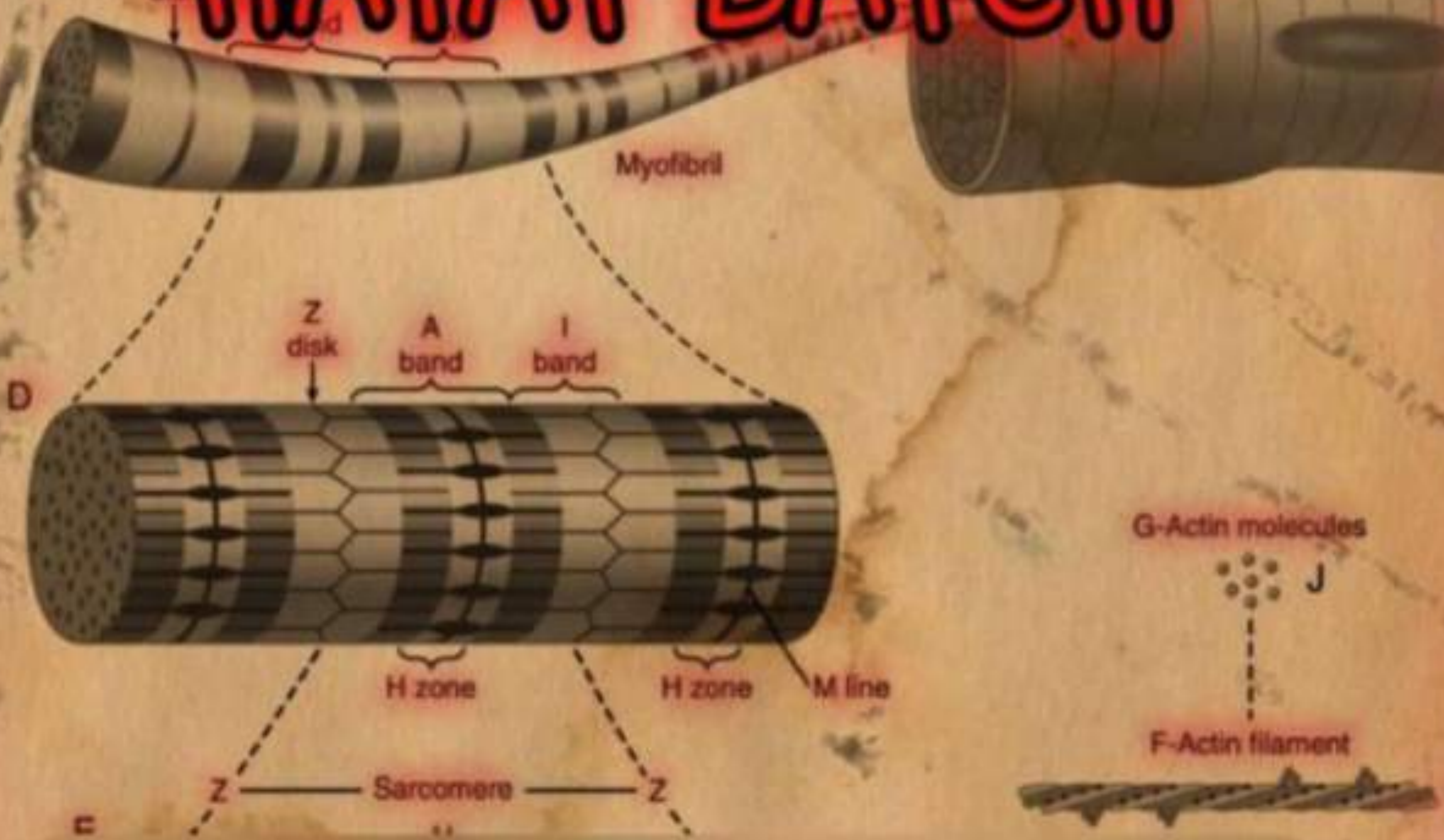




PHYSIOLOGY

HAYAT BATCH



done by :

Phsiology Team



lecture no:

Lecture 23 & 24

General Physiology
Second semester 2023
Lectures 23 and 24
Autonomic Nervous System I , II

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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.

Introduction

The autonomic nervous system (ANS) is the portion of the nervous system that controls most visceral functions of 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, and blood flow.

- The output of the autonomic system is divided functionally and pharmacologically into two divisions: the parasympathetic and sympathetic systems
- 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
- The ANS is characterized by its rapid and intense control of visceral functions
- Dual innervations which are usually antagonistic

أول اشي شو هو ال ANS ...؟ احنا بنعرف وأخدنا ال division تبع ال NS وقلنا انه في CNS وفي PNS

هأ ال ANS يعني:

Classically is defined as the portion of PNS that regulates visceral function : are not initiated by autonomic innervation it is rather the input modulate their activity either increase it or decrease it.

احنا بنوخذ انه القلب بينقبض لحاله.... وال Activity GI and secretion بتعتمد على الأكل

كل الي بسويه ال Sympathetic nervous system انه بيغرلنا ال Activity (depending on what we need) فهو Modularity effect rather than initiating effect

ANS function are related to Gut nervous system.

Introduction

- Localized vs diffused
- Sympathetic and parasympathetic tone
- Cholinergic vs adrenergic systems
- Most of the action of the ANS are mediated through autonomic reflexes
- Regulates the cardiovascular and respiratory systems, gastrointestinal tract, exocrine and endocrine glands throughout the body.
- Is controlled centrally by the brain stem, limbic system and frontal lobes, which are concerned with arousal and behavioral responses to threat.
- 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 in females

Introduction

- Is controlled centrally by the brain stem, limbic system and frontal lobes, which are concerned with arousal and behavioral responses to threat.
- ANS is activated mainly by centers located in the **spinal cord, brain stem,** and **hypothalamus.**
- 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 ANS operates through **subconscious sensory signals** and **subconscious reflex responses** to control visceral activities.

ANS include enteric nervous system and that the major target of the ANS... then we can see that is not only affect the GI... it affects the CVS, Genital organs...

يعني وين في شغلة الANS مو هو الي مخليها.

Generally, when we speak about the ANS... we usually divided it in two functions divisions:-

1. Sympathetic
2. parasympathetic

Usually visceral organs receive dual innervation

شو يعني...؟! عادة بيحيهم من Sympathetic and parasympathetic وفي sweat gland which Exception as -> are mainly receive Sympathetic innervation... when we have dual innervation (the Sympathetic and parasympathetic are antagonist) (يعني اذا واحد بزيد الثاني بقل)

لكن مو دايمًا واحد بزيد والثاني بقل واعطيكم مثال:-

The heart rate → Sympathetic increase HR

parasympathetic decrease HR

The GI → Sympathetic decrease the motility of secretion
of secretion

parasympathetic increase the motility

Whether it is increase or decrease depending on what the function of the organs is all about.

Usually Sympathetic NS activated during stress, excitements. While parasympathetic is usually activated (resting or digesting).

يعني لو الواحد معجوق وتعبان و عليه امتحان الي بيشتغل هو ال Sympathetic مشان يضل صاحي... بس اذا الواحد قاعد على التلفزيون بيشوفله فيلم مثل Titanic وبيشرب وبياكل مكسرات الي بيشتغل هو ال parasympathetic

usually when you activate the Sympathetic NS You've low metabolic demands يعني .energy expenditure when you activate parasympathetic will not be the Same as Sympathetic . لأنه . sympathetic the one e which increases Utilization of energy.

In a sense: one is Catabolic and the other one is anabolic

- usually parasympathetic innervation is more localized:

يعني يكون جاي على أعضاء معينة وفي مناطق معينة

- Sympathetic is diffused because it is all over, so that what was meant by (diffuse and localized)

- Usually there is something is called sympathetic and parasympathetic (**tone**)

هاي مهمه حتى لو احنا نائمين فيه شوية Activity on the sympathetic

And there is some activity on the parasympathetic

- The **tone** or the basal level of activity changed depending on physiological situation

احنا واحنا نائمين بدنا شوي sympathetic وشوي parasympathetic

For example :(To maintain Heart RATE) rhythm مشان تضل السرعة 60 وينبض ب

- بس انا مثلا بحالة ال excitation وبدي ال heart rate يزيد رح ازيد ال sympathetic ورح اقلل ال parasympathetic

وبعدين يعني مثلا هاي ال **tone** مهمه يعني اذا زادت ال parasympathetic tone لسبب او لآخر ممكن يعمل عنا

Cardiac arrest لأنه رح يعمل slow لل Heart Rate وممكن القلب يتوقف فيصير عنا اشي بنسميه vagal arrest

- في ناس مرات من الخوف او اجاهم خبر مش كويس ممكن تلاقوه وقع " لأنه ال parasympathetic system activity زادت وقفت القلب عن العمل " .

في حالة ال Rest ال parasymphathetic فيها signaling أعلى من ال symphathetic

During excitement or stress ال symphathetic بتزيد وال para رح يقل شوي

Most of the actions of symphathetic nervous system are innervated by Autonomic reflex for example:

1) Reflexes that controlled blood pressure and regulate blood pressure include the baroreceptor reflex which is autonomic reflex

2) micturition (empty of the bladder) this is also an autonomic Reflex

ANS are mediated reflexes فكل ال Activity تبعته ال

Somatic reflexes (the reflexes that associated with ANS are refer to As Autonomic reflex)

ANS is classically known as component of peripheral Nervous system

بس هذا لا يعني انه ال CNS بأثر شي عليه

There are many inputs at the ANS which modulating the activity of the ANS give you an example: Excitements, emotional state

هاي مش من ال Autonomic

هاي بتصير في higher levels مثل ال cerebral cortex هذول المناطق بتودي ال inputs على المراكز الي رح نشرحها بالتفصيل لبعدين

A lot of times there is cooperation

يعني مثلا ال sexual act :

One of them causes erection and the other one causes the ejaculation in males

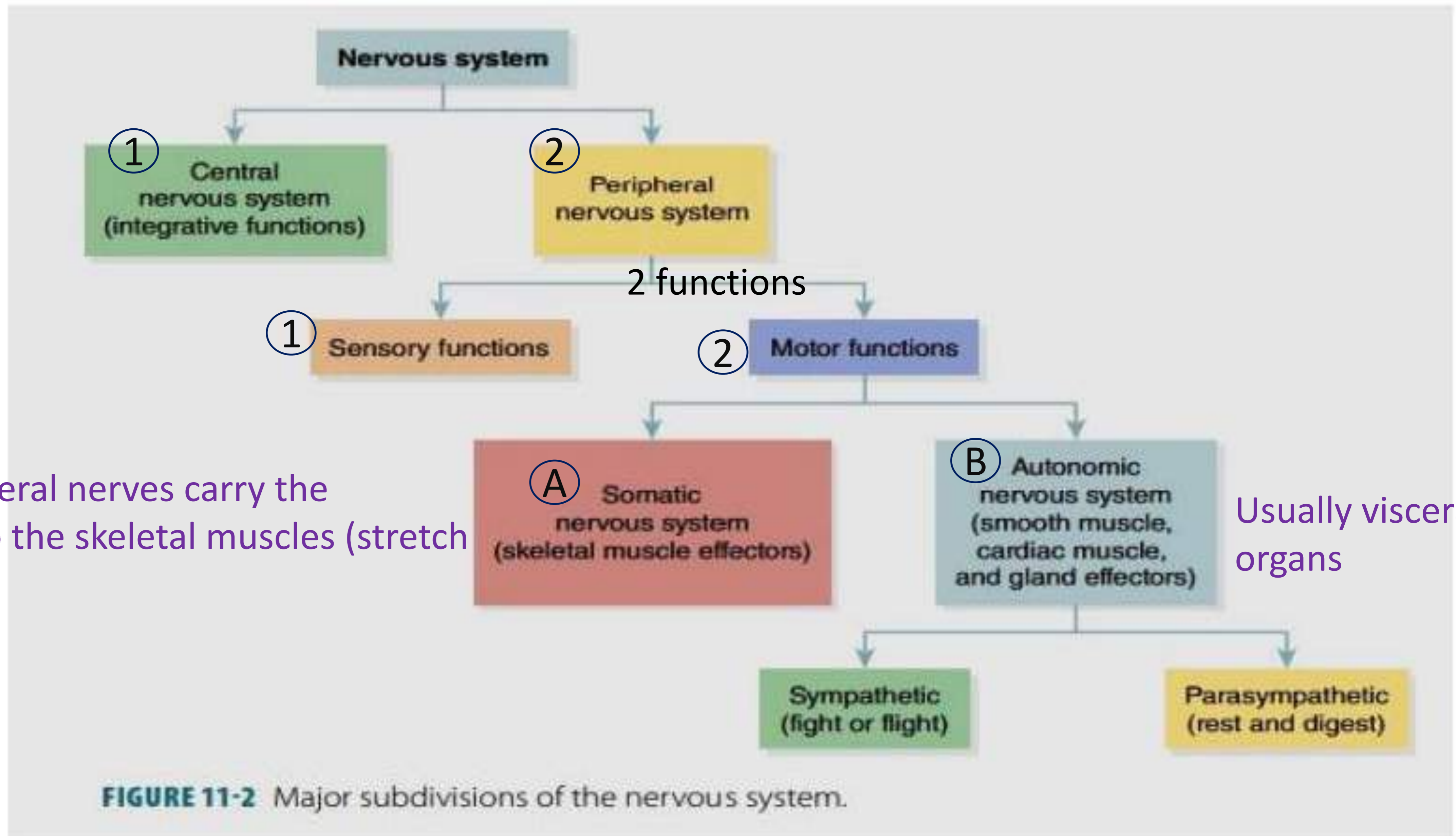
نفس الشيء بصير بال females

There might be some association between Autonomic reflexes

يعني مثلا ال defication reflex لما الواحد بده يروح على الحمام اله علاقة بال empty of the bladder

مشان هيك عنا cooperation و Association

Major subdivisions of the Nervous system



Part of peripheral nerves carry the
nerve to the skeletal muscles (stretch
reflex)

