LECTUR (1)

Functional Anatomy & Physiology of Autonomic NS

INTRODUCTION

THE NERVOUS SYSTEM

- **INTRODUCTION**
- **The nervous system monitors and controls almost every organ / system through a series of positive and negative feedback loops.**
- **The Central Nervous System (CNS): Includes the brain and spinal cord.**
- **The Peripheral Nervous System (PNS): Formed by neurons & their process present in all the regions of the body.**
- **It consists of cranial nerves arises from the brain & spinal nerves arising from the spinal cord.**
- **The peripheral NS is divided into**
- **Somatic Nervous system**
- **Autonomic nervous system**

OBJECTIVES

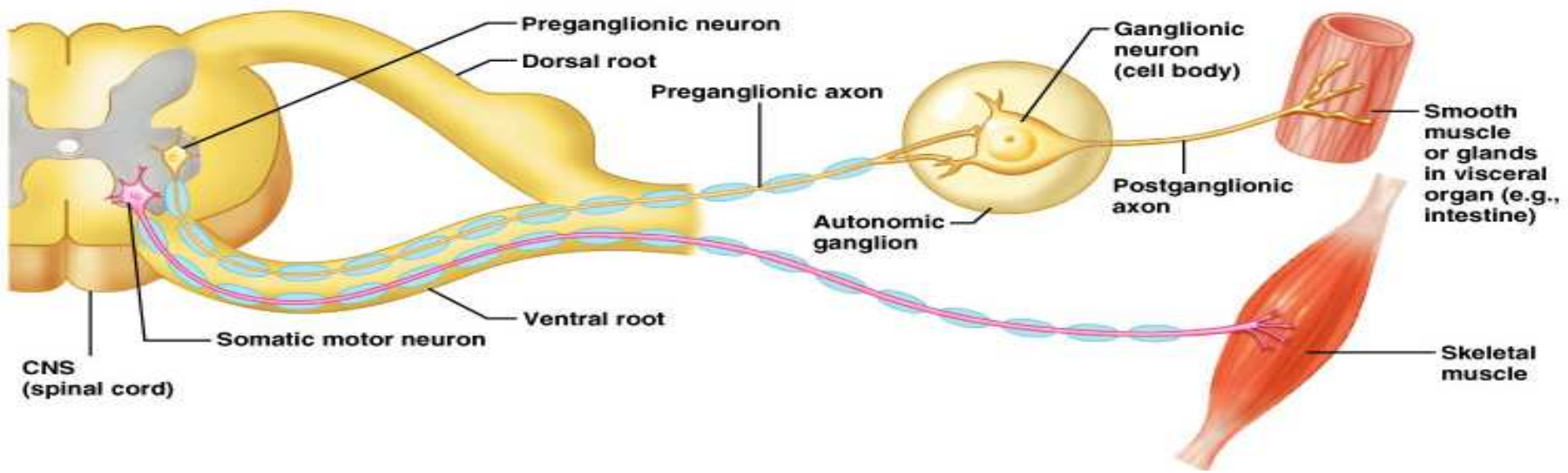
- **Anatomy and physiology of Autonomic Nervous System**
- At the end of this lectutre (1)the student should be able to:-
- -appreciate the anatomy of symathetic& parasympathetic nervous system.
- -explain physiological functions of Symathetic &parasympathetic nerves in head&neck,chest,abdomen and pelvis

FUNCTIONAL ANATOMY OF THE AUTONOMIC NERVOUS SYSTEM

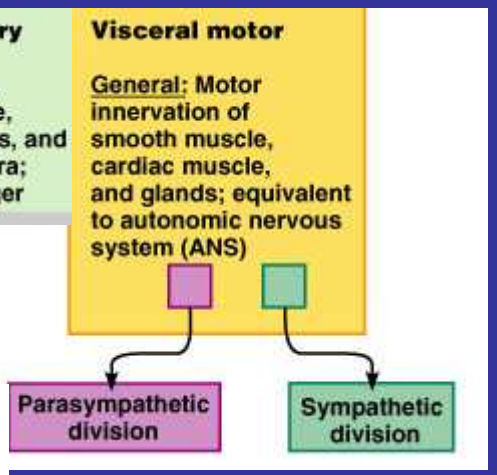
Basic anatomical difference between the motor pathways of the voluntary somatic nervous system (to skeletal muscles) and those of the autonomic nervous system

