

PHYSIOLOGY



Lec: 21 part 1

Done by: Leen Almulaiti

General Physiology
Second semester 2024
Lectures 21
Autonomic Nervous System I

Zuheir A Hasan

Department of anatomy , physiology and biochemistry

College of Medicine

HU

Lecture objectives

- Define the autonomic nervous system
- Describe the functional anatomy ANS
- Describe the autonomic nervous system efferent pathways from the CNS to effector organs and explain how these differ from the pathway of a motor neuron.
- Describe the location of the cell bodies and axonal trajectories of preganglionic sympathetic and parasympathetic neurons.
- Describe the location and trajectories of postganglionic sympathetic and parasympathetic neurons.
- Name the neurotransmitters that are released by preganglionic and postganglionic autonomic neurons
Name the neurotransmitters that are released by preganglionic autonomic neurons, postganglionic sympathetic neurons, postganglionic parasympathetic neurons, and adrenal medullary cells.
- Identify the main types of cholinergic and adrenergic receptors .

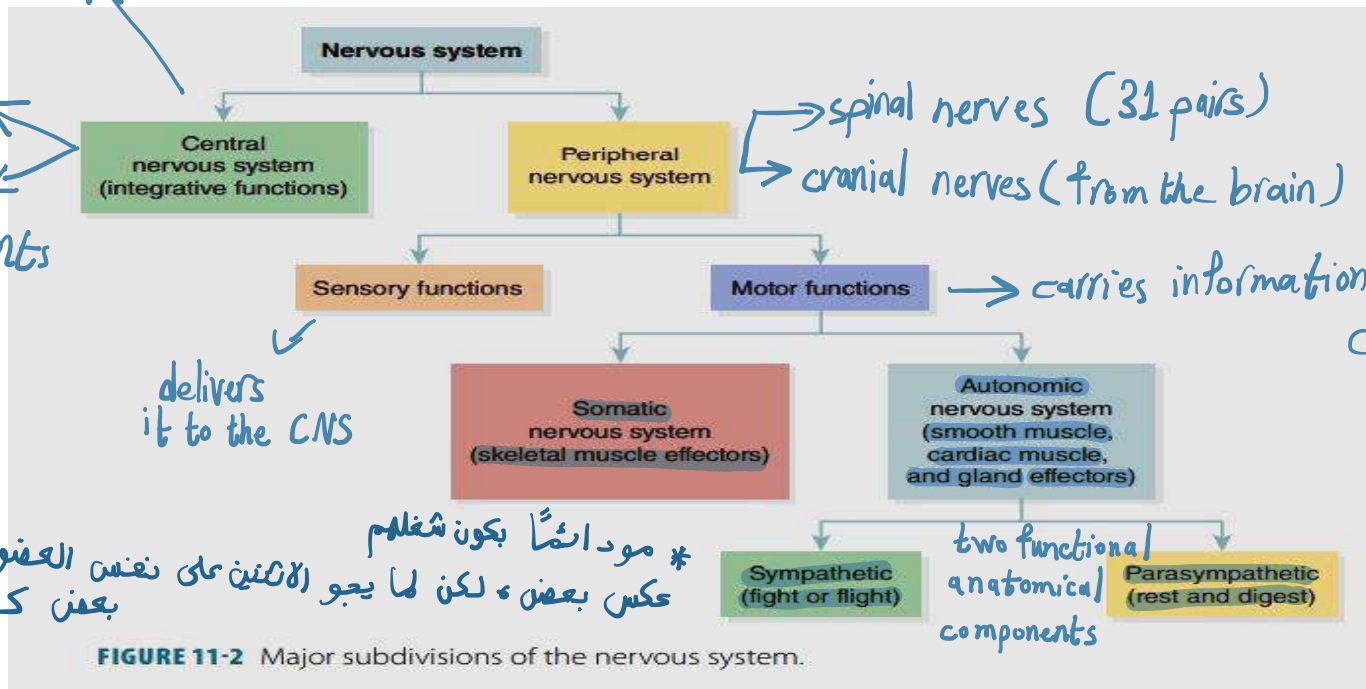
Lecture objective

- List the major functions of the autonomic nervous system.
- Identify some of the neural inputs to sympathetic and parasympathetic neurons from higher brain structures
- Describe the location of the cell bodies and axonal trajectories of preganglionic and postganglionic sympathetic and parasympathetic neurons.
- Name the types of receptors on autonomic ganglia and on various target organs and list the ways that drugs can act to alter the function of the processes involved in transmission within the autonomic nervous system.
- Describe functions of the sympathetic and parasympathetic nervous systems and their effects on target organs .
- Describe the location of some forebrain and brainstem neurons that are components of central autonomic pathways.