Usually visceral
organs

Subdivisions of the PNS

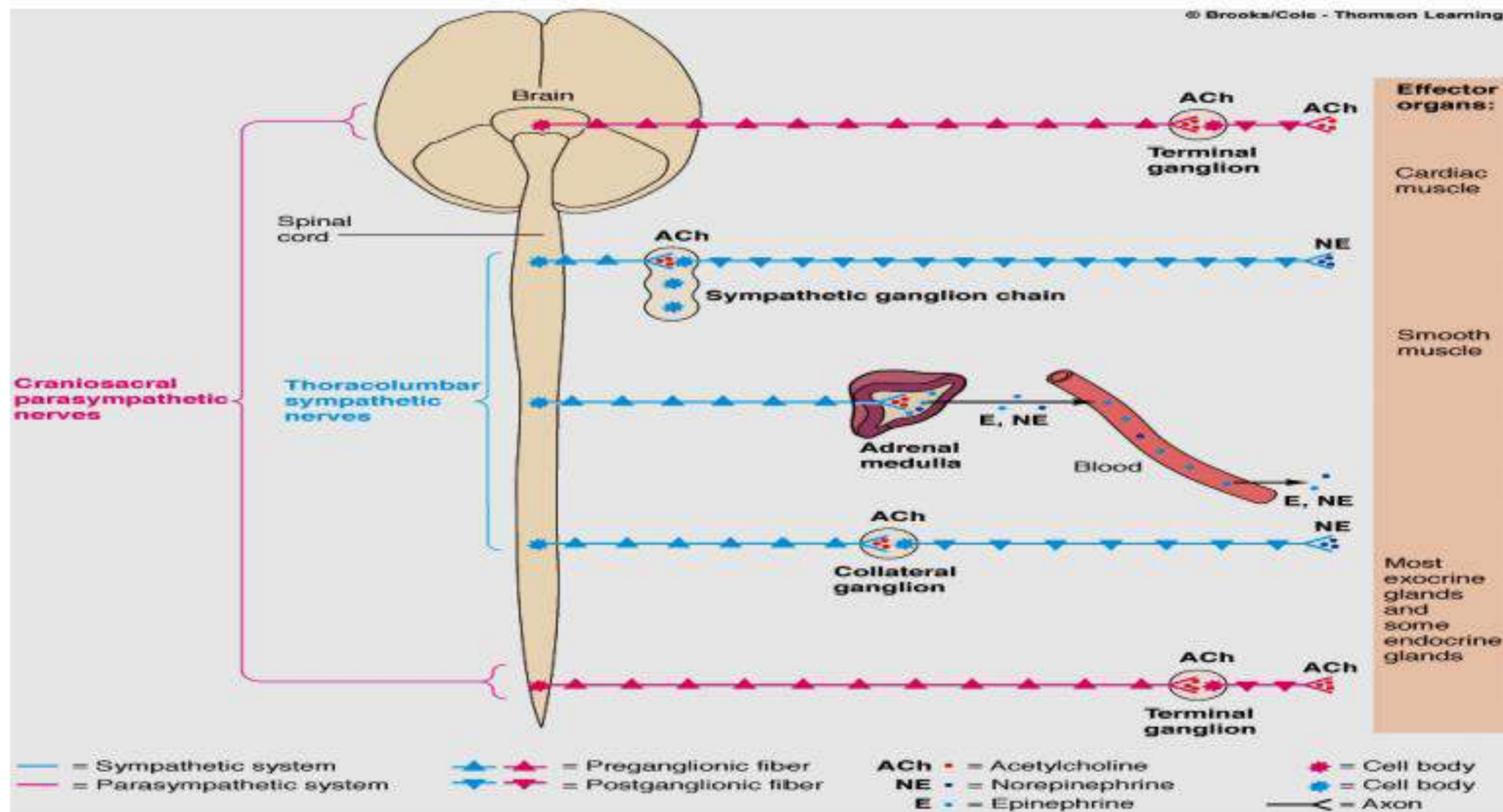
- Somatic (voluntary) nervous system (SNS)
 - Neurons from cutaneous and special sensory receptors to the CNS
 - motor neurons to skeletal muscle tissue
- Autonomic (involuntary) nervous system
 - sensory neurons from visceral organs to CNS
 - motor neurons to smooth & cardiac muscle and glands
 - sympathetic division
 - parasympathetic division •
 - Enteric nervous system (ENS) :
involuntary sensory & motor neurons control GI tract–

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. ANS and somatic هاد هو الفرق بين
- **Antagonist action**
- **Two neuronal chains** In Both the sympathetic and parasympathetic pathways the signal reaches visceral organs through two neuronal
 - Preganglionic طالعة من ال NS وبتروح على Autonomic ganglia
 - Postganglionic بروح من ال ganglia على ال Visceral organs

one out from NS, some how it goes to Something outside the NS called (Autonomic Ganglia)

Sympathetic and parasympathetic divisions



4/19/2023

10

The sympathetic content of two neurons... 1. preganglionic neuron 2. postganglionic neuron

Physiological anatomy Sympathetic nervous system (Thoracolumbar division)

- Preganglionic neurons originate in spinal cord segments between cord segments **T1 and L2**
- **Preganglionic fibers** leaves the spinal cord and **make synapses in the sympathetic ganglia**
- Sympathetic ganglia
- Two **paravertebral sympathetic chains** of ganglia (also called the **sympathetic trunk**), that are interconnected with the spinal nerves on the side of the vertebral
- **Prevertebral ganglia** or **collateral ganglia** (the celiac, superior mesenteric, aortico-renal, inferior mesenteric, and hypogastric ganglia
- Postganglionic fibers leaves ganglia and terminate and synapse with visceral organs

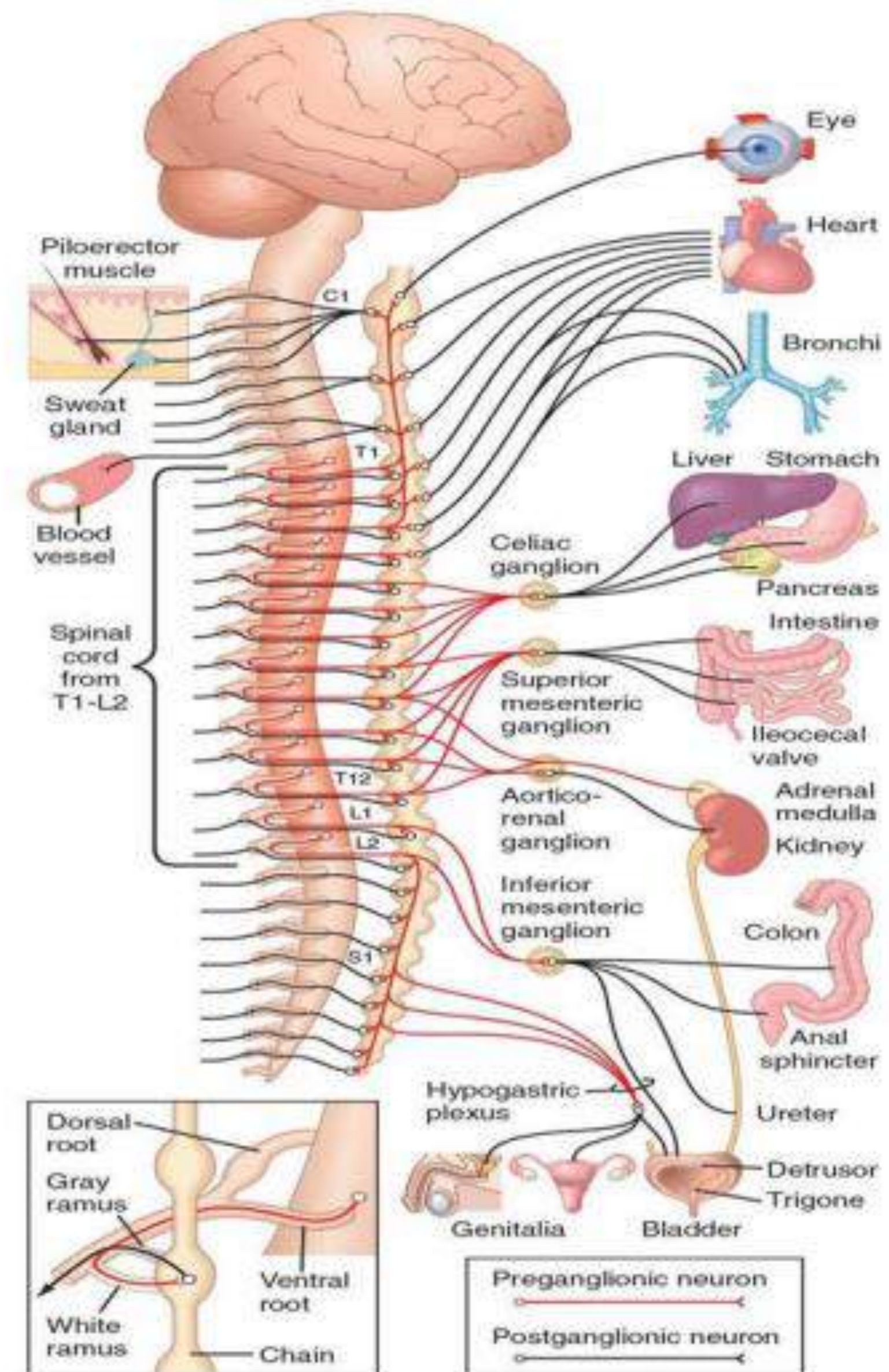


Figure Sympathetic nervous system. The black lines represent postganglionic fibers, and the red lines show preganglionic fibers.

Sympathetic innervation goes to the Blood vessels goes to, sweat glands, paroglagtal muscles, bladder, genital organs, colon, kidney, Pancreas, Liver, heart.....

المنطقة الي بيطلع منها ال Sympathetic nerves بنسميها preganglionic محصورة بمنطقة مو جاي من كل ال segment تبعات ال spinal cord، هي جاية من ال Thoracolumbar

you can see that the preganglionic neurons Leave through the ventral nerves (peripheral nerves) thoracic and lumbar regions الي بيطلعوا من Sympathetic nerves بحملوا معاهم

These nerve can go through several destinations... 1. some of these nerve go to the ganglia (like chain that is near to spinal cord and called “paravertebral ganglia”).

PHYSIOLOGICAL ANATOMY OF THE SYMPATHETIC SYSTEM

- ❑ The peripheral portion of the Sympathetic System include:
 - Two **paravertebral sympathetic chains** of ganglia (also called the **sympathetic trunk**), that are interconnected with the spinal nerves on the side of the vertebral column.
 - **Prevertebral ganglia or collateral ganglia** (the celiac, superior mesenteric, aortico-renal, inferior mesenteric, and hypogastric).
 - Nerves extending from the ganglia to the different internal organs.
- ❑ The sympathetic nerve fibers originate in the spinal cord along with spinal nerves between cord segments **T1 and L2** and pass first into the sympathetic chain and then to the tissues and organs that are stimulated by the sympathetic nerves

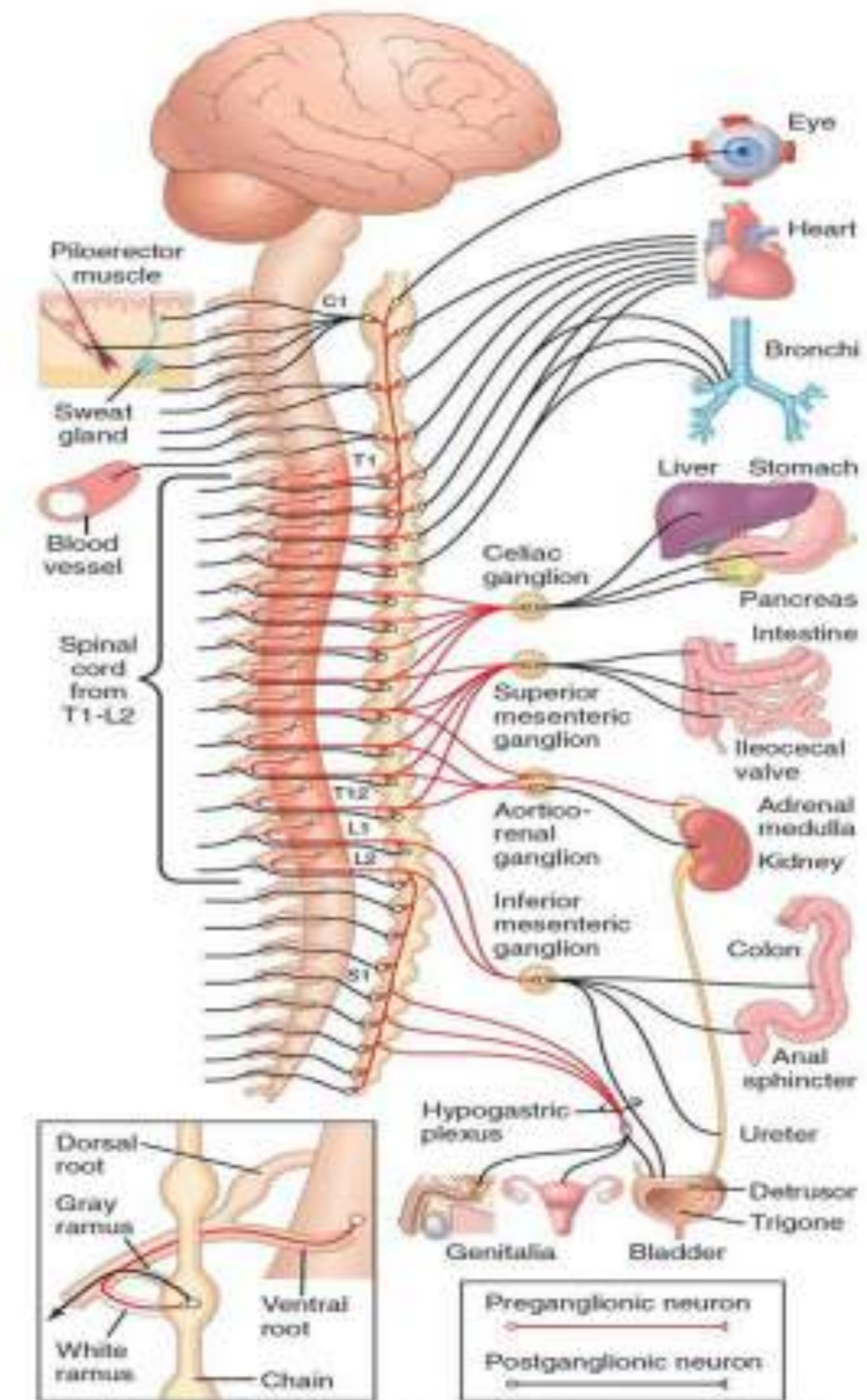


Figure Sympathetic nervous system. The black lines represent postganglionic fibers, and the red lines show preganglionic fibers.

