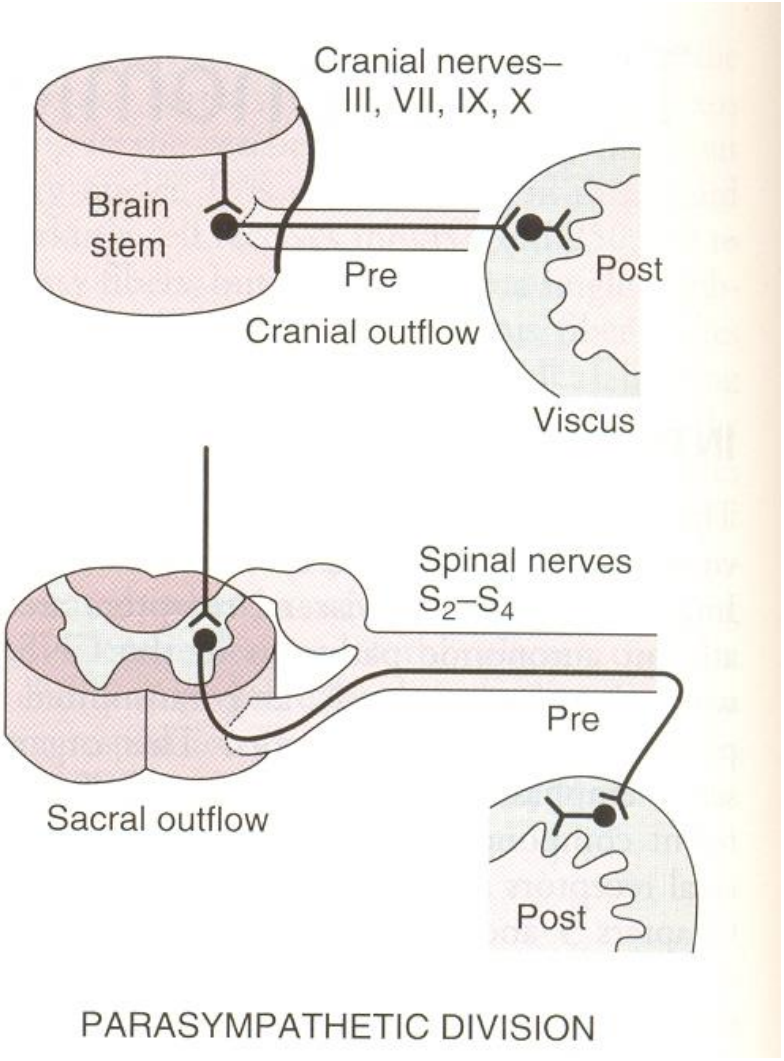
The Fight or Flight Response

1. Increased Blood Pressure
2. Increased Heart Rate (+ chronotropic effect)
3. Increased Force of Cardiac Contraction
4. Increased Heart conduction velocity
5. Increased depth and rate of Respiration
6. Shift of blood flow to skeletal muscles § heart
7. Liver Glycogen → Glucose
8. Mobilization of FFA from adipose tissue
9. Contraction of Spleen capsule (hematocrit)

Fight and Flight….

10. Dilation of Pupil (Mydriasis)
11. Widening of Palpebral fissure
12. Piloerection
13. Inhibition of GI motility, secretion, contraction of sphincters
14. Sweating (cold sweat as skin vessels are constricted)
15. Increased metabolism
16. Increased mental activity
17. Increased muscle Strength

Parasympathetic Division



PARASYMPATHETIC DIVISION

Physiologic Anatomy of the Parasympathetic Nervous System

cranial nerves III, VII, IX, and X;

S2 and S3(S2-S4)

About **75%** of all PS fibers are in the **vagus nerves** to entire thoracic and abdominal regions of the body

to the **heart**, **lungs, esophagus, stomach, small intestine, proximal half of the colon, liver, gallbladder, pancreas, kidneys and ureters**

Parasympatheic…..

