

PHYSIOLOGY



Lec: 21 [part 1 & 2]

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General Physiology
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Lectures 21
Autonomic Nervous System I

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Peripheral Nervous System

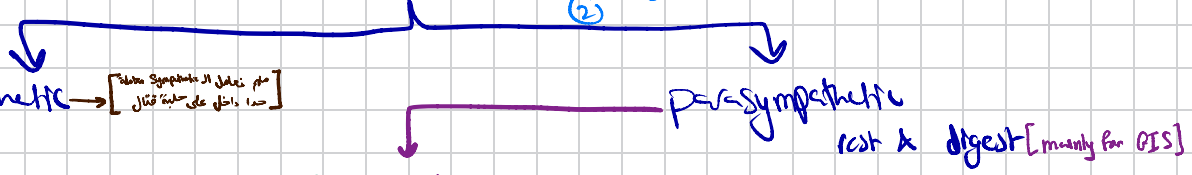


Somatic nervous System



Autonomic nervous System

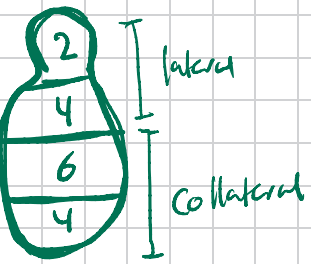
The motor part of nervous system that controls the involuntary actions



Note:

- Structural unit of NS: neuron
- Functional unit of NS: Reflex arc

- Relay: lateral paravertebral sympathetic chain, Except: abdominal parietis [Coeliac ganglion, why? no to do the whole] in BIS
- Origin: Thoracic & upper 3 lumbar, lateral horn cells of spinal cord, why??
- Catabolic reaction [energy consuming]
- [alarm response] for emergencies
 - Fight
 - Flight
- * Sympathetic System vasoconstricts for all vessels in the body, EXCEPT → the affected skeletal muscle & heart, Vasodilation occurs for both
 - ↳ Because in cases of emergency we want the fastest response possible.



Note: The nerve supply for head & neck [2N]
 is from upper 2 thoracic nerves
 من ٢ أعصاب كبدان فوق . . .
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 من ٢ أعصاب كبدان فوق . . .

* Adrenal medulla \rightsquigarrow located above each kidney

① during fetal time:
was a ganglion [has pre + post]

② change occurred that
made the ganglion
lose its -ion

cell body changed into a secretory
gland that secretes 80% adrenaline [epinephrine]
x noradrenaline

MCQ: adrenal medulla is a
modified sympathetic
ganglion.

* Sympathetic $\left\{ \begin{array}{l} \oplus \text{ CVS} \\ \ominus \text{ GIS} \end{array} \right.$ $\left\{ \begin{array}{l} \text{تكون Flight} \\ \text{تزيد القلب و يحد} \\ \text{inhibition} \end{array} \right.$

* parasympathetic $\left\{ \begin{array}{l} \ominus \text{ CVS} \\ \oplus \text{ GIS} \end{array} \right.$ $\left\{ \begin{array}{l} \text{تزيد الراحة و تبطئ القلب} \\ \text{تزيد فيزيات القلب} \end{array} \right.$