Major subdivisions of the Nervous system

جزء منها زي ما اخذنا قبل
بجمل المعلومات من ال CNS
وجزء بودي المعلومات ال CNS

spinal cord
brain
& it's components



spinal nerves (31 pairs)
cranial nerves (from the brain)

carries information away from the CNS

delivers it to the CNS

two functional anatomical components

* مودائماً يكون شغلهم
عكس بعضه لكن لما يجوبوا نفس العضو
يعتبروا antagonists
e.g the heart

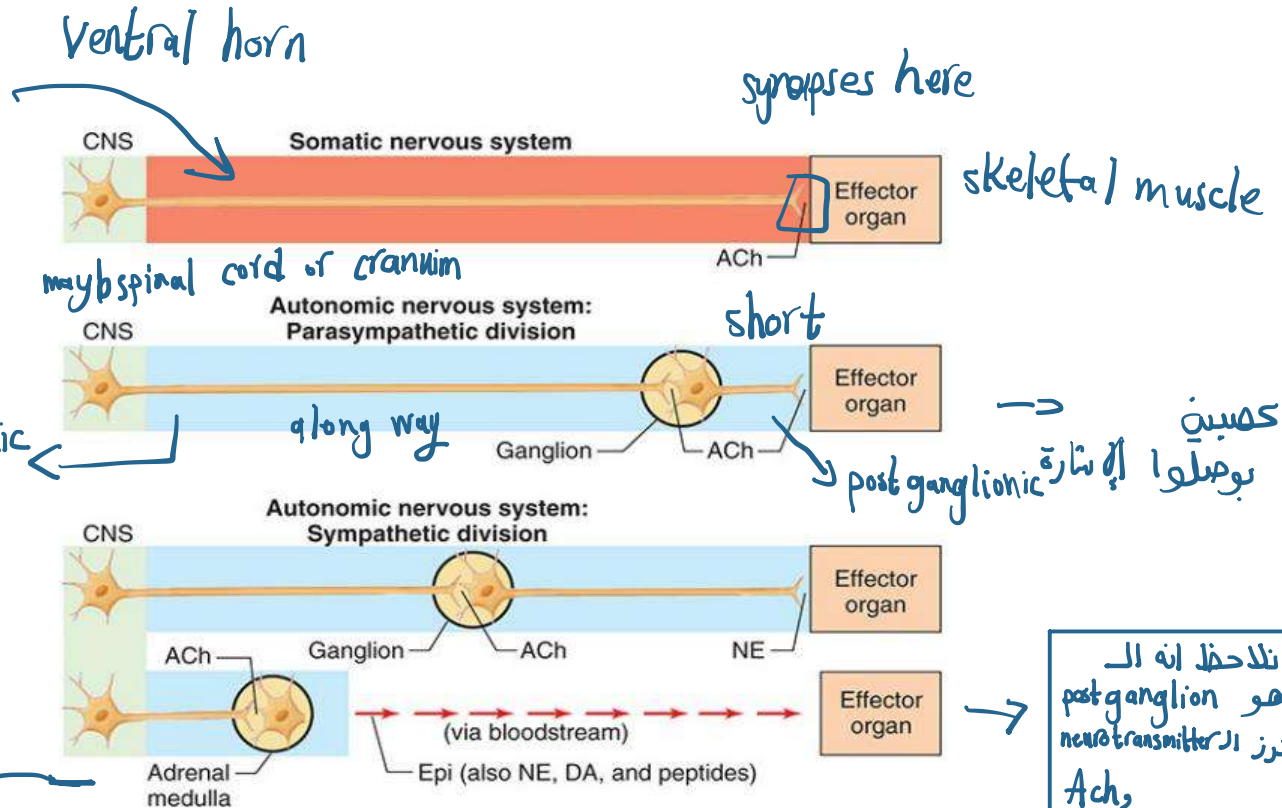
FIGURE 11-2 Major subdivisions of the nervous system.