Parasympathetic fibers in **3rd** cranial nerve → pupillary sphincter and ciliary muscle of the eye

Fibers from the **7th** CN → lacrimal, nasal, and submandibular glands

From **9th** CN → parotid gland

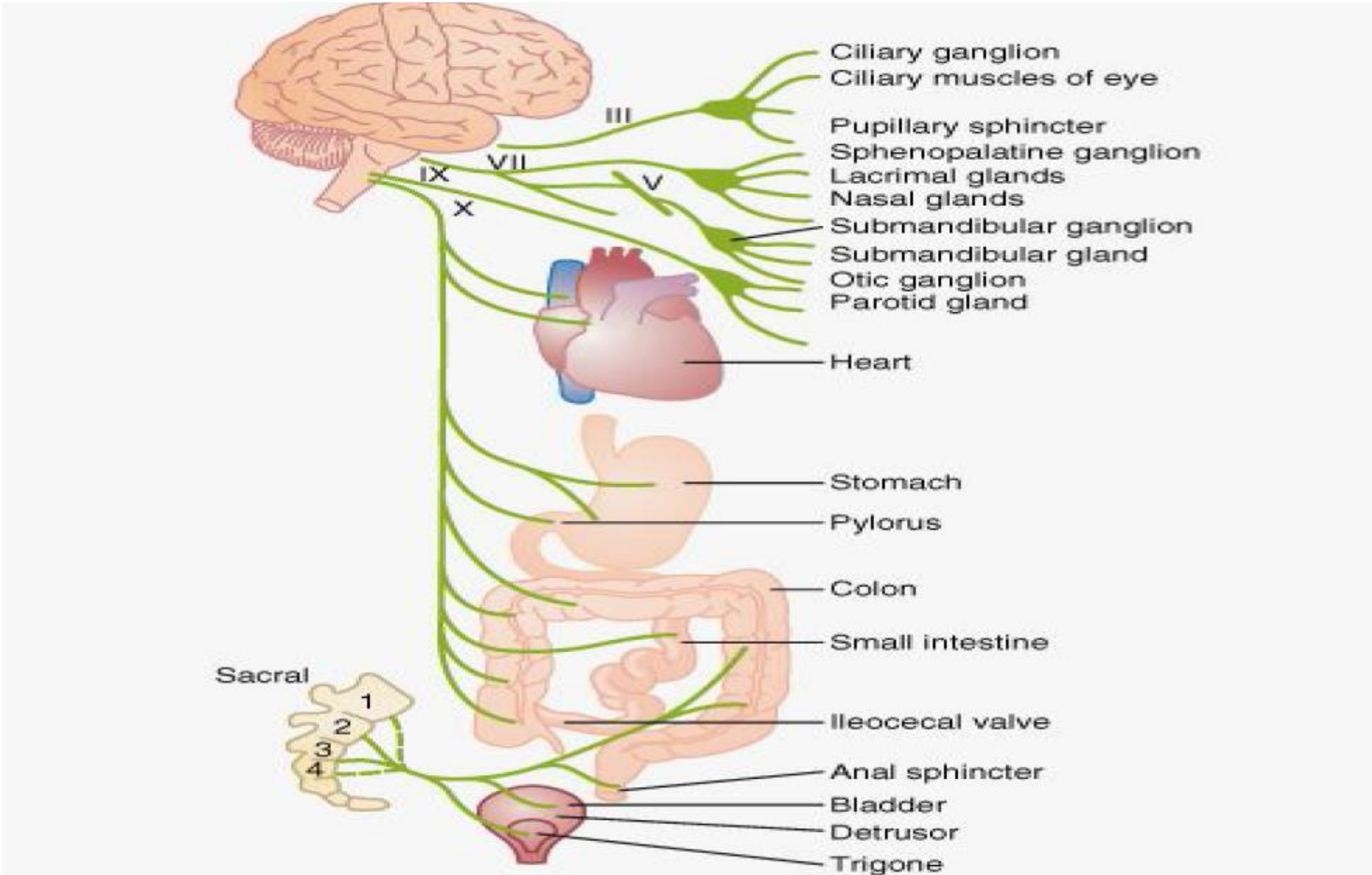
The **sacral** parasympathetic fibers are in the ***pelvic***

Nerves → **descending colon,**

rectum, urinary bladder, lower portions of the

Ureters and external genitalia

Parasympathetic Nervous System



Parasympathetic functions