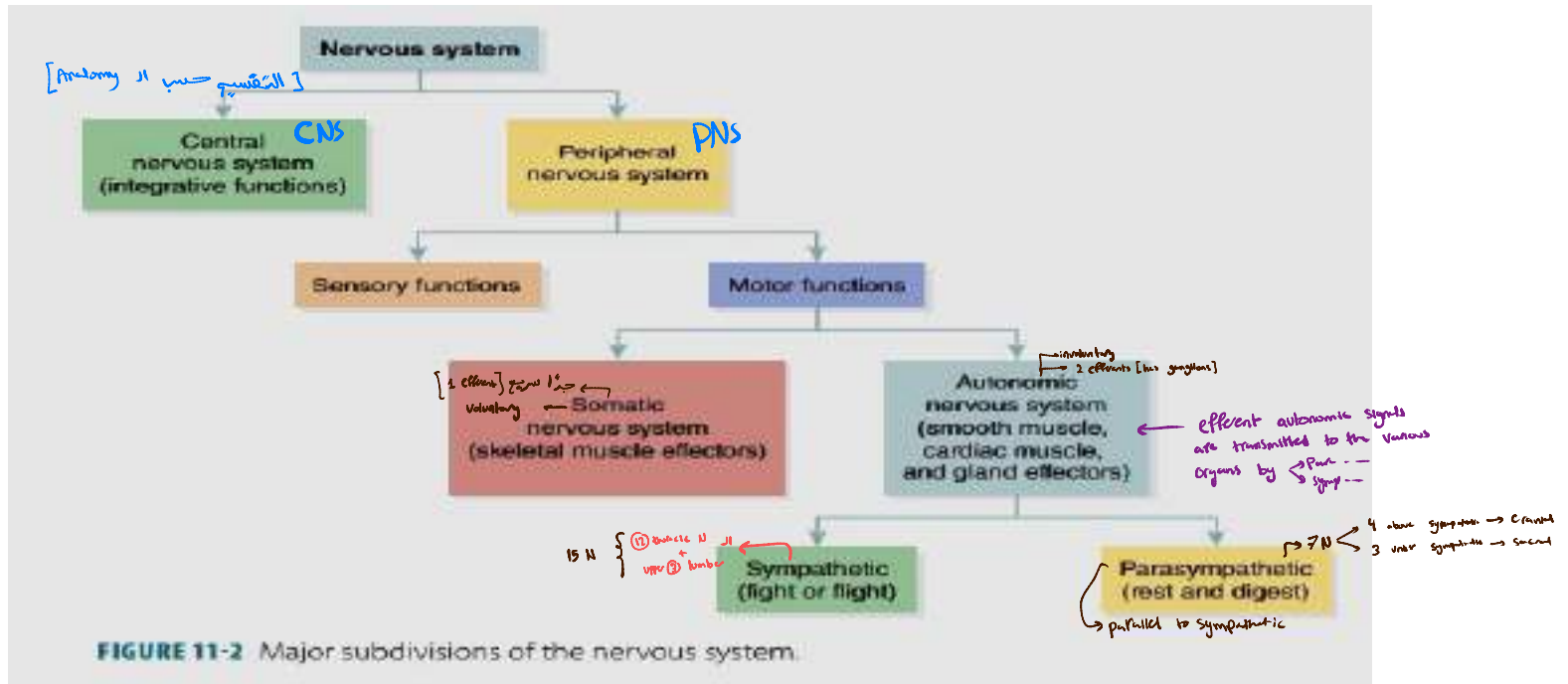
* preganglionic \rightsquigarrow from spinal cord or brain stem \rightarrow ganglion

* postganglionic \rightsquigarrow from ganglion \rightarrow effector organ

• Sympathetic $\left\{ \begin{array}{l} \text{preganglionic} \rightarrow \text{cholinergic ACh} \\ \text{post-ganglionic} \rightarrow \text{adrenergic NE} \end{array} \right.$

• ParaSympathetic $\left\{ \begin{array}{l} \text{preganglionic} \rightarrow \text{cholinergic ACh} \\ \text{post-ganglionic} \rightarrow \text{cholinergic ACh} \end{array} \right.$