Effector is the part that is doing the action

note: - visceral organs are exceptions
they can be innervated by both sympathetic and
parasympathetic e.g heart and small intestine

A ganglion (pl. : ganglia) is a group of neuron cell bodies in the peripheral nervous system

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



no synapses here even if it was a cranial nerve

notes- the function of the Adrenal medulla is related to the function of the cell membrane

* note:- the only gland that receives the information directly and not via bloodstream is Adrenal medulla

كصبين بوصولوا الإشارة postganglionic

بدنا نلاحظ انه الـ postganglion هو الذي افترز الـ neurotransmitter ACh

ملاحظة مهمة :- في الـ pre ganglionic يتم إفراز الـ Acetylcholine

سواء كان sympathetic أو parasympathetic

لكن بالنسبة للـ post ganglionic هناك ٣ حالات

- ١- إذا كان parasympathetic فيفرز Acetylcholine
 - ٢- إذا كان sympathetic احتمال أن تفرز NE (أي من النواقل المذكورة)
- بالمجزة الأخيد من الصورة

أسماء أخرى

pre ganglionic → pre system

post ganglionic → post system

* اختصار الـ Acetylcholine هو Ach

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

→ but does not initiate!

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.

عشان هيك بنحكي عن ال
gut انها عقلنا الثاني 🤔

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

→ release of

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

↳ main neurotransmitter is Ach

★ 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

→ main neurotransmitter is adrenaline & substances like it e.g NE
epinephrine هو نوره ال

Introduction and general characteristics of the ANS

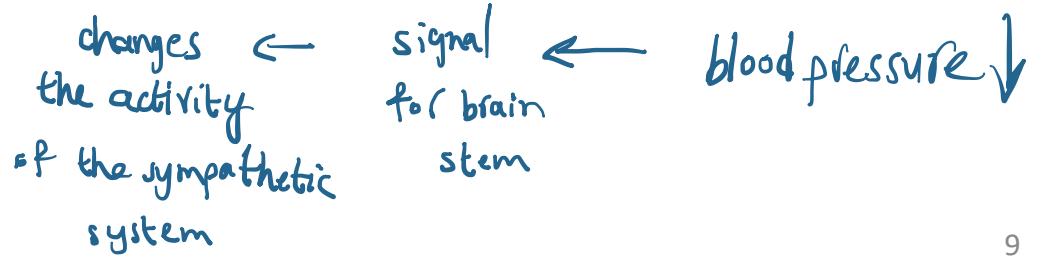
initiated

but it can be moderated from any parts in the higher center e.g.

- 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 transmit signals to the lower centers and can, as such, influence autonomic control.
- The sympathetic is usually activated during stress, excitement
- 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 → in sexual functions, a dual innervation will happen
- 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

عشان صيكة
ما الواحد بيزعل
بيرتفع ضغطه

we will talk about it later



one

sweat glands are only innervated by sympathetic

smooth muscles that make the hair in our body stands up are also sympathetic
e.g. arrector pili muscles

blood vessels → main innervation is sympathetic, very later parasympathetic

← ما سمعت واضح هون لكن افلن كان همد

الدكتور في حالة الـ alkalosis

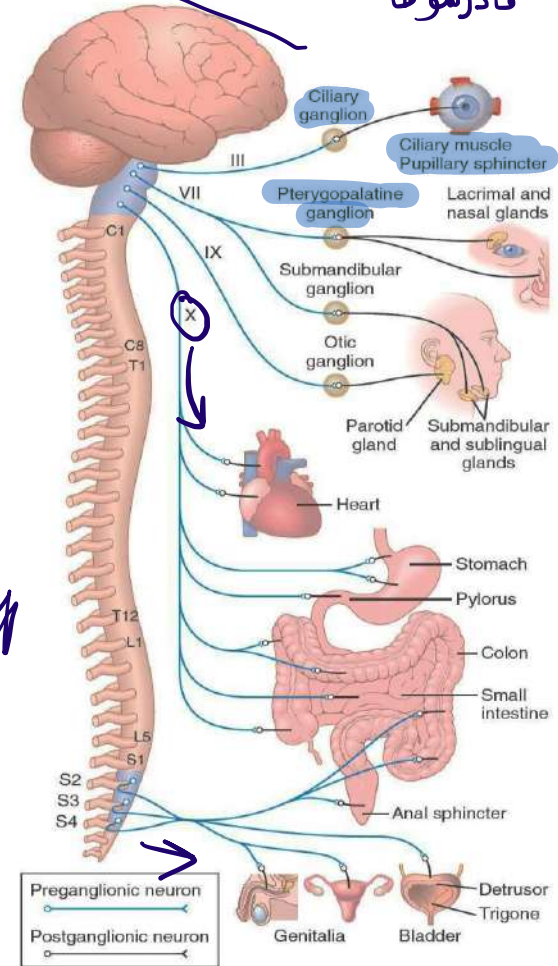
Sympathetic → does mydriasis (dilation of pupil)