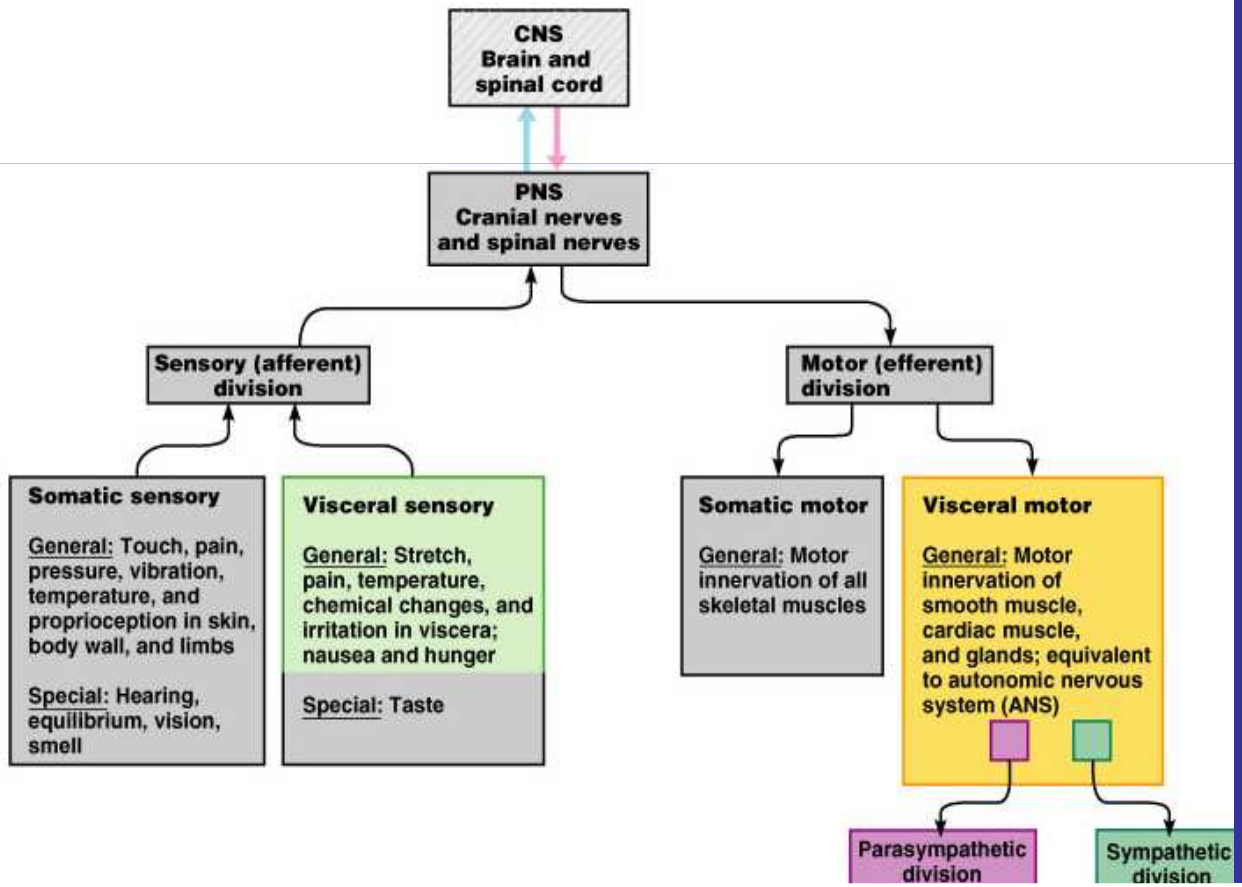
- Somatic division:
  - Cell bodies of motor neurons reside in CNS (brain or spinal cord)
  - Their axons (sheathed in spinal nerves) extend all the way to their skeletal muscles
- Autonomic system: chains of two motor neurons
  - 1st = preganglionic neuron (in brain or cord)
  - 2nd = gangionic neuron (cell body in ganglion outside CNS)
  - Slower because lightly or unmyelinated

Basic anatomical difference between the motor pathways of the voluntary somatic nervous system (to skeletal muscles) and those of the autonomic nervous system



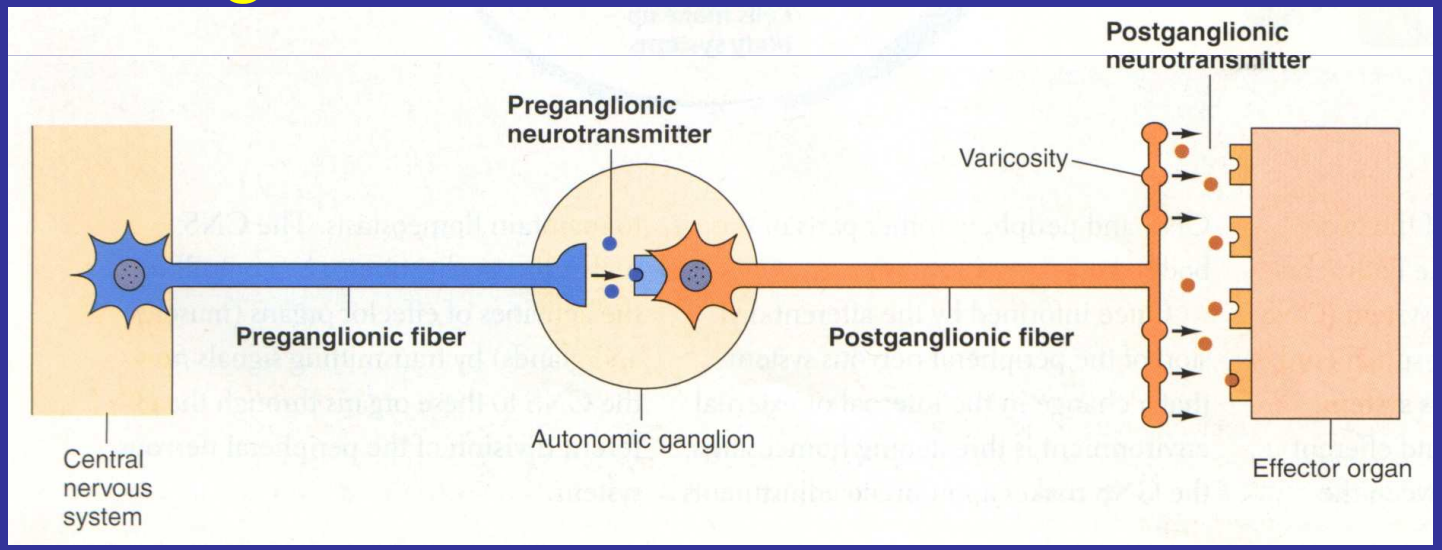
The Autonomic Nervous System





- ANS is the subdivision of the peripheral nervous system that regulates body activities that are generally ***not under conscious control***
- ***Visceral motor*** innervates ***non-skeletal (non-somatic) muscles***
- Composed of a special group of neurons serving:
  - Cardiac muscle (the heart)
  - Smooth muscle (walls of viscera and blood vessels)
  - Internal organs
  - Skin