Major subdivisions of the Nervous system



* Note = All nerves have Somatic motor functions

But

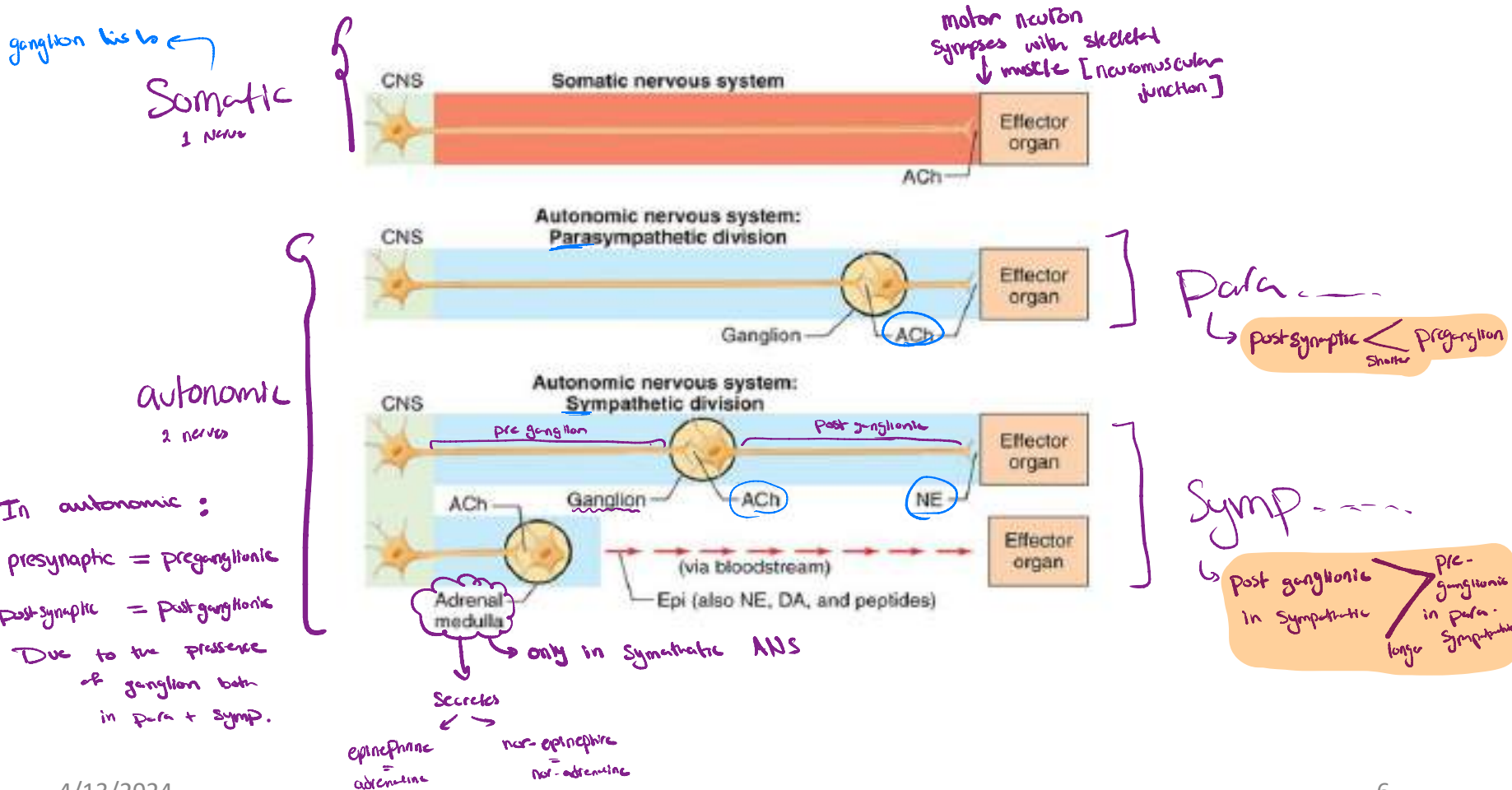
Not all nerves have autonomic motor functions
 autonomic → sympathetic / parasympathetic

* most visceral organs are innervated by both sympathetic & parasympathetic nerve fibres.

4/13/2024

[Autonomic + Somatic] كلتا النوعين في جميع الأعصاب، ولكن ليس في جميع الأعصاب Somatic

Comparison of peripheral organization and transmitters released by somatomotor and autonomic nervous systems



Subdivision of ANS

- The efferent autonomic signals are transmitted to the various organs of the body through two major subdivisions
 - **Sympathetic** nervous system
 - **parasympathetic** nervous system.
- **Dual innervation**: Most visceral organs are innervated by both sympathetic and parasympathetic nerve fibers.
- **Antagonist action**
- Two neuronal chains: In Both the sympathetic and parasympathetic pathways the signal reaches visceral organs through two neuronal
 - Preganglionic
 - Postganglionic

Introduction and general characteristics of the ANS

The autonomic nervous system (ANS) is the portion of the nervous system that controls most visceral functions of the body.