Physiological Anatomy Sympathetic nervous system (Thoracolumbar division)

- Unlike a single neuron in the skeletal motor pathway, the sympathetic pathway is composed of two 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 a ventral root of the cord into the corresponding spinal nerve.
- The preganglionic sympathetic fibers leave the spinal nerve and pass through a white ramus into one of the ganglia of the sympathetic chain. Then fibers can take one of the following three courses:
 - Synapse with postganglionic sympathetic neurons in the ganglion that they enter.
 - Pass upward or downward in the chain and synapse in one of the other ganglia of the chain.
 - Pass for variable distances through the chain and then through one of the sympathetic nerves radiating outward from the chain, finally synapsing in a peripheral sympathetic ganglion (collateral ganglia) about halfway between the CNS and the innervated organs.

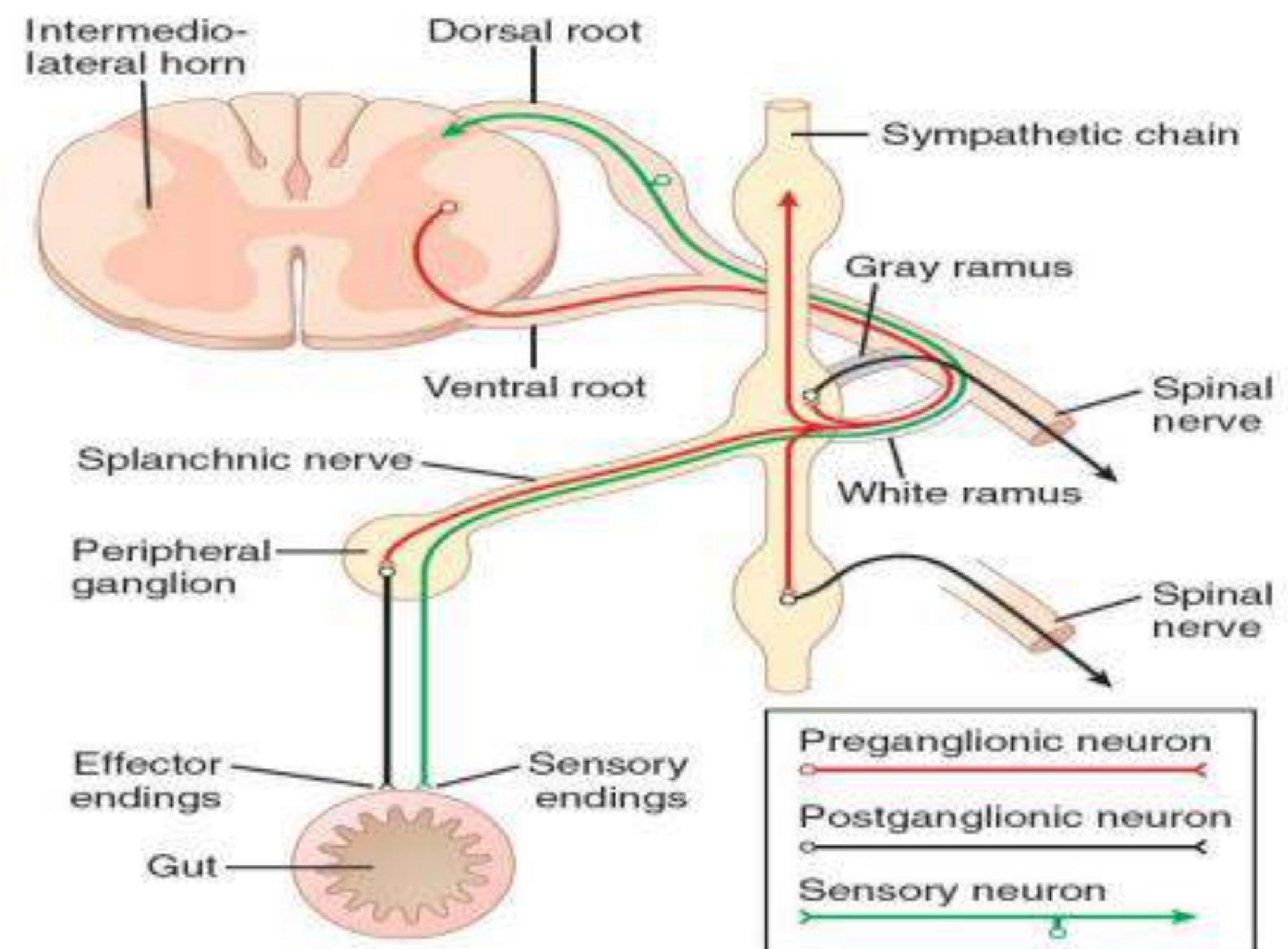


Figure Nerve connections among the spinal cord, spinal nerves, sympathetic chain, and peripheral sympathetic nerves.

SNS anatomy

- The postganglionic sympathetic neuron originates either in one of the sympathetic chain ganglia or in one of the peripheral sympathetic ganglia. From either of these two sources, the postganglionic fibers then travel to their destinations in the various organs.
- Some of the postganglionic fibers pass back from the sympathetic chain into the spinal nerves through **gray rami** at all levels of the cord. These sympathetic fibers are all **very small type C fibers**, and they extend to all parts of the body by way of the skeletal nerves.
- The sympathetic pathways that originate in the different segments of the spinal cord are not necessarily distributed to the same dermatomes as somatic nerves.

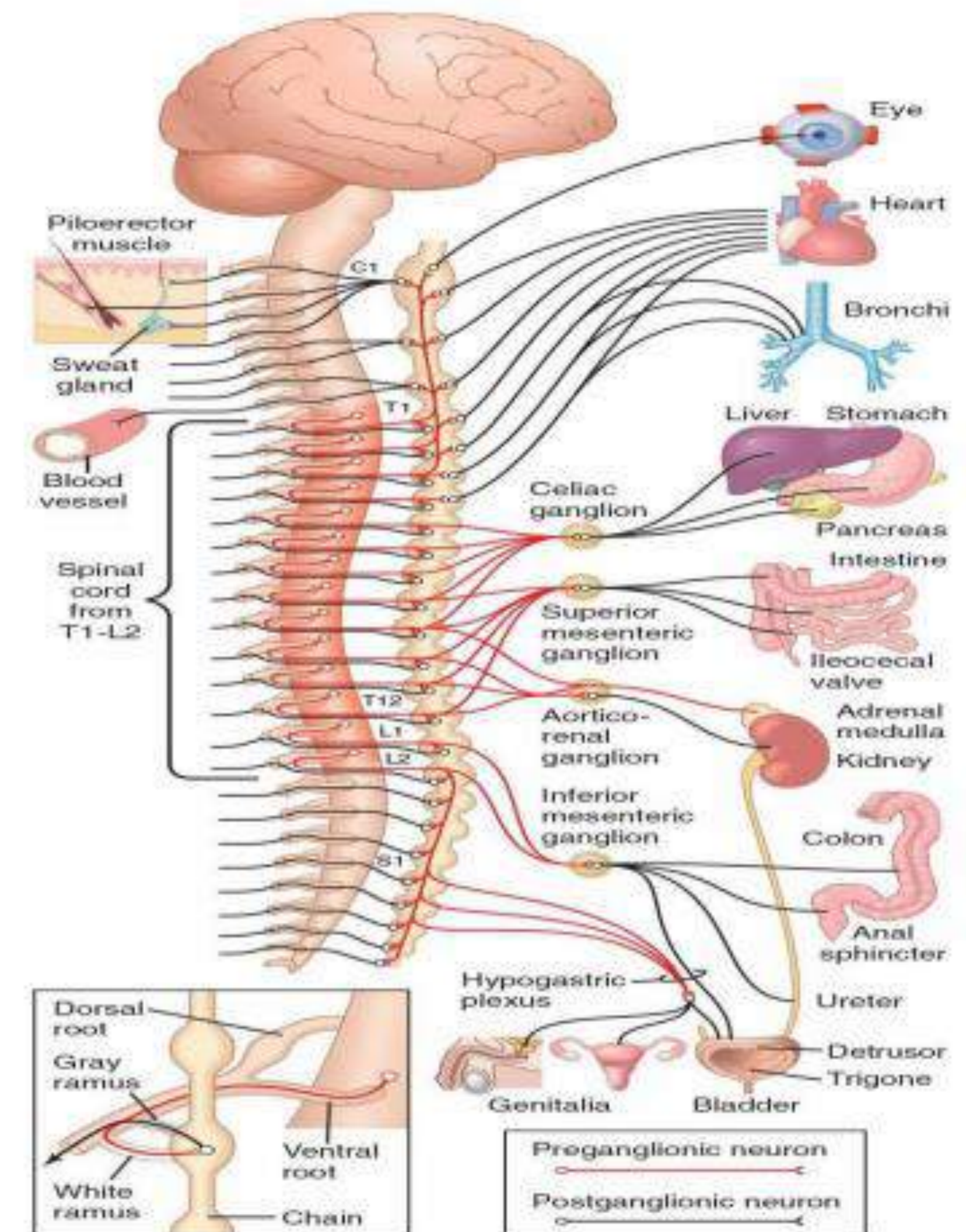
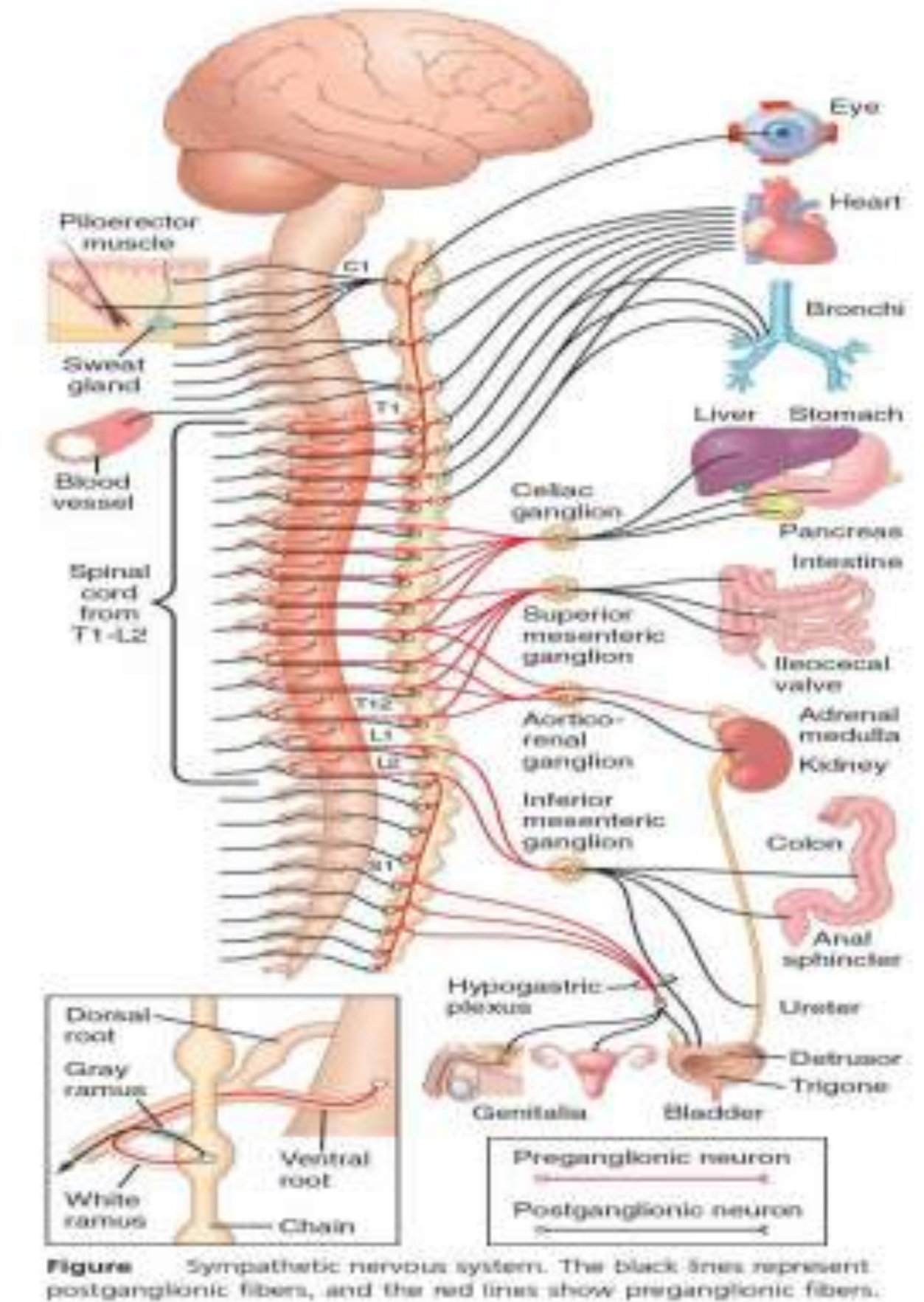


Figure Sympathetic nervous system. The black lines represent postganglionic fibers, and the red lines show preganglionic fibers.

الدكتور حكي هي التفاصيل مو مهمة...