PHYSIOLOGICAL ANATOMY of PSN

ما الهم خلافة بجرعة العيون (لليمين واليسار ولعقود ولتحت) بتخلي البؤبؤ يمتدز (حالة طبية اسمها (meiosis) مهمة كلمة) *constricts* بمعنى يضيق *تقليل كمية الضوء الداخلة*

الرسمه موضحه للنقاط فادرسوها

- 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). *مهم جدًا*
- 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.

* ال ganglia تكون عريضة جداً من ال effector أو تقع فيه

لهذا السبب يكون presympathetic طويل وأطول من ال postsympathetic nerve

* اسم آخر لل parasympathetic NS هو craniosacral division

وظائف ال ciliary muscle :-

١- بتشتغل على ال pupil ← meiosis

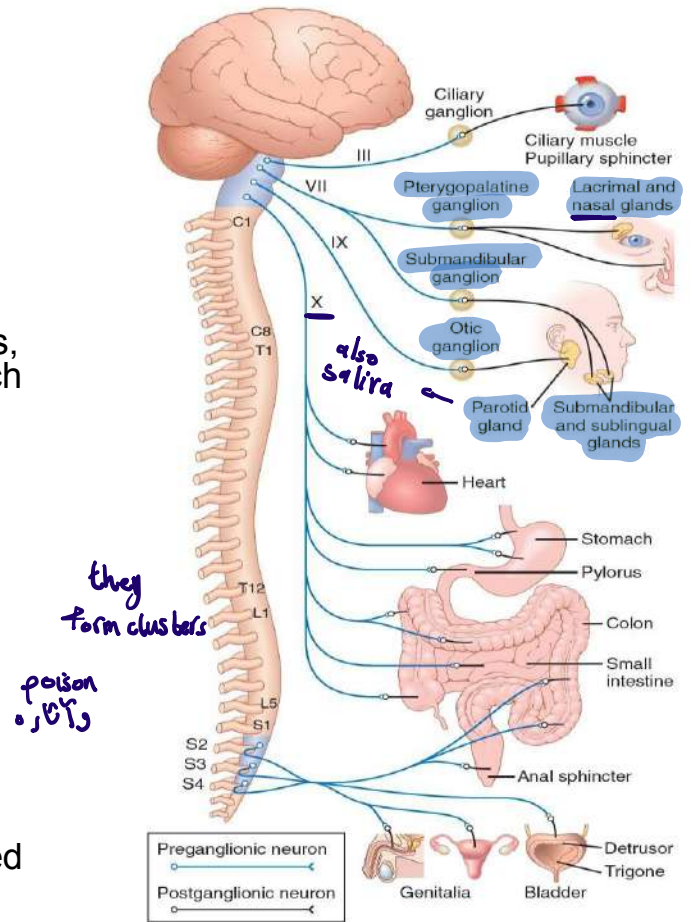
٢- بتشتغل على ال lens ← contraction of the ciliary muscle will loosen the zonular fibers, increasing the convexity of the lens

مثلاً لما الواحد يقرأ يحتاج يزيد شدة تحب ال lens حتى يصير انكسار الضوء

PHYSIOLOGICAL ANATOMY of PSN

- Fibers from the VII cranial (facial) nerve pass to the lacrimal, nasal, and submandibular glands, and fibers from the IX cranial (glossopharyngeal) nerve go to the parotid gland.
- * وصلنا لهن . 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.
- 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

* وصلنا لهن



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

تأثير الparasympathetic على الglands
NS

facial nerve is the same as cranial nerve VII

it affects :-

- 1 - lacrimal + nasal glands $\xrightarrow{\text{by}}$ increases secretion of tears + mucus
- 2 - sublingual + submandibular glands $\xrightarrow{\text{by}}$ increases saliva secretion while eating
- 3 - parotid gland $\xrightarrow{\text{by}}$ increases secretion of saliva

تلكم الدكتور على تأثير الpoison على الجسم
الpoison يعمل كمثبط للACh فرح يتوقف عمل الsympathetic NS ورح يزيد عمل
بالتالي رح يزيد إفراز اللعاب ورح يصيب الشخص إسهال وتشنجات
والغناط