Regulates the cardiovascular and respiratory systems, gastrointestinal tract, exocrine and endocrine glands throughout the body

The ANS also includes the enteric nervous system that functions within the gastrointestinal tract and influences the pancreas, liver, and gallbladder, thereby controlling gastrointestinal motility, secretion.

The two divisions counterbalance each other's activity and most glands & organs are innervated by both. Dual innervations which are usually antagonistic

The output of the autonomic system is divided functionally and pharmacologically into two divisions: the parasympathetic and sympathetic systems

PSN is also known as cholinergic and sympathetic nervous system is also known as adrenergic systems

Most of the action of the ANS are mediated through autonomic reflexes. The ANS operates through **subconscious sensory signals** and **subconscious reflex responses** to control visceral activities

Introduction and general characteristics of the ANS

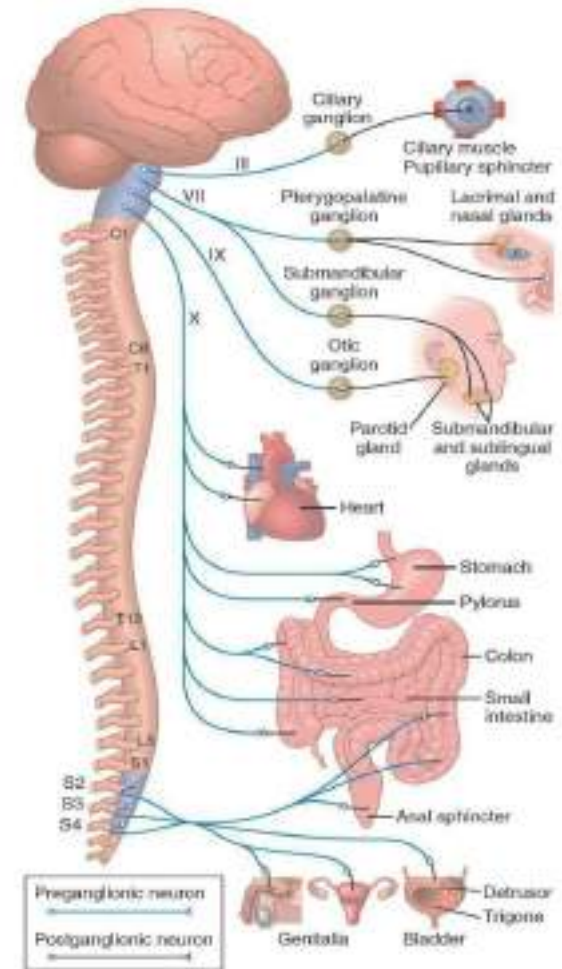
- ANS is activated mainly by centers located in the spinal cord, brain stem, and its activity is affected by hypothalamus and its activity is affected by brain stem, limbic system and frontal lobes, which are concerned with arousal and behavioral responses to threat.
- These central regulators of the ANS also adjust the secretion of hormones that influence blood volume and total peripheral resistance.
- The central regulators of the ANS also coordinate the stress response (e.g., fight-or-flight response), reproduction, and thermoregulation.
- At the conscious level, the limbic cortex transmits signals to the lower centers and can, as such, influence autonomic control.
- The sympathetic is usually activated during stress, excitement // *جهدات* *عناش يزيف ال*
- The parasympathetic performs maintenance activities and conserves body energy – “Resting and Digesting”
- The two divisions counterbalance each other’s activity and most glands & organs are innervated by both. Dual innervations which are usually antagonistic
- The ANS is characterized by its rapid and intense control of visceral functions
- Sympathetic effects are usually widespread and parasympathetic are more localized
- ANS cooperation is best seen in control of the external genitalia
- Parasympathetic fibers cause vasodilation and are responsible for erection of the penis and clitoris
- Sympathetic fibers cause ejaculation of semen in males and reflex peristalsis rhythmic vaginal contractions during orgasm in females
- Sympathetic and parasympathetic tone

Sympathetic & parasympathetic ^① *usually antagonistic*
^② *other times both work together to achieve a goal → ex: sexual activity*