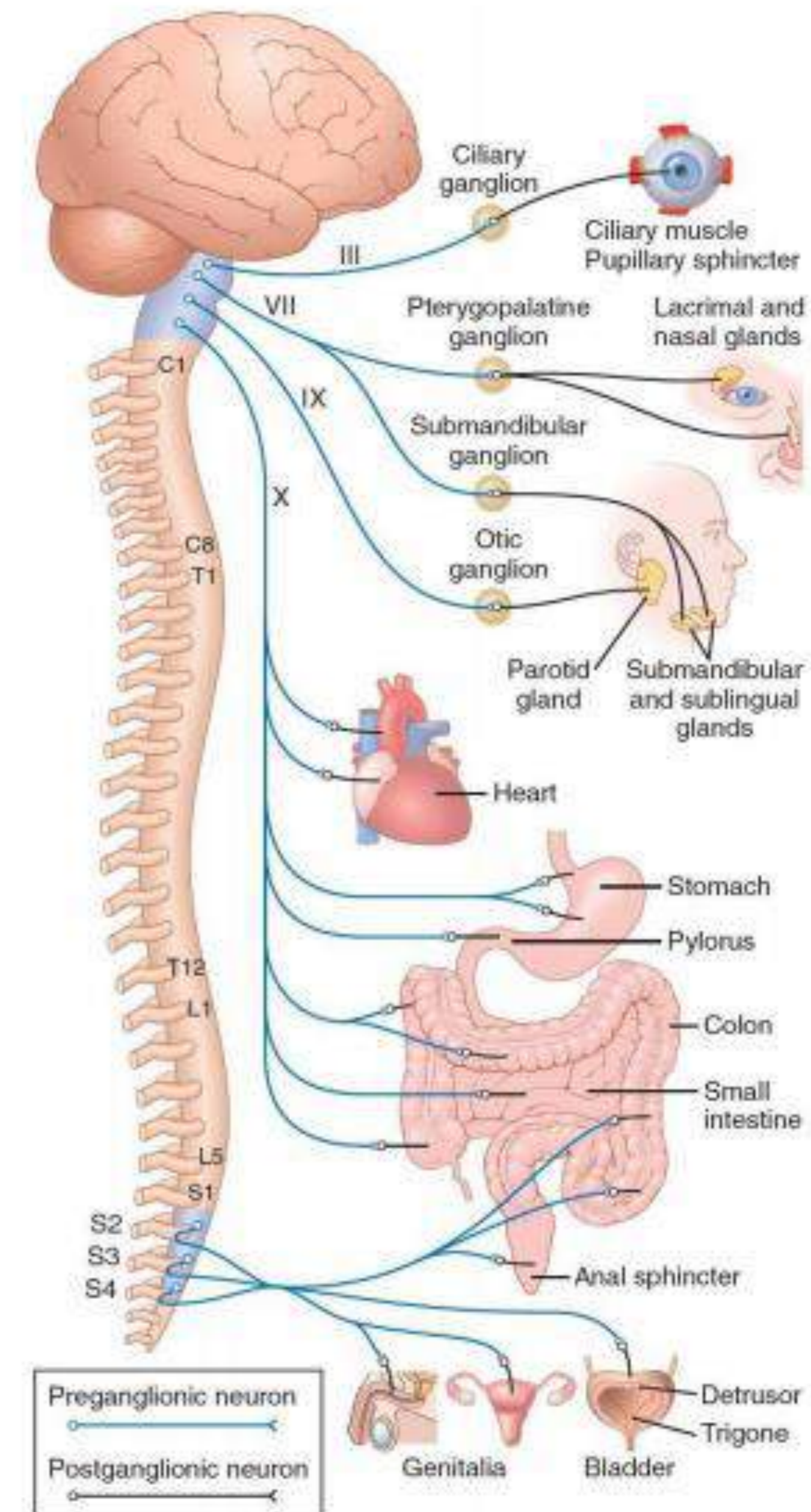
- ❑ Instead, the sympathetic fibers from:
 1. Cord segment T1 generally pass up the sympathetic chain to terminate in the head.
 2. Cord segment T2 terminates in the neck.
 3. Cord segments T3, T4, T5, and T6 terminate into the
 1. thorax.
 1. Cord segments T7, T8, T9, T10, and T11 terminate into the abdomen.
 2. Cord segments T12, L1, and L2 terminate into the legs.
- ❑ It should be noted that the sympathetic distribution shows great degree of overlaps between humans.



هون حكي الدكتور انه مش مهم نحفظ مواقعهم ووين بروحوا

PHYSIOLOGICAL ANATOMY of PSN

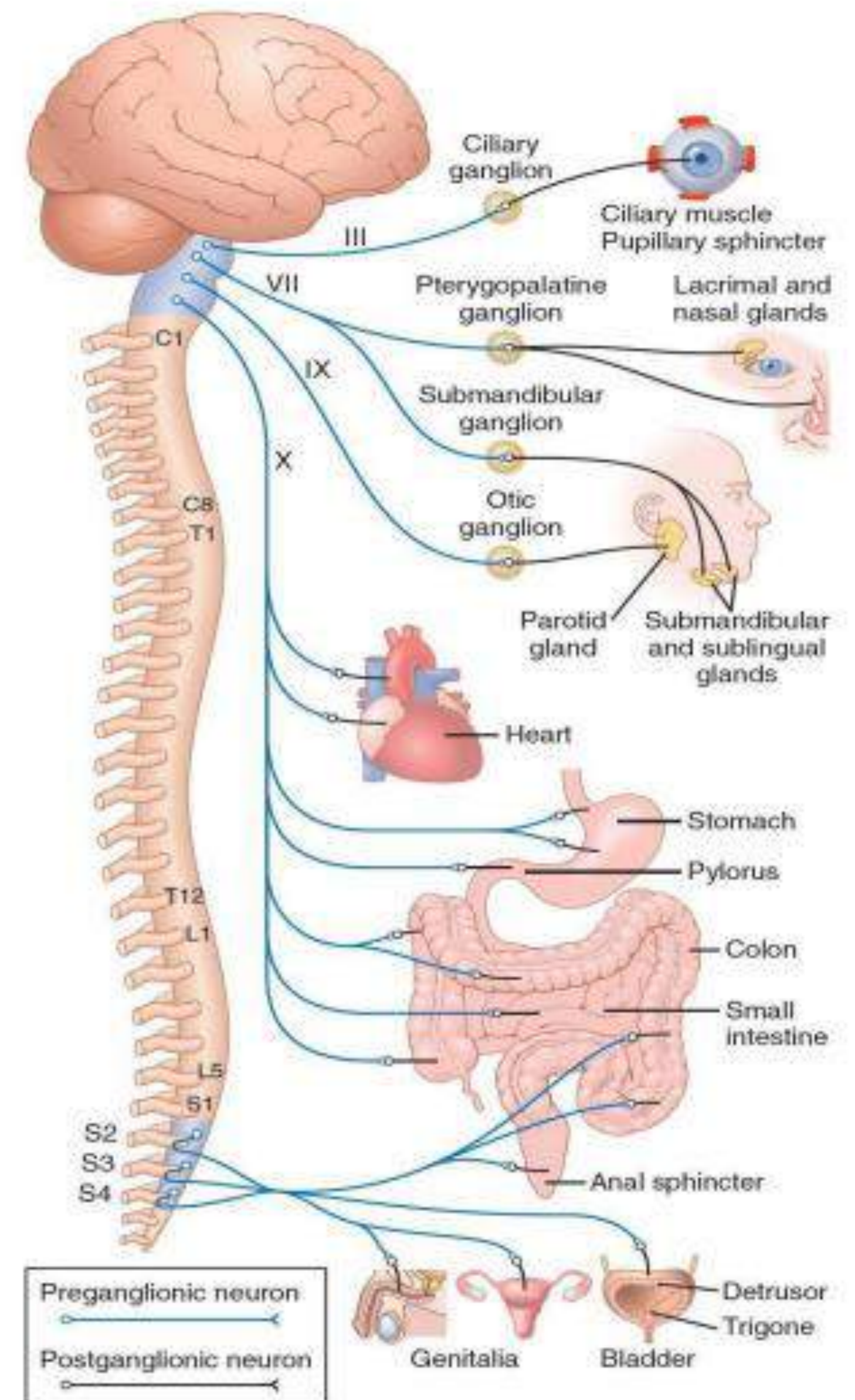
- ❑ The parasympathetic nerve fibers leave the CNS through two divisions; **cranial nerves III, VII, IX, and X**. And through the **second and third sacral spinal nerves** and occasionally the first and fourth sacral nerves.
- ❑ These fibers are longer than sympathetic preganglionic fibers because they 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

- 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.
- 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



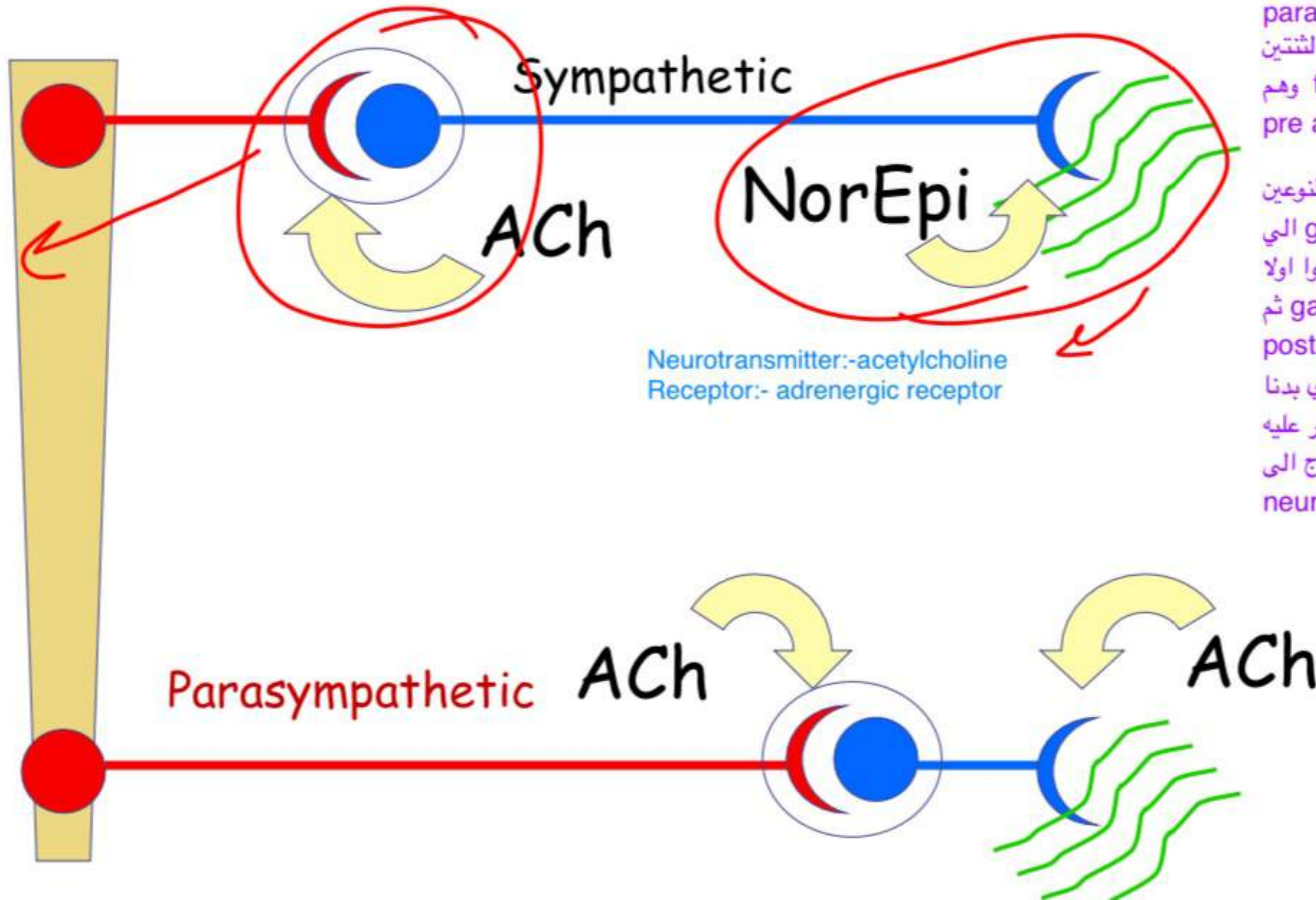
The parasympathetic nervous system. The blue lines represent preganglionic fibers and the black lines show postganglionic fibers.

Neurotransmitters of ANS

- The autonomic synaptic transmitter substances are either acetylcholine or norepinephrine
- **Cholinergic fibers:** The fibers that secrete acetylcholine (Ach)
- **Adrenergic fibers :** The that secrete norepinephrine (NE)
- All preganglionic neurons are cholinergic in both the sympathetic and the parasympathetic nervous systems.
- Either all or almost all of the postganglionic parasympathetic neurons are cholinergic
- However, the postganglionic sympathetic nerve fibers to the **sweat glands** and perhaps to a very few blood vessels are cholinergic.