- Axon of 1st (*preganglionic*) neuron leaves CNS to synapse with the 2nd (*ganglionic*) neuron
- Axon of 2nd (*ganglionic*) neuron extends to the organ it serves



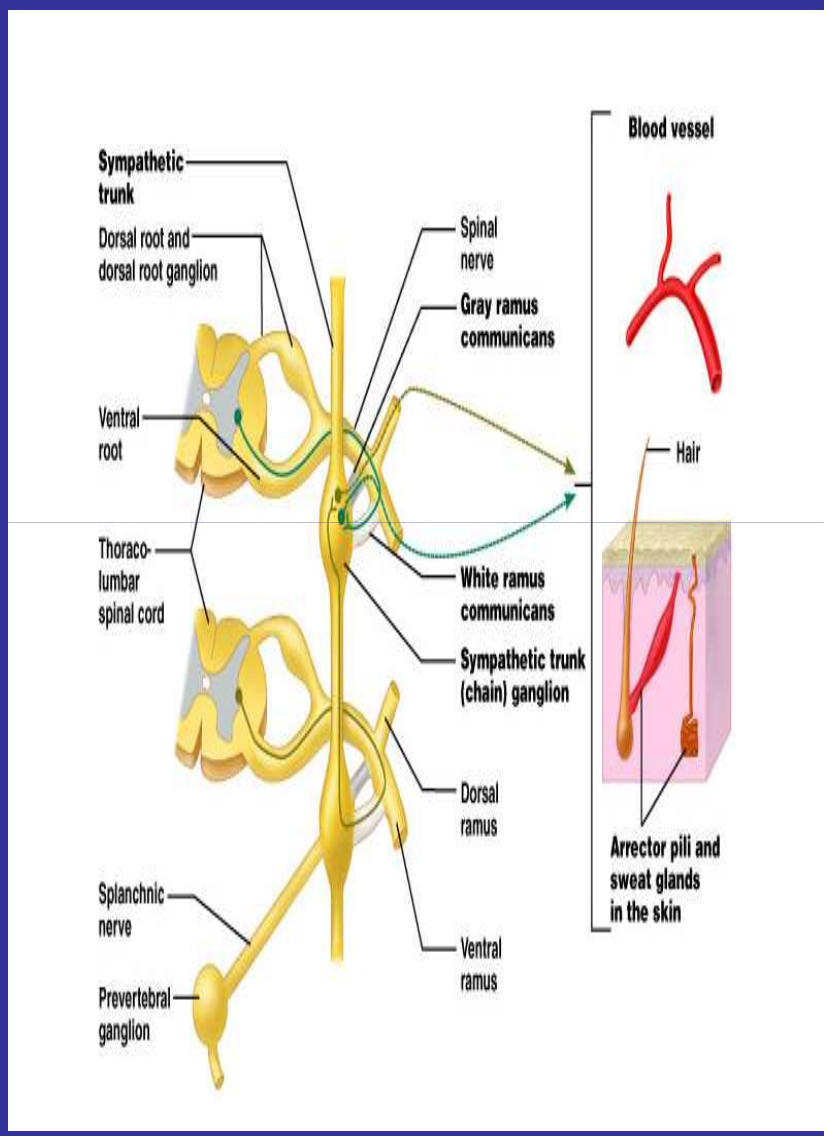
LOCATIONS OF AUTONOMIC GANGLIA

Sympathetic Ganglia:

- **Paravertebral Ganglia**
- **Prevertebral ganglia**

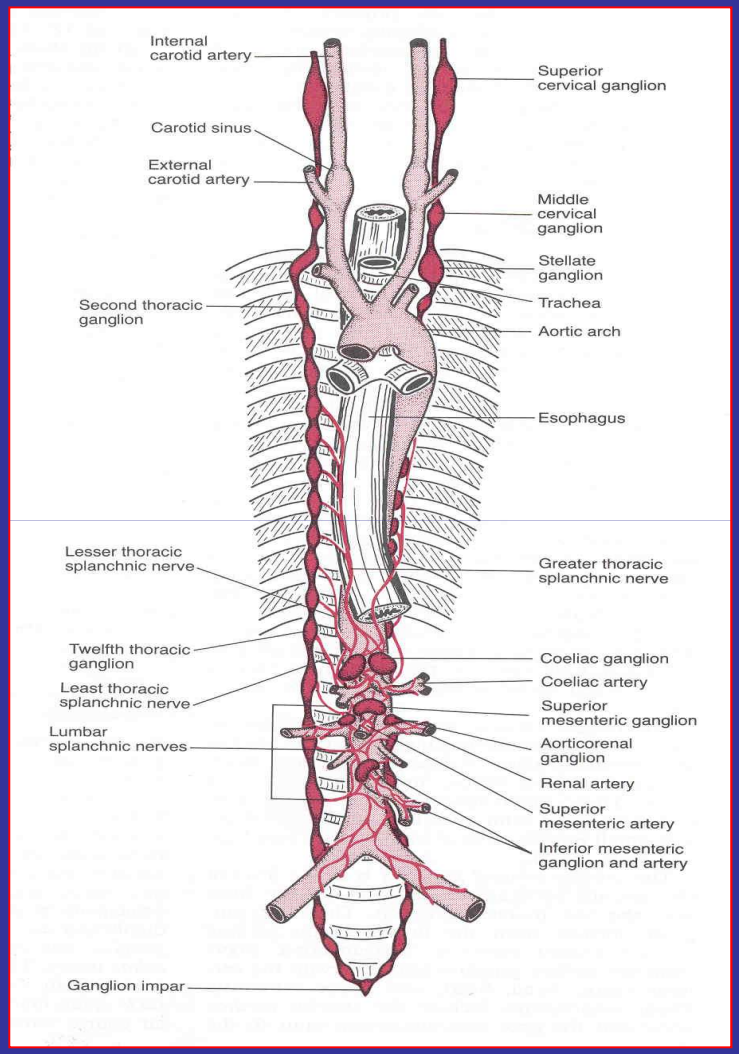
Parasympathetic Ganglia:

Terminal ganglia in the wall of organ



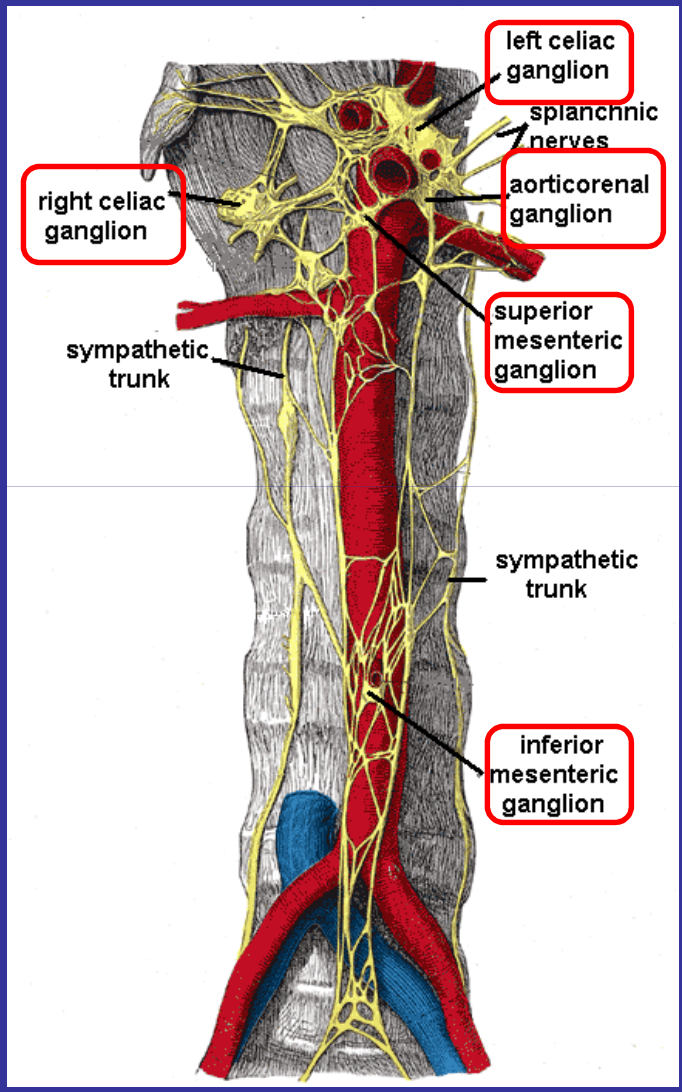
Paravertebral Ganglia

- Consist of the right and left sympathetic chains or trunks.
- The chains lie next to the vertebral column throughout its length
- There is approximately one ganglion associated with each spinal cord segment, except in the cervical and the sacral regions.
- The chains end into a common ‘ganglion impar’ in front of coccyx
- Ref : fondation blook anatomy