PHYSIOLOGICAL ANATOMY of PSN

Parasympathetic N. fibers = Cranio Sacral

- ❑ The parasympathetic nerve fibers leave the CNS through two divisions; **cranial nerves III, VII, IX, and X.** And through the **second and third sacral spinal nerves** and occasionally the first and fourth sacral nerves.
- ❑ These fibers are longer than sympathetic preganglionic fibers because they do not end until they reach terminal ganglia that lie in or near the effector organs.
- ❑ About 75% of all parasympathetic nerve fibers are in the vagus nerves (cranial nerve X).
- ❑ The vagus nerves supply parasympathetic nerves to the heart, lungs, esophagus, stomach, entire small intestine, proximal half of the colon, liver, gallbladder, pancreas, kidneys, and upper portions of the ureters.
- ❑ Parasympathetic fibers in the III cranial (oculomotor) nerve go to the pupillary sphincter and ciliary muscle of the eye

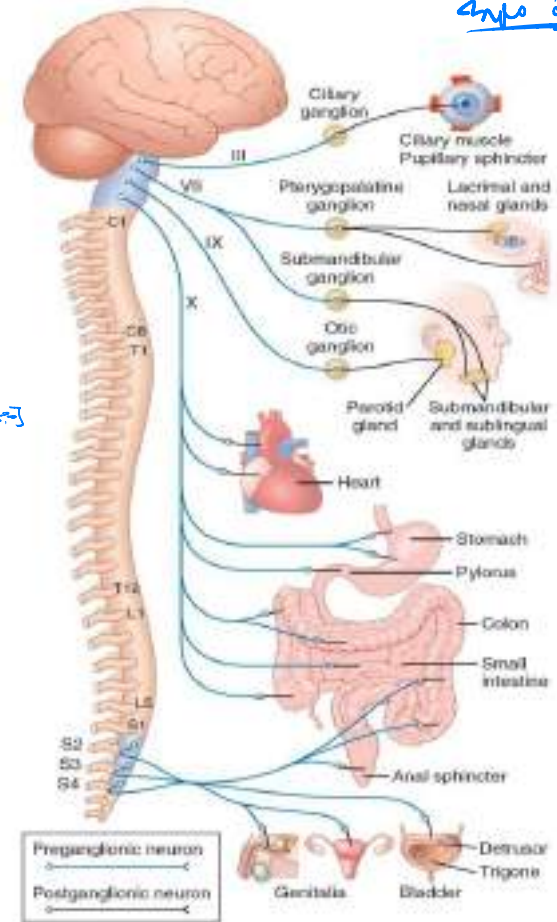


The parasympathetic nervous system. The blue lines represent preganglionic fibers and the black lines show postganglionic fibers.

PHYSIOLOGICAL ANATOMY of PSN

* اللمعة مهمة

- Fibers from the VII cranial (facial) ^{↑ water + ↑ Salivary enzymes [for digestion]} nerve pass to the lacrimal, nasal, and **submandibular** glands, and fibers from the IX cranial (glossopharyngeal) nerve go to the **parotid gland.** ^{↑↑ mucus in saliva [↑ viscosity]}
- The sacral parasympathetic fibers are in the pelvic nerves, which pass through the spinal nerve sacral **plexus** on each side of the cord at the S2 and S3 levels. ^{nerve network [شبكة عصبية]}
- The sacral division of the parasympathetic innervates the descending colon, rectum, urinary bladder, and lower portions of the ureters. Also, this sacral group of parasympathetics supplies nerve signals to the external genitalia to cause erection.
- Like the sympathetic system, the parasympathetic system has both **preganglionic** and **postganglionic** neurons. However, the preganglionic fibers pass uninterrupted all the way to the organ that is to be controlled (except for few cranial parasympathetic nerves).
- The **extremely short postganglionic** neurons are located in the wall of the organ



The parasympathetic nervous system. The blue lines represent preganglionic fibers and the black lines show postganglionic fibers.

→ long preganglionic * short postganglionic in parasympathetic

* GI has its own "brain" → called: myenteric plexus → role: initiate reflexes but aim to help in digestion