هنا هو عبارة عن استثناء لانه post ganglionic sympathetic nerves تكون adrenergic

Transmitters and Receptors of ANS



هون اعزائي
 Neurotransmitter:-
 acetylcholine
 Receptor:- nicotinic

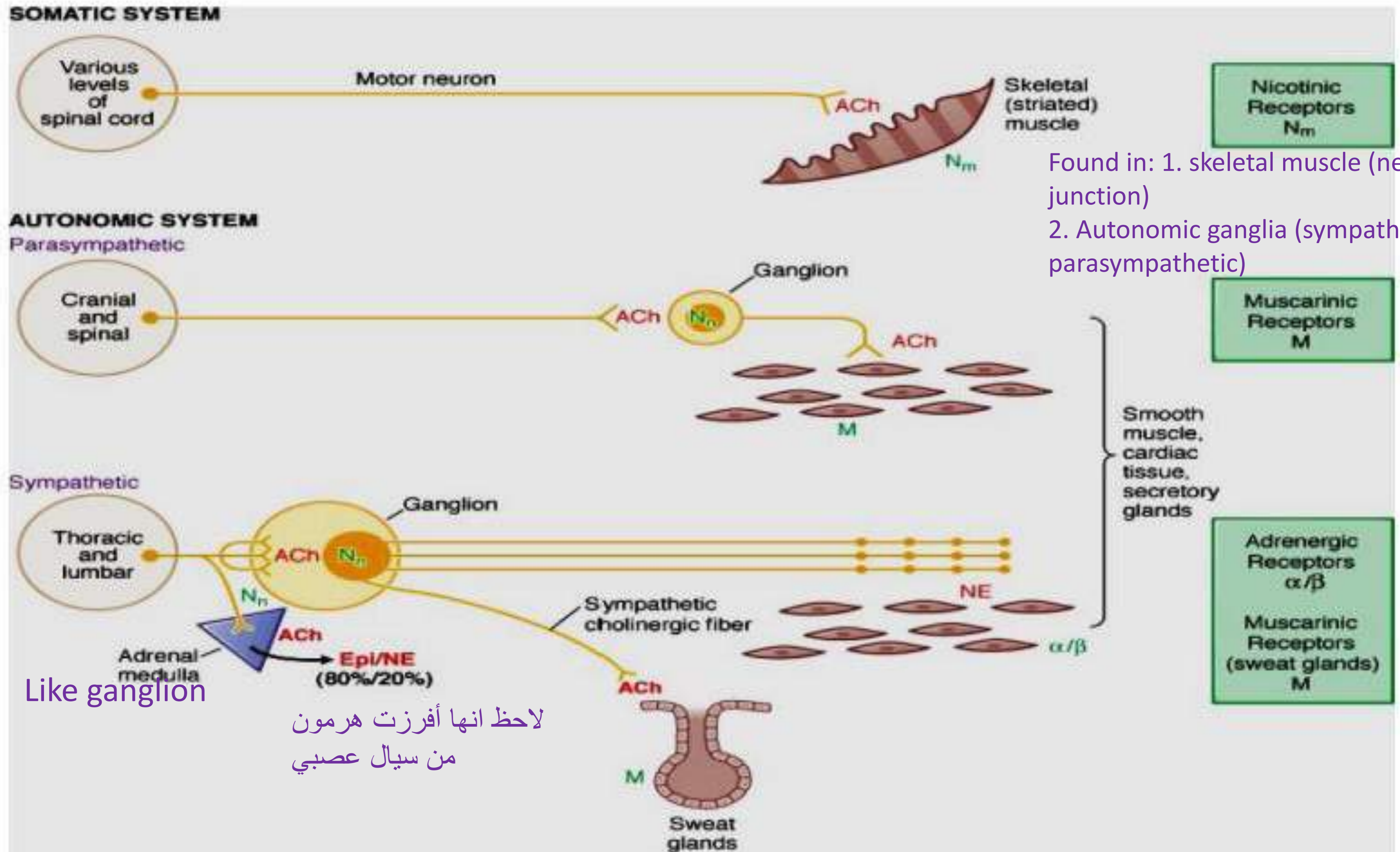
Neurotransmitter:-acetylcholine
 Receptor:- adrenergic receptor

طيب خيلنا نتفق على شغلة مهمة
 sympathetic and
 by خصوص
 para sympathetic
 systems وهي انه الثنتين
 يتكونوا من two chains وهم
 pre and post ganglionic

طيب وفي شغلة كمان انه النوعين
 من ganglionic neurons الي
 ذكرتهم فوق هذول يتشابكوا اولاً
 مع بعض في ganglia ثم
 يتشابك post ganglionic
 neuron مع العضو الذي بدنا
 نأثر عليه
 لذلك نحتاج الى
 neurotransmitter

Somatic and autonomic systems

Transmitters and Receptors of ANS



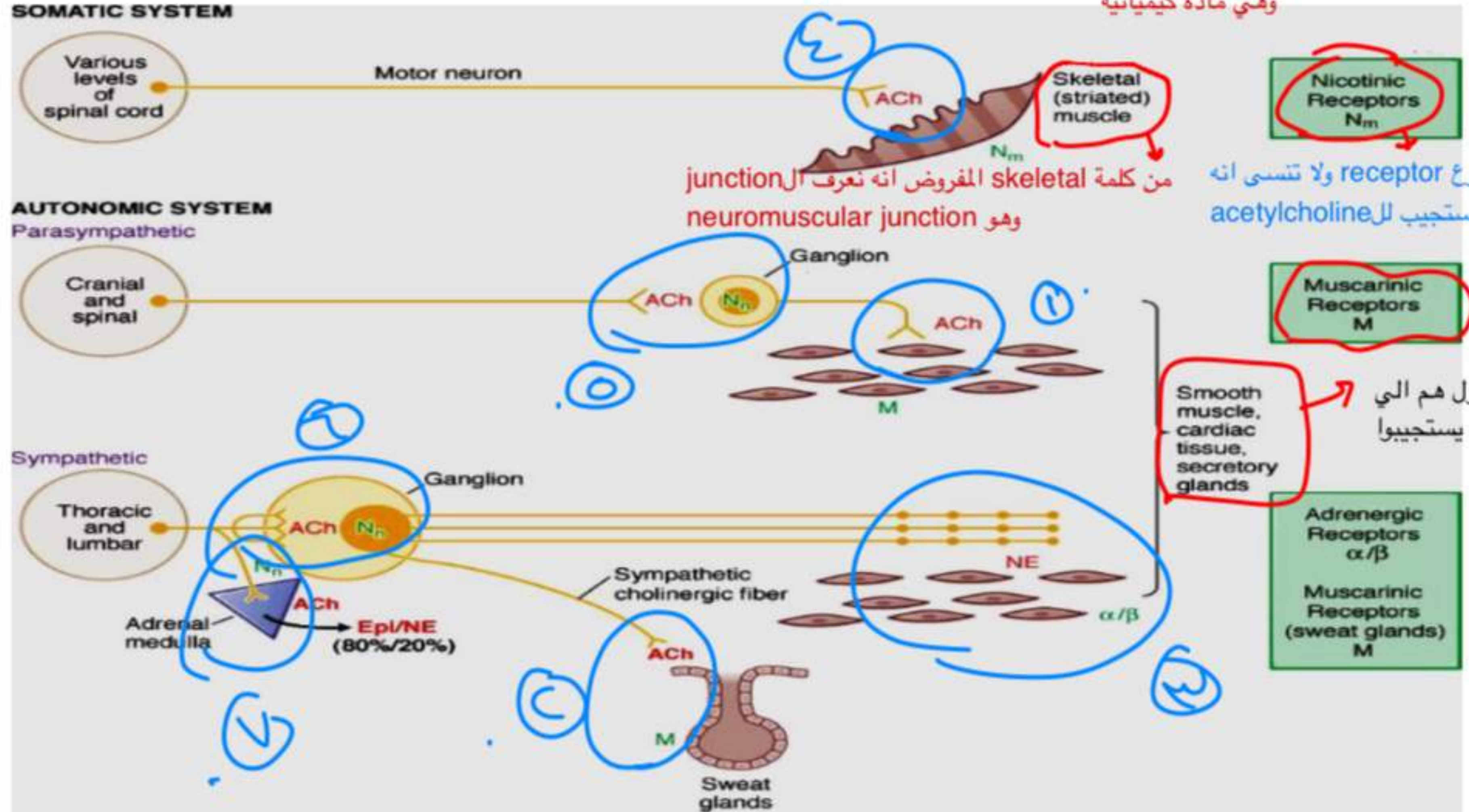
Found in: 1. skeletal muscle (neuromuscular junction)
2. Autonomic ganglia (sympathetic, parasympathetic)

Like ganglion

لاحظ انها أفرزت هرمون من سيال عصبي

Somatic and autonomic systems Transmitters and Receptors of ANS

الحين هاذ receptor هو نفسه
adrenergic receptor
ويستقبل nor-adrenaline
وسمي هكذا لانه يستقبل muscarine
وهي مادة كيميائية



من كلمة skeletal المفروض انه نعرف ال junction وهو neuromuscular junction

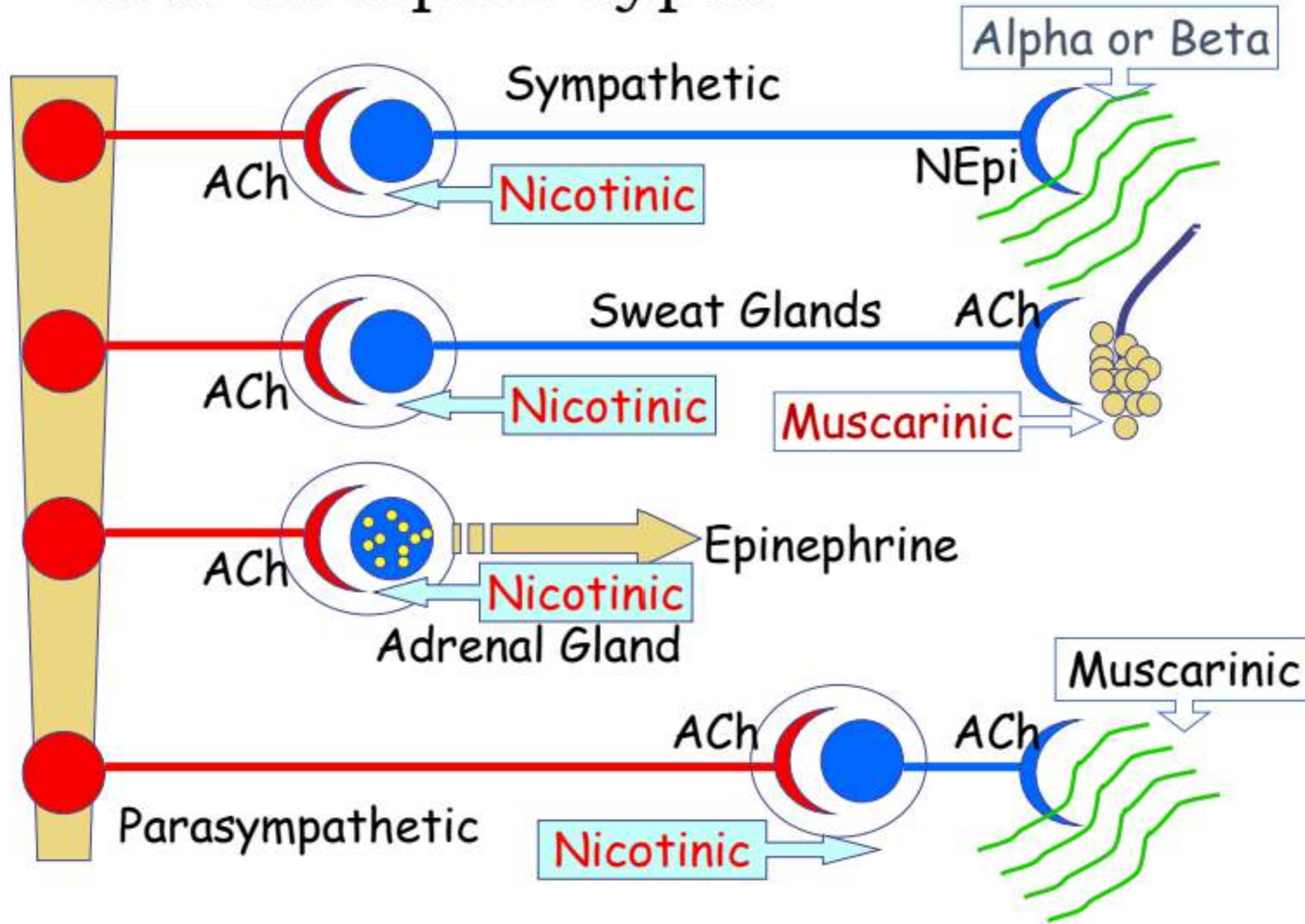
هو نوع receptor ولا تنسى انه يستجيب لل acetylcholine

هذول هم الي يستجيبوا

١/٢ يتواجد فيها muscarinic receptor
٢ يتواجد فيها adrenergic receptors
٤/٥/٦/٧ يتواجد فيها nicotinic receptor (معلومة)
على الهامش هاذ الريسبتور مسؤول عن استقبال نيكوتين الموجود السجائر

Source: Brunton LL, Chabner BA, Knollmann BC: Goodman & Gilman's The Pharmacological Basis of Therapeutics, 12th Edition: www.accessmedicine.com
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ANS Receptor Types



Neurotransmitters and receptors

- Neurotransmitter-receptor binding causes changes in post synaptic cell membrane depending on whether it is inotropic or metabotropic
- Autonomic transmitter substance can cause inhibition in some organs or excitation in others. This effect is determined by the nature of the receptor protein in the cell membrane.

Inotropic receptors :

ليش سموه العلماء بهاذ الاسم يا فطحل؟ لانه يستقبل الايونات

* A change in cell membrane permeability to one or more ions. A change in cell membrane permeability results in either opening or closing of an ion channel

* Opening of Na^+ and/or Ca^{2+} ion channels \rightarrow rapid influx of the respective ions into the cell \rightarrow depolarizing the cell membrane and exciting the effector cell.

* Opening of potassium channels \rightarrow K^+ efflux \rightarrow inhibition of the effector cell because of the hyper-negativity inside the effector cell.

بالنسبة لهذول
الخطوات المفروض
منا انه نكون عارفين
انه
٢- كيف بصير
التحفيز
٣- كيف بصير
التثبيط

Metabotropic receptors

نفس سؤال الي فوق (ليش سموه العلماء هيك؟) لانه هو مسؤول عن استقبال g-protein المرتبط فيه المادة المستقبلة

- Metabotropic receptors
- Neurotransmitter usually binds with a receptor protein linked to G protein located inside the cell. Activation or inactivation of an enzyme attached to the intracellular side of the receptor protein.

For example: Binding of NE with its receptor on the outside of many cells acts through the **second messenger mechanism** by increasing the activity of the enzyme adenylyl cyclase on the inside of the cell, which causes formation of **cAMP**.

خلينا نفهم المثال هاذ لانه مهم :-نوريبينفرين (نفسه nor-adrenaline) لما يتحد مع مستقبله (بحيث هاذ المستقبل كما ذكر فوق انه مرتبط مع g-protein رح يعمل عنا cascade بسبب تنشيط g-protein (اذا مو ذاكرها ارجع لمادة الميد نصيحة) وهاذ يكون يكون second messenger inside the cell طيب مين first؟؟؟ هو nor-epinphrine

ملاحظة مهمة:- اذا مو دراس مادة الميد ارجع الها وخصوصا من ١٦-٢٠

Acetylcholine Receptors

هون اعزائي مستقبلات
acetylcholine

- Two types
- **Muscarinic receptors** : The terminology comes from **muscarine**, a poison from toadstools
 - Muscarinic receptors are **metatoropic**, which **use G proteins** couple receptors as their signaling mechanism, are found on all **target** effector cells that are **stimulated by the postganglionic cholinergic neurons** of either the parasympathetic nervous system or cholinergic fibers of the sympathetic system
- **Nicotinic receptor : stimulated by Nicotine**
 - Nicotinic receptors are **ligand-gated ion channels**
 - Located in **autonomic ganglia** at the synapses between the preganglionic and postganglionic
 - These receptors are also found in myoneural junction (Synapse between somatic motor neurons and skeletal muscle fibers)

Adrenergic Receptors

هون يا جماعة الخير هاذ receptor مسؤول عن
استقبال adrenaline
معلومة عن هاذ السلايد :- adrenaline يعتبر
منشط الاول لعضلة القلب وفي بعض الحالات
يستخدموا الاطباء ابرة منها لتنشيط عضلة القلب
وعدم موتها

• Alpha and Beta Receptors

➤ There are two major types of alpha receptors, **alpha1 and alpha2**, which are **linked to different G proteins**.