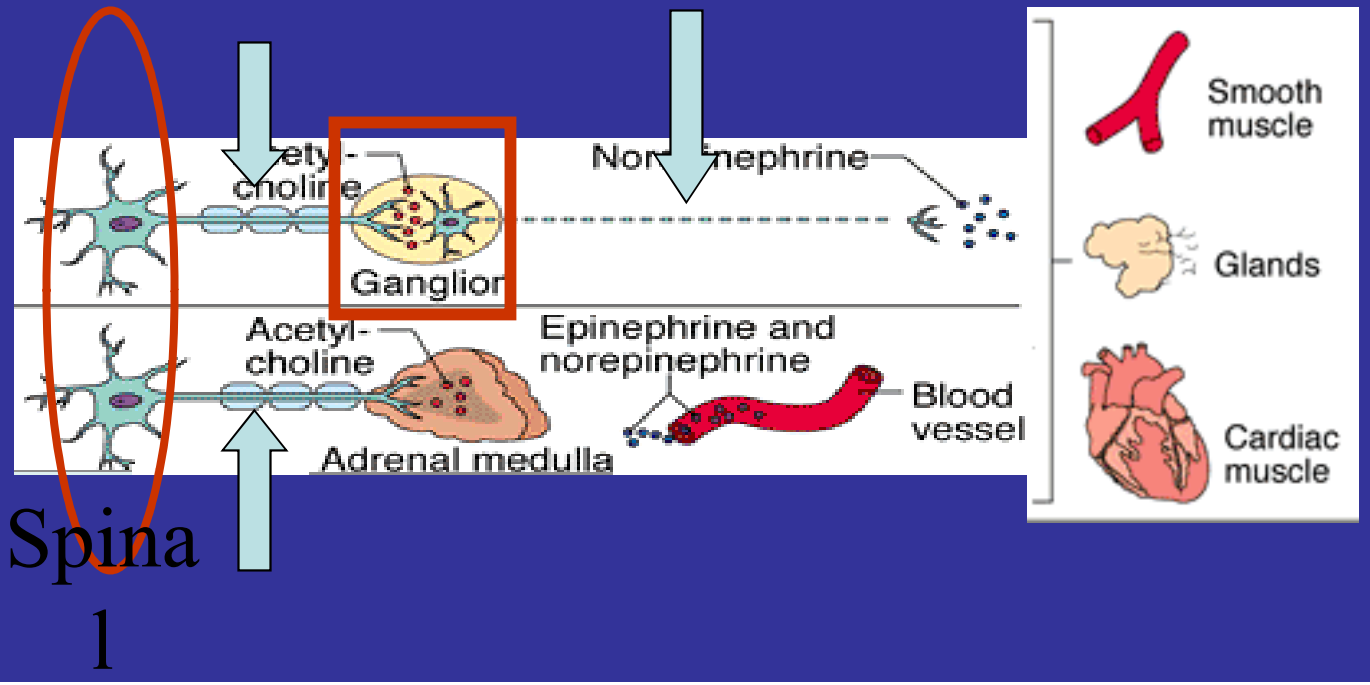
Prevertebral Ganglia

- Unpaired, not segmentally arranged
- Located in abdomen, anterior to the vertebral column
- Main ganglia
  - Celiac
  - Superior mesenteric
  - Inferior mesenteric
  - Aorticorenal
- Ref : fondation blook anatomy



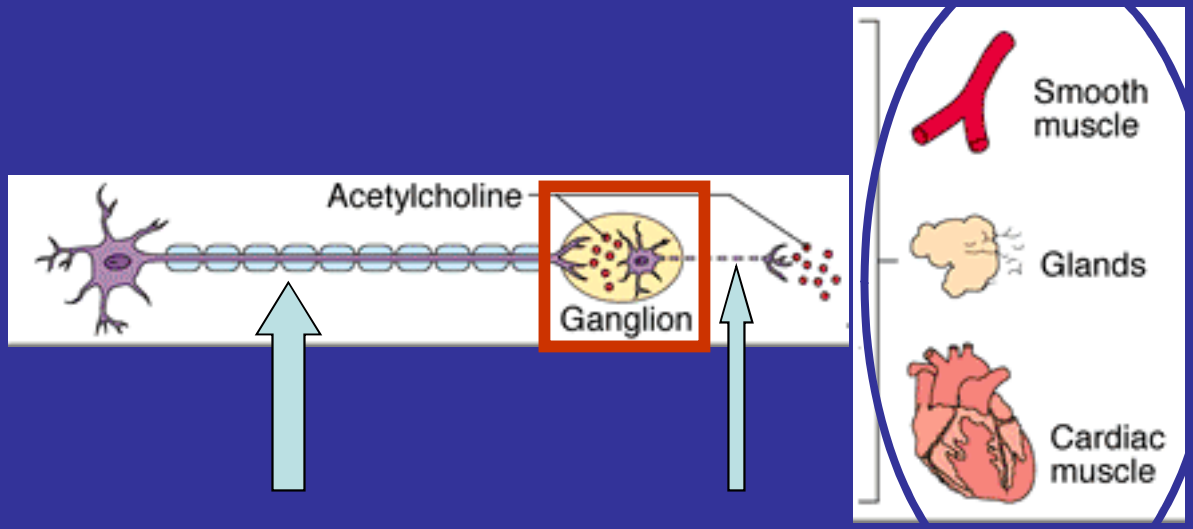
Sympathetic Innervation of Visceral Targets

- Short, lightly myelinated preganglionic neurons
- Long, unmyelinated postganglionic neurons
- Ganglia close to spinal cord

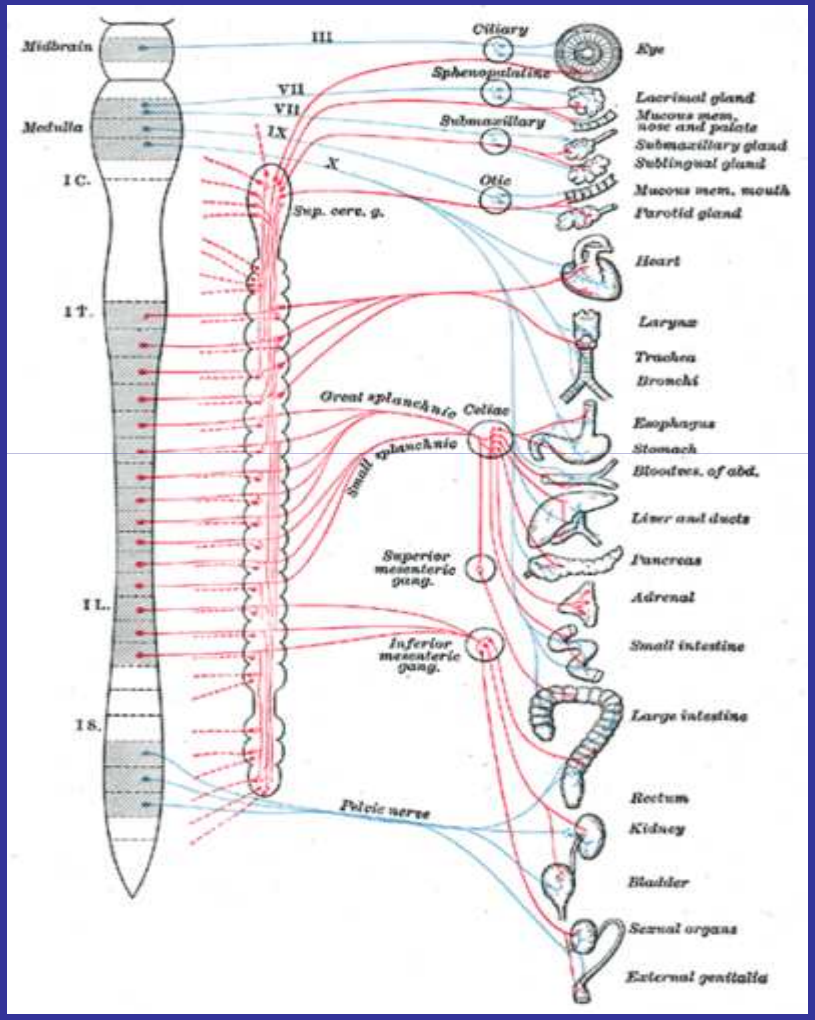


Parasympathetic Innervation of Visceral Targets

- Ganglia close to or on target organs
- Preganglionic neurons - long
- Post ganglionic neurons - short



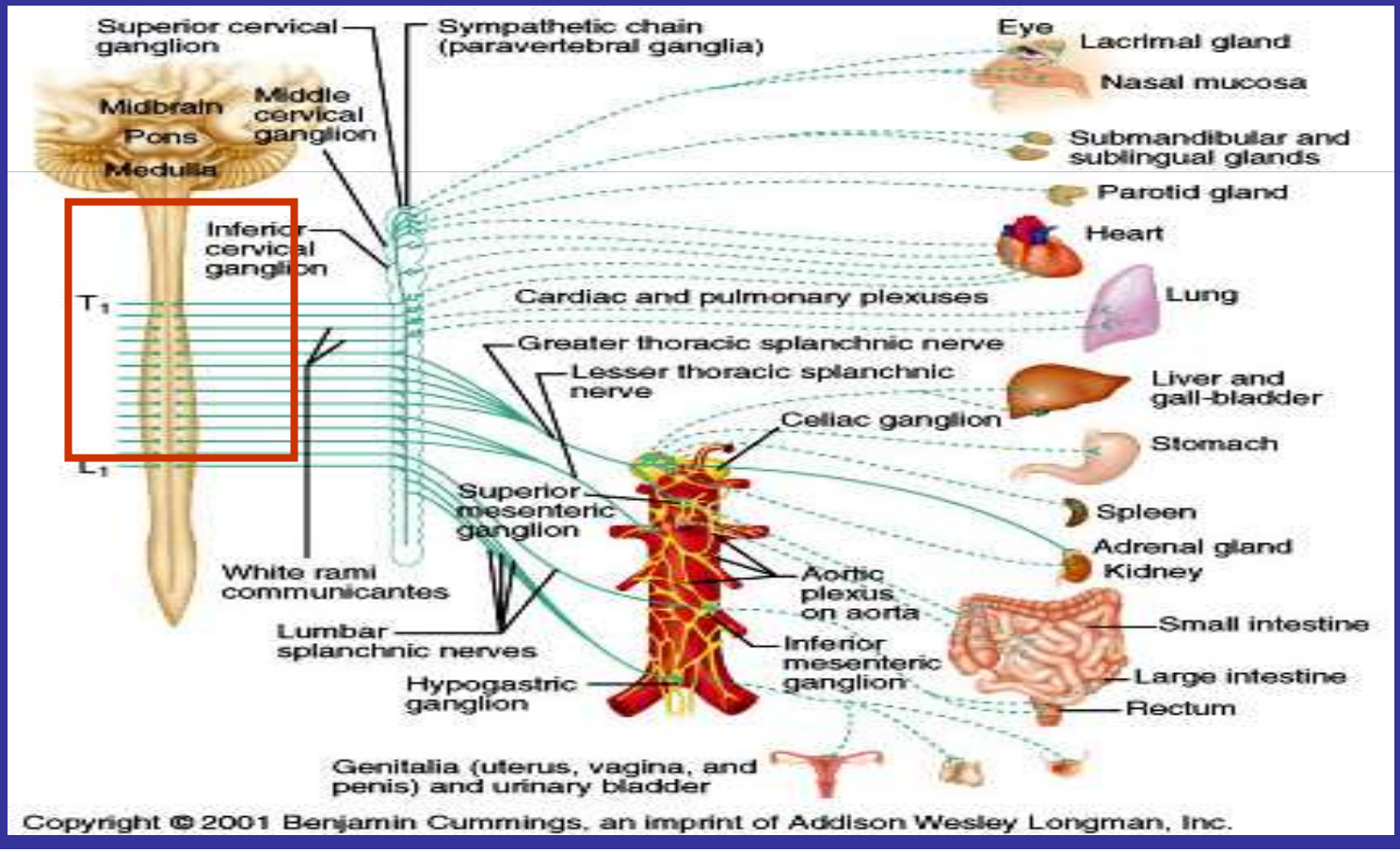
SYMPATHETIC & PARASYMPATHETIC NERVOUS SYSTEM ORIGIN