➤ The **beta receptors** are divided into **beta1, beta2, and beta3** receptors. The beta receptors also use **G proteins** for signaling

~~The beta receptors are divided into beta1, beta2, and beta3 receptors. The beta receptors also use G proteins for signaling.~~

➤ Norepinephrine and epinephrine, both of which are secreted into the blood by the adrenal medulla, have slightly different effects in exciting the alpha and beta receptors.

Norepinephrine excites mainly **alpha receptors** but excites the beta receptors to a lesser extent as well

Epinephrine is a **universal stimulator** and can **excite** both **types of receptors** approximately equally.

➤ Therefore, if an organ has just beta receptors (such as the **heart**), **epinephrine will be the more effective excitant**.

انتبه هون عدد
alpha هو ٢
و beta هو ٣
والثنتين يعتمدوا
على G-protein

يسبب تضيق في الاوعية الدموية (vasoconstriction)

يزيد القوة انقباض عضلة القلب

Adrenergic Receptors

- Alpha and Beta Receptors
 - There are two major types of alpha receptors, alpha1 and alpha2, which are linked to different G proteins.
 - The beta receptors are divided into beta1, beta2, and beta3 receptors. The beta receptors also use G proteins for signaling
 - The beta receptors are divided into beta1, beta2, and beta3 receptors. The beta receptors also use G proteins for signaling.
 - Norepinephrine and epinephrine, both of which are secreted into the blood by the adrenal medulla, have slightly different effects in exciting the alpha and beta receptors.
 - Norepinephrine excites mainly **alpha receptors** but excites the beta receptors to a lesser extent as well
 - Epinephrine is a **universal stimulator** and can excite both types of receptors approximately equally.
 - Therefore, if an organ has just beta receptors (such as the heart), epinephrine will be the more effective excitant.

Alpha receptors: vasoconstriction in the systemic circulation of the heart, not in the heart -→ bronchoconstriction in the respiratory system --→ bronchoconstriction طبعاً هو فعلياً لا يوجد في الرئة alpha عشان ما تسوي 4/19/2023 26

Beta receptors: are more important in the heart and are involved in increasing the myocardial counteractivity and the force of contraction (causes vasodilation / bronchodilation)

Adrenergic Receptors and Function

شايفين هاز الجدول اكيد
شايفينه

هاذ حفظ من اوله لاخره مع
التركيز على انواع alpha و
beta

الي عليهم نجمة تخص عضلة
القلب وهذول ابصمهم زي اسمك

Alpha Receptor

Vasoconstriction

Iris dilation

Intestinal relaxation

Intestinal sphincter
contraction

Pilomotor contraction

Bladder sphincter
contraction

Inhibits neuro-
transmitter
release (α_2)

Beta Receptor

Vasodilation (β_2)

Cardioacceleration (β_1)

Increased myocardial strength (β_1)

Intestinal relaxation (β_2)

Uterus relaxation (β_2)

Bronchodilation (β_2)

Calorigenesis (β_2)

Glycogenolysis (β_2)

Lipolysis (β_1)

Bladder wall relaxation (β_2)

Thermogenesis (β_3)

لهدسر يع القلبيه (زي ياقه هيربات القلب)

قزحية العين

تاثير الفا او بيتا على
امعاء نفس الاشعي

هون اذا تذكروا اخذناها
بالبيو عشن تمنع انتقال
الاكل لمنطقة ثانية

عشان البول ما
يطيح لحاله

تعتبر
Metabolic
activities

Adrenergic Receptors and Function

هذا الجدول مطلوب نعرفه

| Alpha Receptor | Beta Receptor |
|--|---|
| Vasoconstriction | Vasodilation (β_2) |
| Iris dilation | Cardioacceleration (β_1) |
| Intestinal relaxation | Increased myocardial strength (β_1) |
| Intestinal sphincter contraction | Intestinal relaxation (β_2) Uterus relaxation (β_2) |
| Pilomotor contraction | Bronchodilation (β_2) |
| Bladder sphincter contraction | Calorigenesis (β_2) |
| Inhibits neurotransmitter release (α_2) | Glycogenolysis (β_2) Lipolysis (β_1) Bladder wall relaxation (β_2) Thermogenesis (β_3) |

Most of the effects of the heart are mediated by beta receptors

قزحية

تسارع القلب

مهم

مهم

العضلات التي ترفرف الشعر

ي عنده ضيق نفس، ال epinephrine بخليه

نفس لانه يقلل Airway resistance وبفوت الهواء

على الرئة بسهولة

مهم

metabolic effect and metabolic activi

مهم

Autonomic Effects on Various Organs of the Body

برهون على الدكتور انه حق

ورکز مینج

عاشاي عليه فخر

| Organ | Effect of Sympathetic Stimulation | Effect of Parasympathetic Stimulation |
|-----------------|---|--|
| Eye | | |
| *Pupil | Dilated | Constricted |
| Ciliary muscle | Slight relaxation (far vision) | Constricted (near vision) |
| Glands | Vasoconstriction and slight secretion | Stimulation of copious secretion (containing many enzymes for enzyme-secreting glands) |
| Nasal | | |
| Lacrimal | | |
| Parotid | | |
| Submandibular | | |
| Gastric | | |
| Pancreatic | | |
| Sweat glands | Copious sweating (cholinergic) | Sweating on palms of hands |
| Apocrine glands | Thick, odoriferous secretion | None |
| *Blood vessels | Most often constricted | Most often little or no effect |
| *Heart | | |
| Muscle | Increased rate | Slowed rate (Bradycardia) |
| | Increased force of contraction | Decreased force of contraction (especially of atria) |
| Coronaries | Dilated (β_2); constricted (α) | Dilated |
| *Lungs | | |
| Bronchi | Dilated | Constricted |
| Blood vessels | Mildly constricted | ? Dilated |
| *Gut | | |
| Lumen | Decreased peristalsis and tone | Increased peristalsis and tone |
| Sphincter | Increased tone (most times) | Relaxed (most times) |

يتم تزويد هذه الغدة بشكل رئيسي من Sympathetic nervous system باستثناء الموجودة في اليدين والقدمين والاصابع

المستقبل الرئيسي هو β_2 في الشرايين التاجية حيث الجهاز العصبي الودي sympathetic يقوم بتوسيع هذه الشرايين التاجية وتقليصها (بس الاغلبية العظمى بوسعها عشان القلب بده دم لنعيش وسلامتكم)

تباطؤ ضربات القلب

Autonomic Effects on Various Organs of the Body

هاد الجدول في السلايدين التاليين مطلوب



| Organ | Effect of Sympathetic Stimulation | Effect of Parasympathetic Stimulation |
|-----------------|---|--|
| Eye | | |
| Pupil | Dilated mydriasis | Constricted |
| Ciliary muscle | Slight relaxation (far vision) | Constricted (near vision) myosis |
| Glands | Vasoconstriction and slight secretion | Stimulation of copious secretion (containing many enzymes for enzyme-secreting glands) |
| Nasal | | |
| Lacrimal | | |
| Parotid | | |
| Submandibular | | |
| Gastric | | |
| Pancreatic | | |
| Sweat glands | Copious sweating (cholinergic) | Sweating on palms of hands Soles of foot |
| Apocrine glands | Thick, odoriferous secretion | None |
| Blood vessels | Most often constricted | Most often little or no effect |
| Heart | | |
| Muscle | Increased rate tachycardia | Slowed rate bradycardia |
| | Increased force of contraction | Decreased force of contraction (especially of atria) |
| Coronaries | Dilated (β_2); constricted (α) | Dilated |
| | Main little | |
| Lungs | | |
| Bronchi | Dilated | Constricted |
| Blood vessels | Mildly constricted | ? Dilated |
| Gut | | |
| Lumen | Decreased peristalsis and tone | move of intestine:-peristalsis of intestine Increased peristalsis and tone |
| Sphincter | Increased tone (most times) | Relaxed (most times) |

بخلينا نعرق زيادة
↑

ما شرحها الدكتور



Autonomic Effects on Various Organs of the Body

| Organ | Effect of Sympathetic Stimulation | Effect of Parasympathetic Stimulation |
|--------------------------------|---|---------------------------------------|
| * Liver | Glucose released | Slight glycogen synthesis |
| * Gallbladder and bile ducts | Relaxed | Contracted |
| * Kidney | Decreased urine output and increased renin secretion | None |
| Bladder Detrusor Trigone | Relaxed (slight) Contracted | Contracted Relaxed |
| * Penis | Ejaculation القذف | Erection الانتصاب |
| Systemic arterioles | Constricted | None |
| Abdominal viscera | Constricted (adrenergic α) | None |
| Muscle | Dilated (adrenergic β_2) Dilated (cholinergic) | None |
| Skin | Constricted | None |
| Blood | | |
| Coagulation | Increased | None |
| Glucose | Increased | None |
| Lipids | Increased | None |
| Basal metabolism | Increased up to 100% | None |
| * Adrenal medullary secretion | Increased | None |
| * Mental activity | Increased | None |
| Piloerector muscles | Contracted | None |
| Skeletal muscle | Increased glycogenolysis Increased strength | None |
| Pat cells | Lipolysis | None |

انزيم يفرزه ال kidney ويقوم بارتفاع ضغط الدم

الطاقة اللازمة للعيش بصحة جيدة

الهرمونين (epinephrine and Norepinephrine) يزيدان من استفادة الجسم من الطاقة ويطلق عليها energy utilization ويحرران المزيد من الطاقة لذلك هم يزيدوا من bazal metabolic rate

Reticular activating system هو الذي يزداد

Autonomic Effects on Various Organs of the Body

| Organ | Effect of Sympathetic Stimulation | Effect of Parasympathetic Stimulation |
|--------------------------------|--|---------------------------------------|
| Liver | Glucose released | Slight glycogen synthesis |
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| Penis | Ejaculation | Erection |
| Systemic arterioles | | |
| Abdominal viscera | Constricted | None |
| Muscle | Constricted (adrenergic α) Dilated (adrenergic β_2) Dilated (cholinergic) | None |
| Skin | Constricted | None |
| Blood | | |
| Coagulation | Increased | None |
| Glucose | Increased | None |
| Lipids | Increased | None |
| Basal metabolism | Increased up to 100% | None |
| Adrenal medullary secretion | Increased | None |
| Mental activity | Increased | None |
| Piloerector muscles | Contracted | None |
| Skeletal muscle | Increased glycogenolysis Increased strength | None |
| Fat cells | Lipolysis | None |

عضلات بترفع شعيرات الايد



اتفضلوا يجماعه حتى أنا وجمع
بالتفريغ صرت أدمع فكيف انتو
الله بعينا على حفظ الجداول ❄️

بعدين لاحظوا جبتلكم علبة محارم
الضيوف ما في اشي من قيمتكم يعني 😊

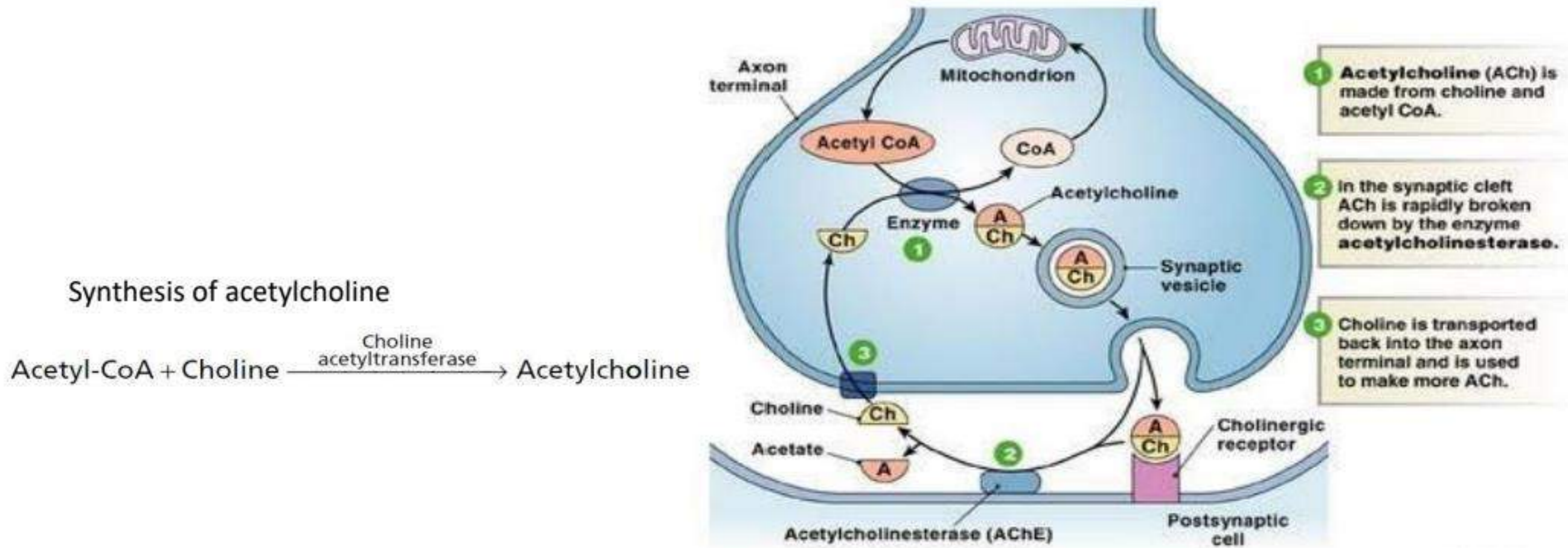


يلا نرجع نكمل



صحيح في سلايدات مكررة بس هاد مش معناه ما
يندرسوا 🤔
هدول بيكونوا هيك لانه بيكون ما بدنا نعجق السلايد
أو بيكون دكتور حكا عن السلايد مرتين مرة بمحاضرة
23 ومرة 24
لهيك يلي أوتهم يرجلهم أشوف 🛠

Cholinergic synapse: Synthesis, release and degradation of acetylcholine



4/19/2023

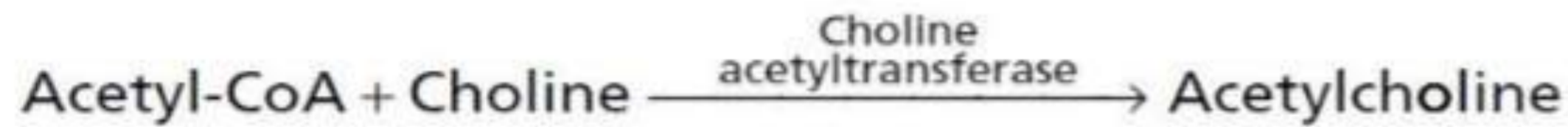
30

Organophosphate → inhibit Acetylcholinesterase = accumulation of ACh → salivation, diarrhea, lacrimation.