Blue= Para symp; Red symp

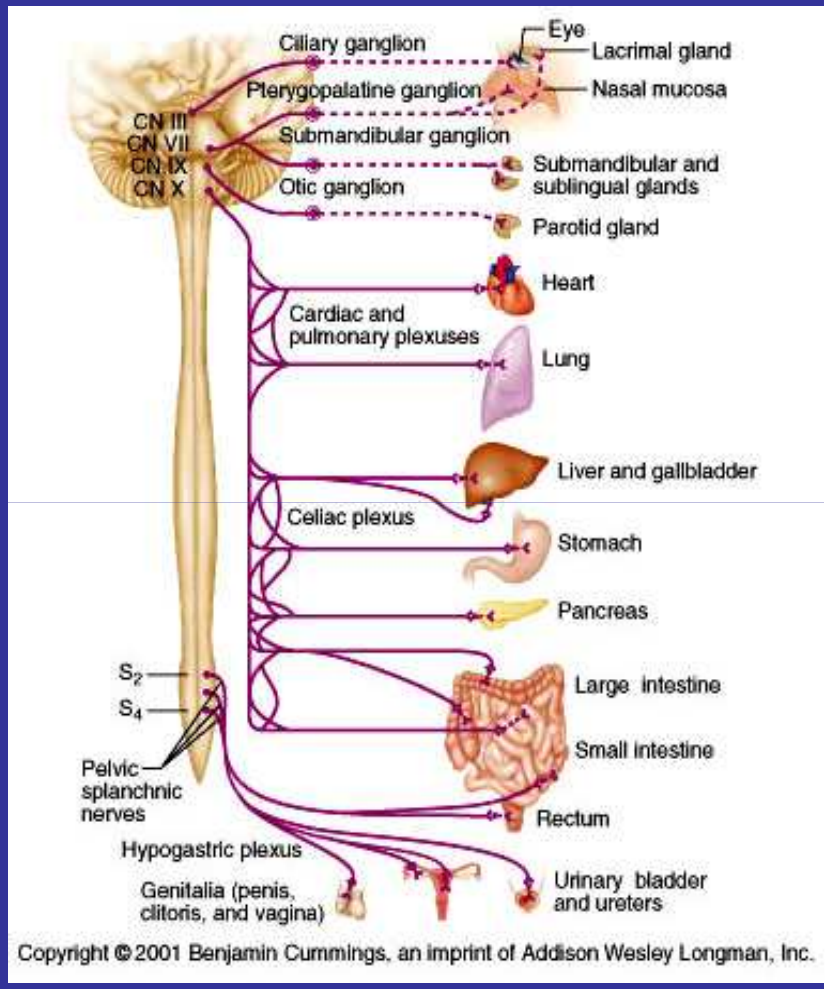
Sympathetic - Origin

- Thoracolumbar **lateral horns of the spinal segments T1-L2.**
- Nerve fibers originate between T1 & L2



Parasympathetic - Origin

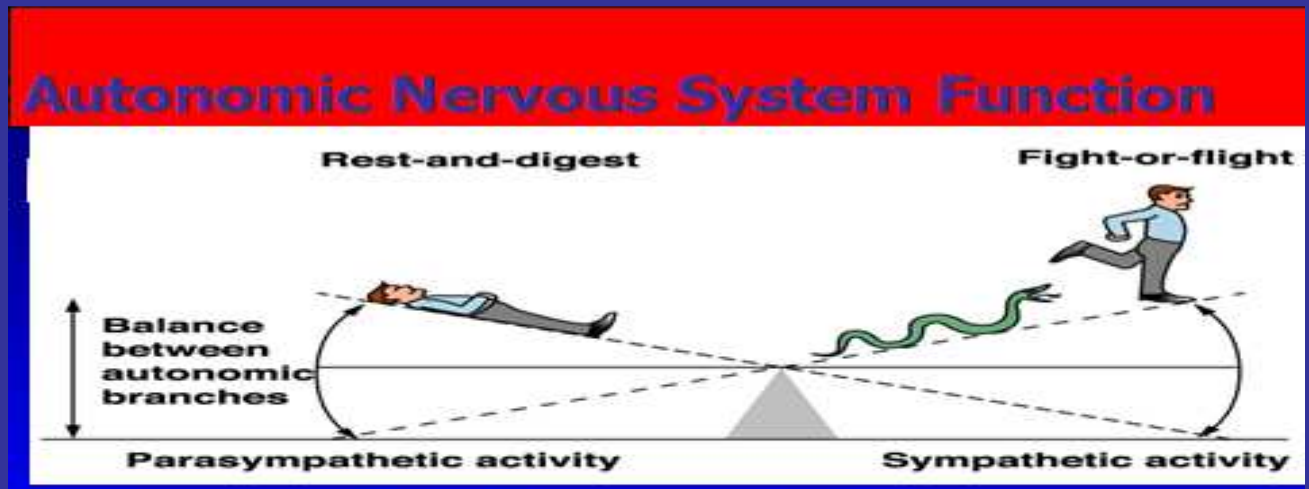
- Craniosacral Cell bodies of the motor nuclei of the cranial nerves III, VII, IX and X in the brain stem
- Second, third and fourth [S2-S4] sacral segments of the spinal cord
  - Nerve fibers emerge from brain & sacrum
    - cranio-sacral outflow



PARASYMPATHETIC NERVOUS SYSTEM

- The cranial nerves III, VII and IX affect the pupil and salivary gland secretion
- Vagus nerve (X) carries fibres to the heart, lungs, stomach, upper intestine and ureter
- The sacral fibres form pelvic plexuses which innervate the distal colon, rectum, bladder and reproductive organs.

PHYSIOLOGICAL FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM



These 2 systems are antagonistic.

Typically, we balance these 2 to keep ourselves in a state of dynamic balance.

We'll go further into the difference btwn these 2 later!

SYMPATHETIC NERVOUS SYSTEM FUNCTIONS

FEAR, FLIGHT OR FIGHT

- The sympathetic system enables the body to be prepared for fear, flight or fight
- Sympathetic responses include an increase in heart rate, blood pressure and cardiac output
- Diversion of blood flow from the skin and splanchnic vessels to those supplying skeletal muscle
- Increased pupil size, bronchiolar dilation, contraction of sphincters and metabolic changes such as the mobilisation of fat and glycogen.

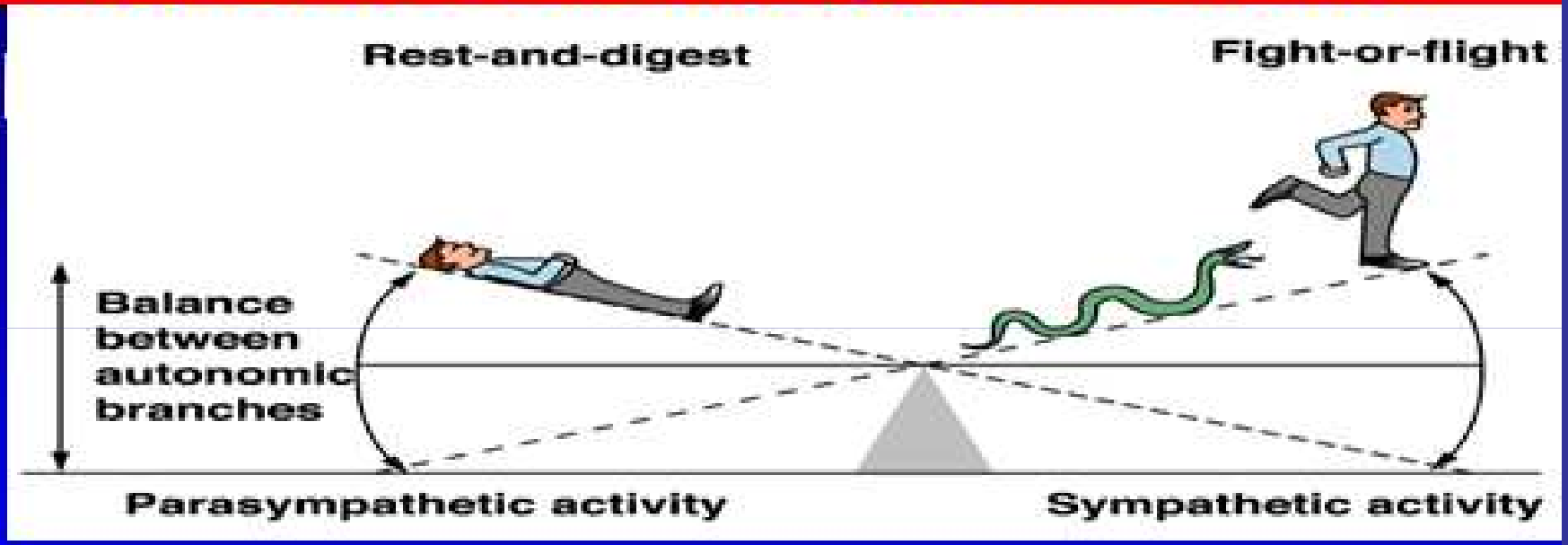
FUNCTIONS OF SYMPATHETIC NERVOUS SYSTEM

- Sympathetic nerves dilate the pupil and relax the lens, allowing more light to enter the eye.
- Bronchioles dilate, which allows for greater alveolar oxygen exchange.
- It increases heart rate and the contractility of cardiac cells (myocytes), thereby providing a mechanism for the enhanced blood flow to skeletal muscles.

PARASYMPATHETIC NERVOUS SYSTEM FUNCTIONS

- The parasympathetic nervous system has "rest and digest" activity.
- In physiological terms, the parasympathetic system is concerned with conservation and restoration of energy, as it causes a reduction in heart rate and blood pressure, and facilitates digestion and absorption of nutrients, and consequently the excretion of waste products

Autonomic Nervous System Function



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PHYSIOLOGICAL FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM

The Autonomic Nervous System

Structure	Sympathetic Stimulation	Parasympathetic Stimulation
Iris (eye muscle)	Pupil dilation	Pupil constriction
Salivary Glands	Saliva production reduced	Saliva production increased
Oral/ Nasal Mucosa	Mucus production reduced	Mucus production increased
Heart	Heart rate and force increased	Heart rate and force decreased
Lung	Bronchial muscle relaxed	Bronchial muscle contracted

The Autonomic Nervous System

Structure	Sympathetic Stimulation	Parasympathetic Stimulation
Stomach	Peristalsis reduced	Gastric juice secreted; motility increased
Small Intes	Motility reduced	Digestion increased
Large Intes	Motility reduced	Secretions and motility increased
Liver	Increased conversion of glycogen to glucose	
Kidney	Decreased urine secretion	Increased urine secretion
Adrenal medulla	Norepinephrine and epinephrine secreted	
Bladder	Wall relaxed Sphincter closed	Wall contracted Sphincter relaxed

THANK YOU