Cholinergic synapse: Synthesis, release and degradation of acetylcholine

بعد ما تم تكون الاسيتيلكولين يتم تخزينه في الحويصلات داخل الخلية ويظلله غاد حتى تيجي الإشارة والتي تؤدي لتحريره ويخرج اى شق التشابكي يقوم بالاتحاد مع مستقبله في الخلية بعد التشابكية (post ganglionic neuron) الالة الرئيسية لانتهاء عمل الاسيتيلكولين في التشابكات الذي يكون هو الناقل العصبي هي enzymatic degradation حيث يأتي acetylcholinesterase الذي يوجد في الشق التشابكي ويفكك acetylcholine وتحدث هذه العملية من اجل الحفاظ على الكفاءة يعني يشتغل باحسن جودة واقل تكلفة ويعود choline الى العصبون قبل التشابكي ويعاد استخدامه لتكوين استيلكولين من جديد

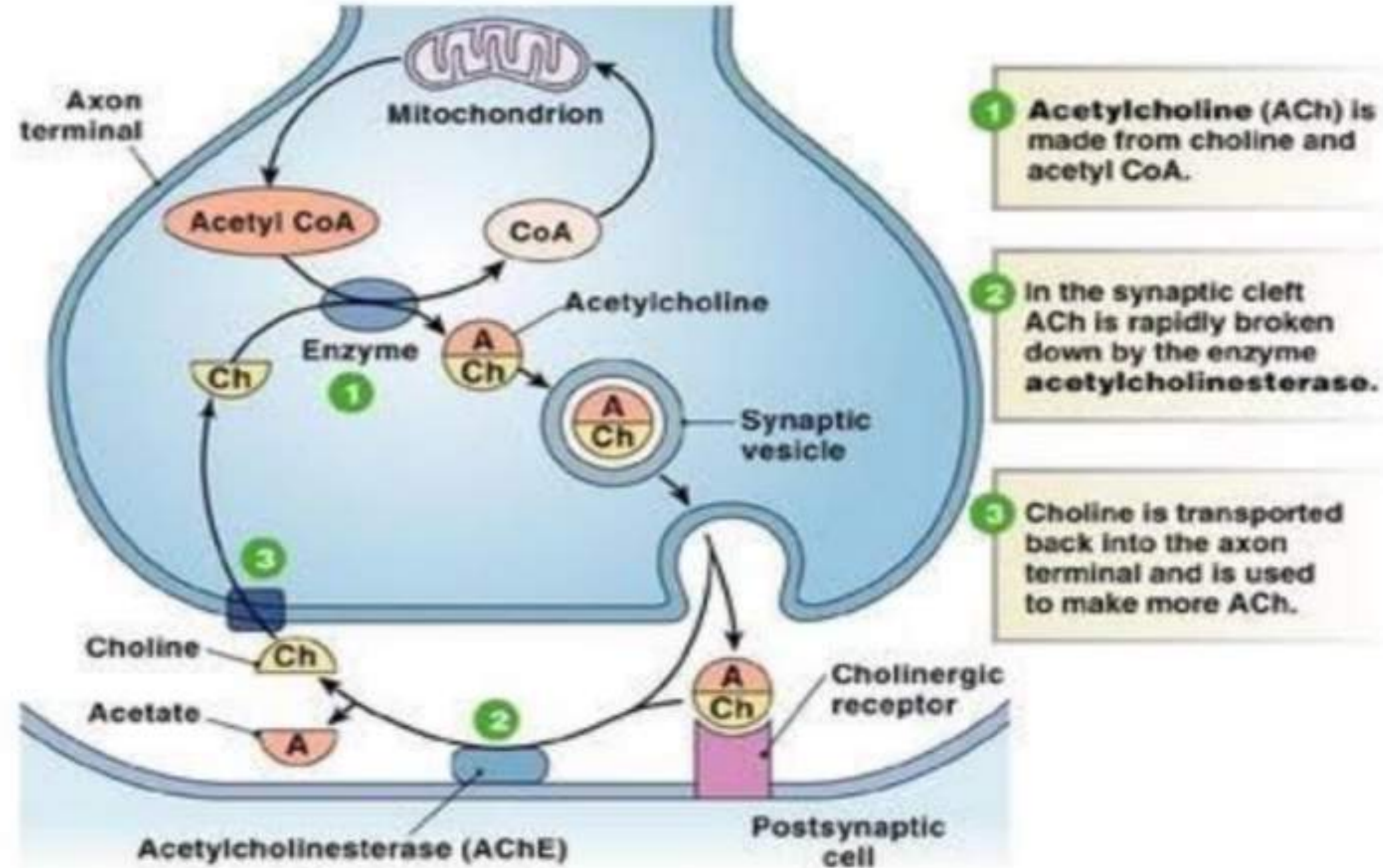
Synthesis of acetylcholine



ذكر الدكتور زهير معلومة مهمة وهي ليش ما يضل اسيتيلكولين على حاله؟ وليش بصير الة degradation؟

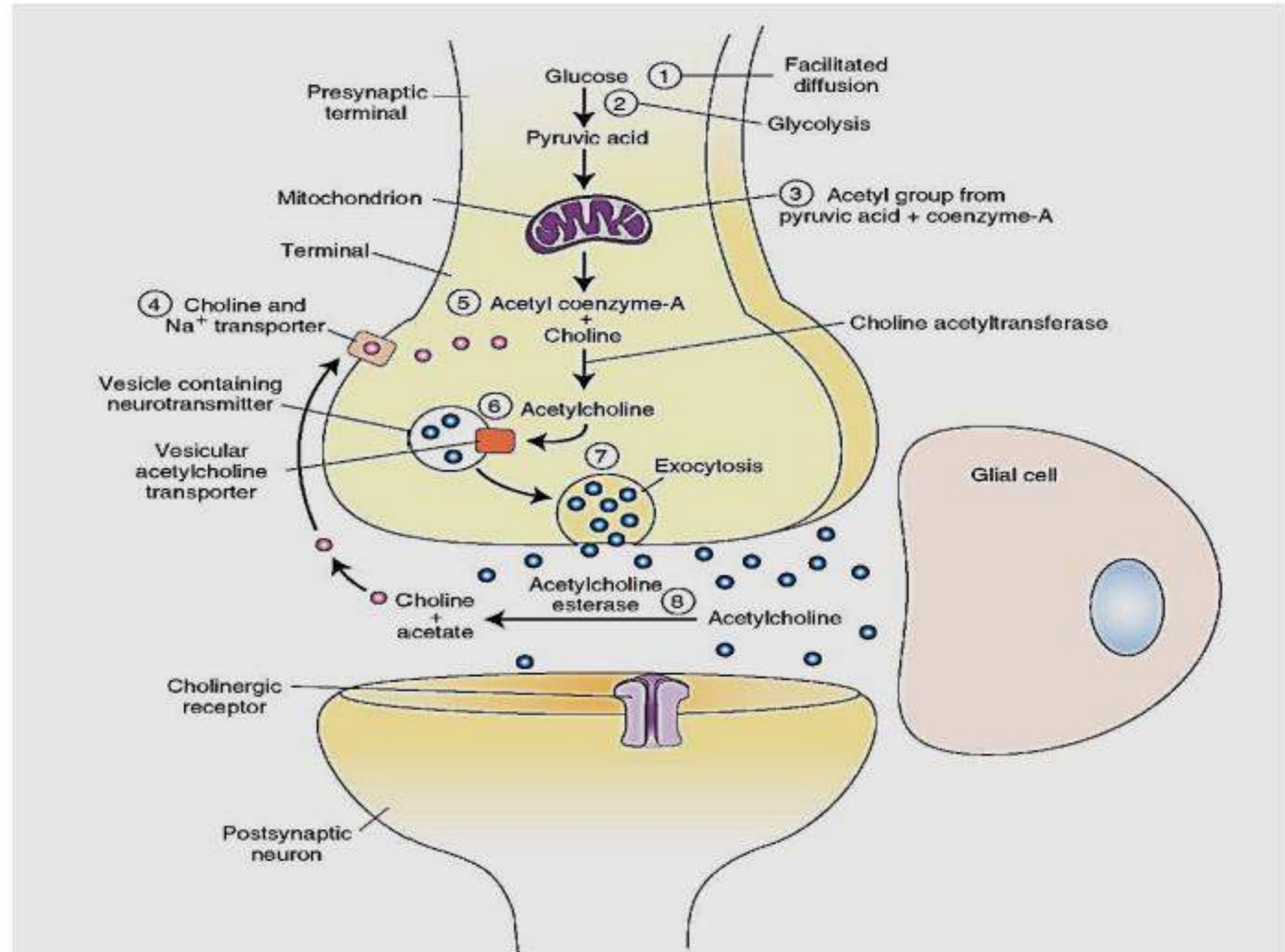
لانه تراكم acetylcholine في التشابك العصبي نتيجة لاحد هذه المثبطات مثل organophosphate الذي يستخدم في الحروب warfares سيحدث اعراض معينة لدى الاشخاص المصابين مثل

سيلان اللعاب والدموع وتضيق القصبات الهوائية



**Cholinergic synapse:
synthesis, release and
degradation of acetylcholine**

فقط العضل هو المطلوب
منا هون



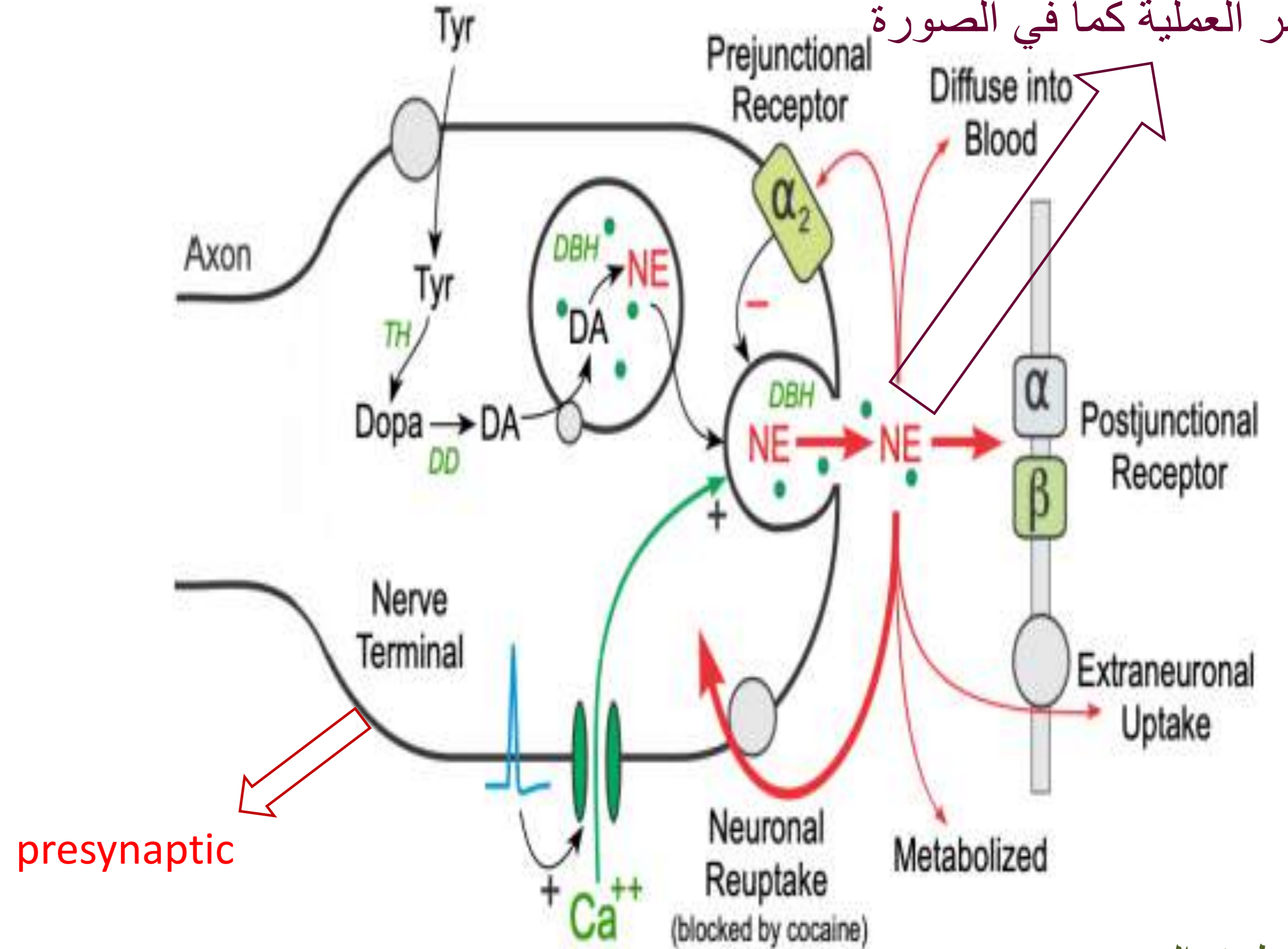
Catecholamine= Dopamine, NE, E

Synthesis , release and termination of action of NE

Termination of action of NE

- Reuptake into the adrenergic nerve endings by an **active transport process**, accounting for removal of 50 to 80% of the secreted norepinephrine
- Diffusion away from the nerve endings into the surrounding body fluids and then into the blood
- Destruction of small amounts by tissue enzymes (one of these enzymes is monoamine oxidase (MAO), which is found in the nerve endings, and another is catechol-O-methyl transferase (COMT), which is present diffusely in the tissues especially the liver).

مصدر ل Catecholamine



في ال Sympathetic تتوقف العملية

لهذا الحد الآ في ال Adrenal medulla

رح تستمر العملية كما في الصورة

طرق ال Termination

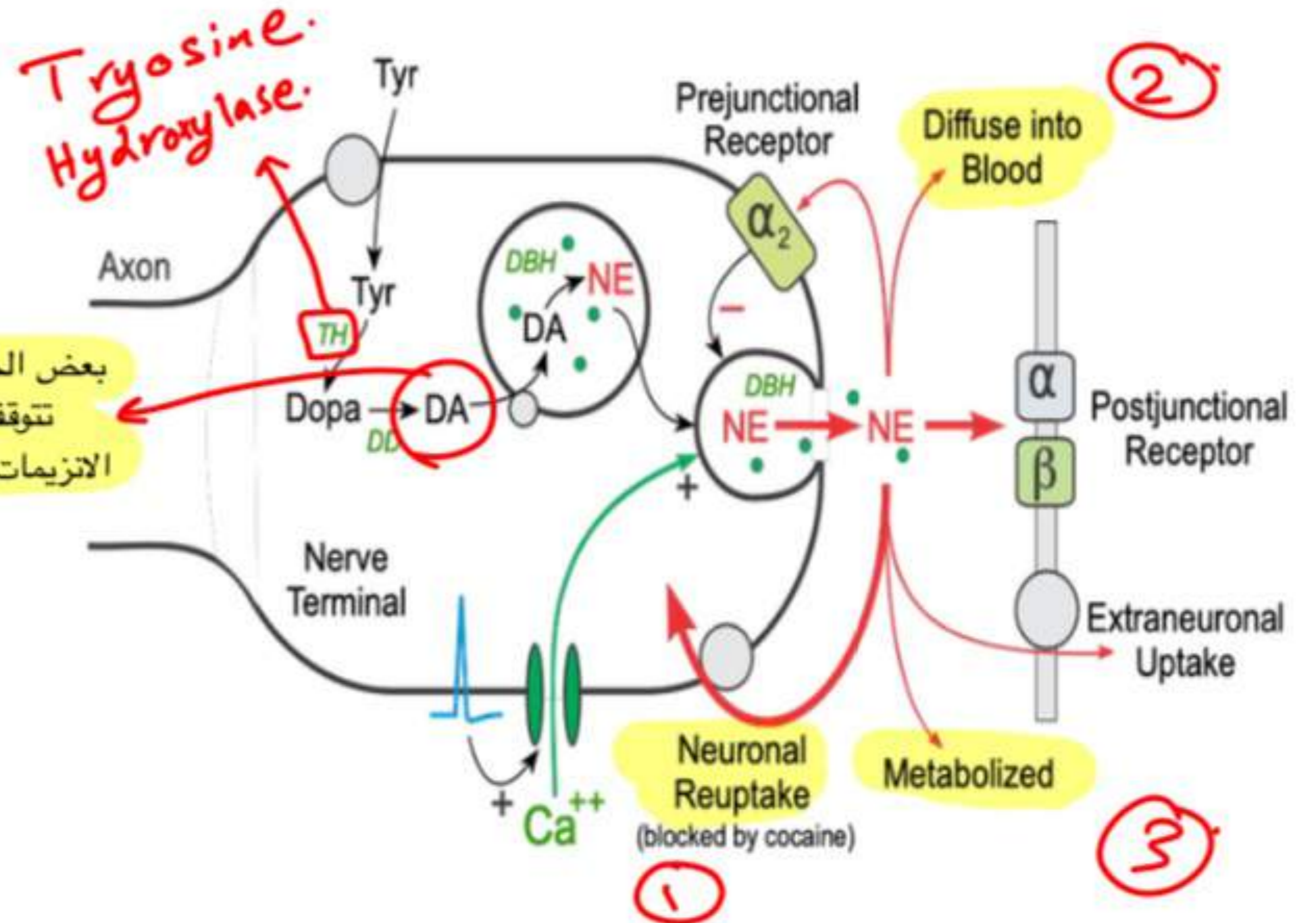
Tyr, tyrosine; TH, tyrosine hydroxylase; DD, DOPA decarboxylase; DA, dopamine; DBH, dopamine β-hydroxylase; NE, norepinephrine

Synthesis , release and termination of action of NE

Termination of action of NE

- ① • Reuptake into the adrenergic nerve endings by an **active transport process**, accounting for removal of 50 to 80% of the secreted norepinephrine
- ② • Diffusion away from the nerve endings into the surrounding body fluids and then into the blood
- ③ • Destruction of small amounts by tissue enzymes (one of these enzymes is monoamine oxidase (MAO), which is found in the nerve endings, and another is catechol-O-methyl transferase (COMT), which is present diffusely in the tissues especially the liver).

بعض الخلايا العصبية ممكن تتوقف العملية عندها لان الانزيمات المطلوبة غير متوفرة



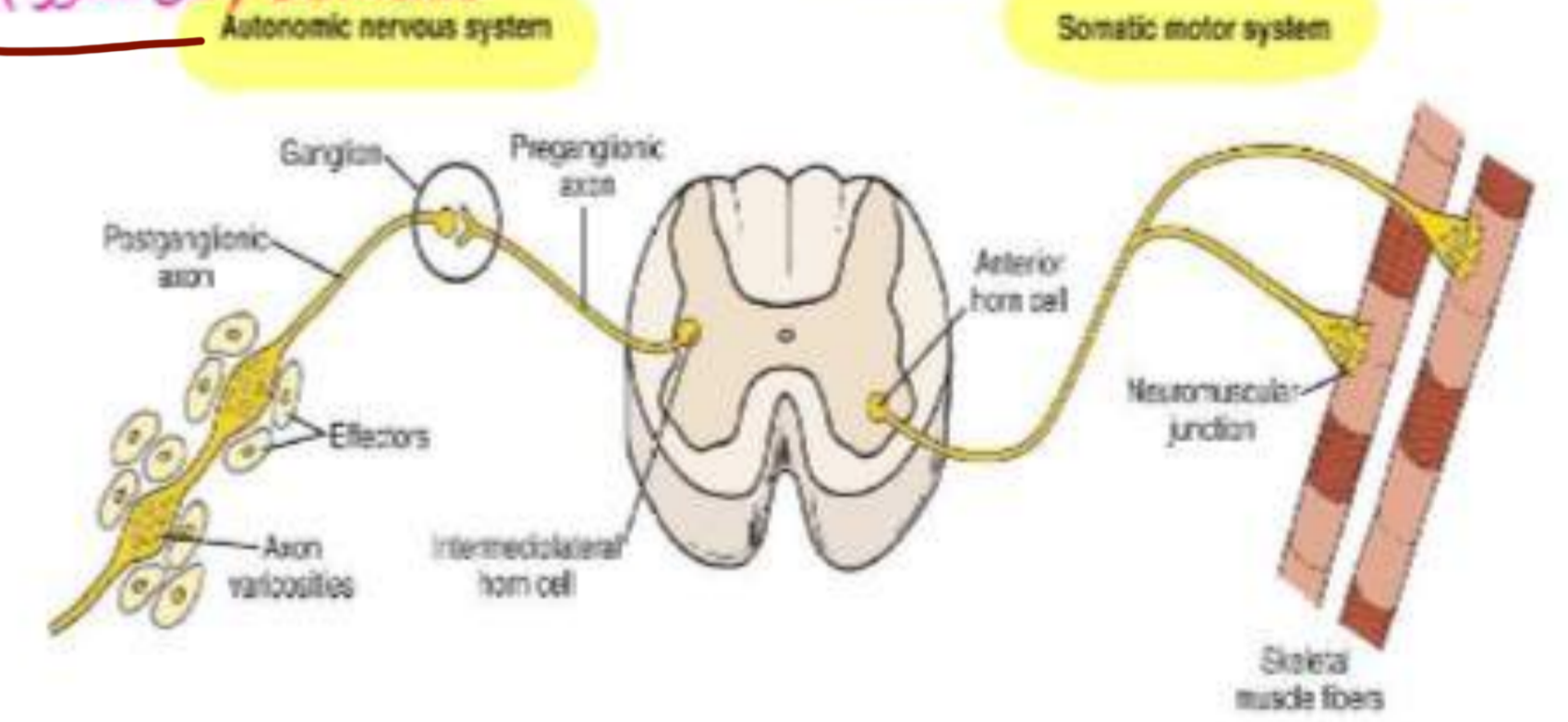
Tyr, tyrosine; TH, tyrosine hydroxylase; DD, DOPA decarboxylase; DA, dopamine; DBH, dopamine β -hydroxylase; NE, norepinephrine

Secretion and synthesis of Ach and NE by Postganglionic Nerve Endings:

في الautonomic نجد التشابكات العصبية لكنها لا تكون مثل التشابكات في somatic (اقل تطورا)

في somatic يكون التشابك العصبي مع العضلة Neuromuscular junction

ما عندها سomatic متطورة مثل Somatic



➤ Many of the parasympathetic nerve fibers and almost all the sympathetic fibers merely touch the effector cells.

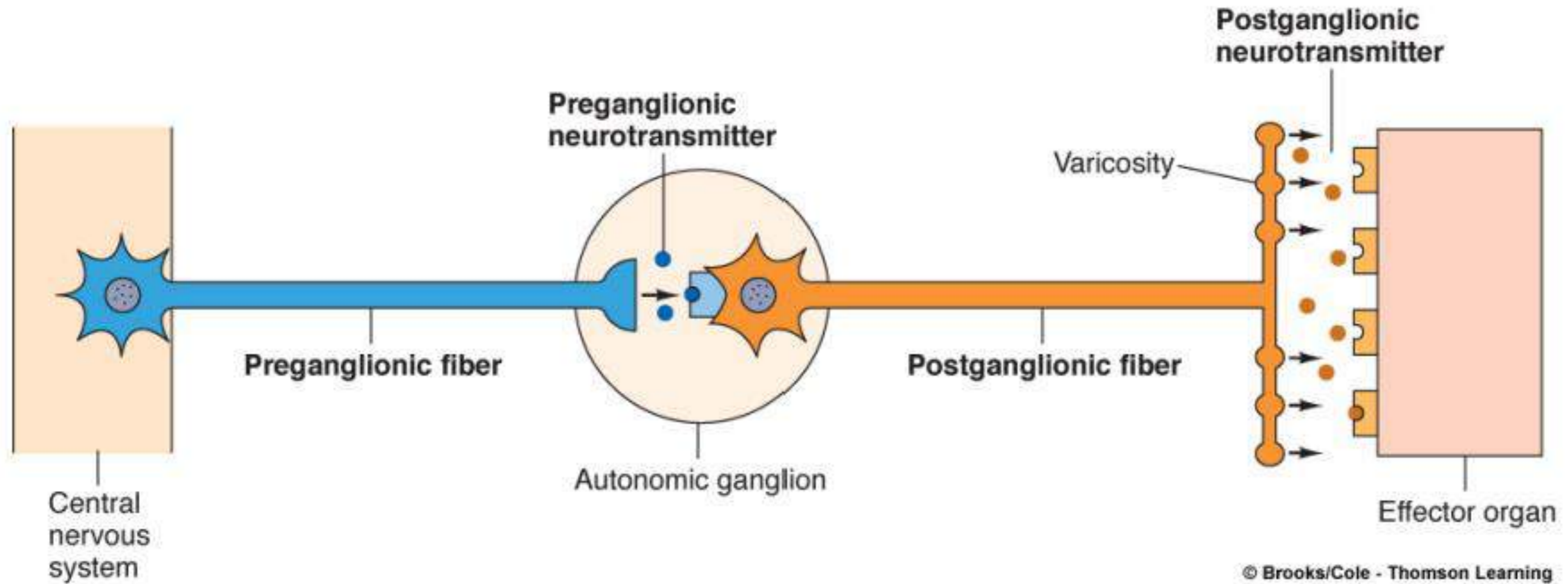
➤ Autonomic postganglionic unmyelinated C fibers have bulbous enlargements called **varicosities**; it is in these varicosities that the transmitter vesicles of acetylcholine or norepinephrine are synthesized and stored.

هنا مرض تسميه بالدوالي يعني توسعات او تضخمات في الاوعية الدموية

➤ Once an action potential spreads over the terminal fibers, the depolarization process increases the permeability of the fiber membrane to Ca^{2+} , allowing these ions to diffuse into the nerve varicosities. The calcium ions in turn cause the terminals or varicosities to secrete the transmitter substance to the exterior.

➤ Ach is synthesized and stored in vesicles in the varicosities of the cholinergic nerve fibers in highly concentrated form until it is released

varicosities



مافي somatic synapsis واضحة زي ال somatic ، بدلاً من ذلك يوجد varicosities تقوم بعملية ال neurotransmitters Realise to

MCQ

- Which of the following statements about the parasympathetic nervous system is correct?

A. Postganglionic parasympathetic nerves release acetylcholine to activate muscarinic receptors on sweat glands ✗

يوثر ايضا على cardiac muscle كمان

B. Parasympathetic nerve activity affects ~~only~~ smooth muscles and glands —

C. Parasympathetic nerve activity causes contraction of smooth muscles of the gastrointestinal wall and relaxation of the gastrointestinal sphincter

D. Parasympathetic nerve activity causes dilation of the pupil ✗

E. An increase in parasympathetic activity causes an increase in heart rate ✗.



وبس كده انتهى التفريغ

كان هذا ملف عمل أعضاء فريق الفسيولوجي العظيم جدا 🏽

الطباعة + تفريغ :

Lana Altutanji // Sulaiman Madani // Eman Etoom

تجميع الملف :

Khalida Al Baddawi

بالتوفيق

#النادي_الطبي

#معكم_خطوة_بخطوة

