

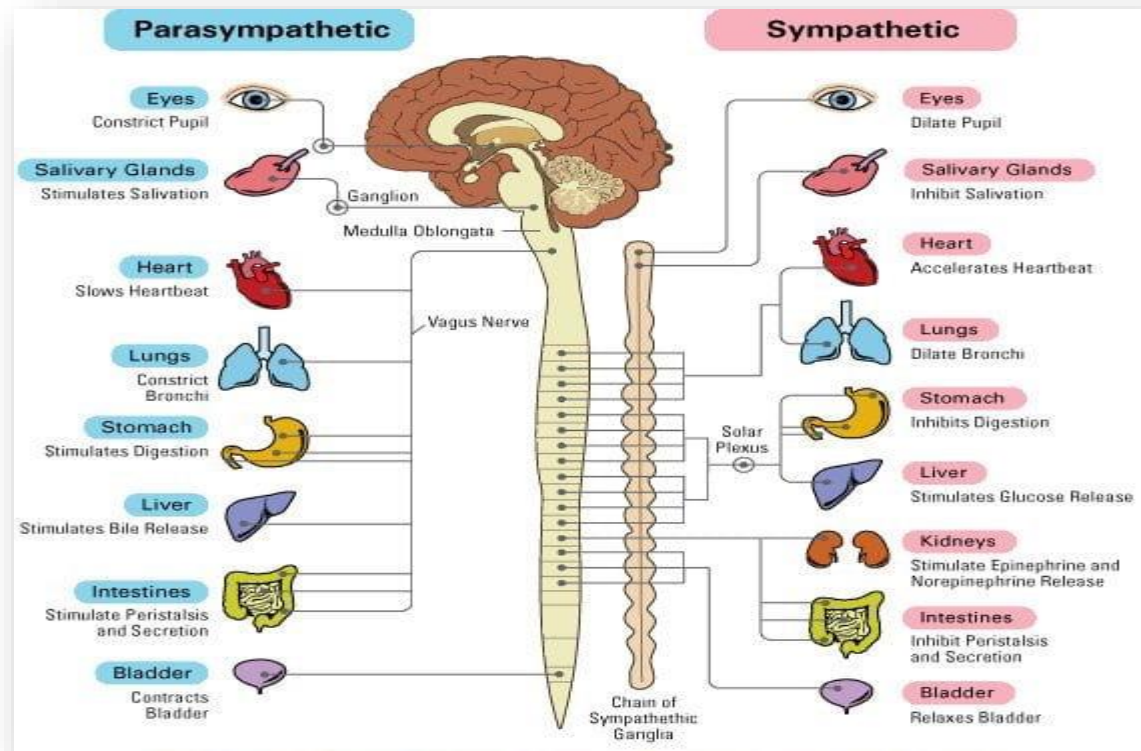
# GENERAL PHYSIOLOGY

## (Lecture 19)

### (Overview of Autonomic nervous system II)

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- The **parasympathetic** nervous system **acts during rest and sleep**.
- It is **anabolic**, helps to digest, absorb, metabolize food, **produce and store energy** as ATP store.
- **It is called craniosacral outflow.**
- It produces V.D. and increases secretions.
- All preganglionic parasympathetic fibers **relay in terminal (peripheral) ganglia.**
- Acts on **individual organs separately** and **not as a whole** like the Sympathetic.
- **Generalized parasympathetic** activity is **fatal.**
- **Structures supplied by parasympathetic fibers only:** these are constrictor pupillae muscle and esophagus.
- **Structures supplied by sympathetic fibers only:** these are dilator pupillae muscle, skin, skeletal muscle blood vessels, ventricles of the heart, spleen and adrenal medulla.

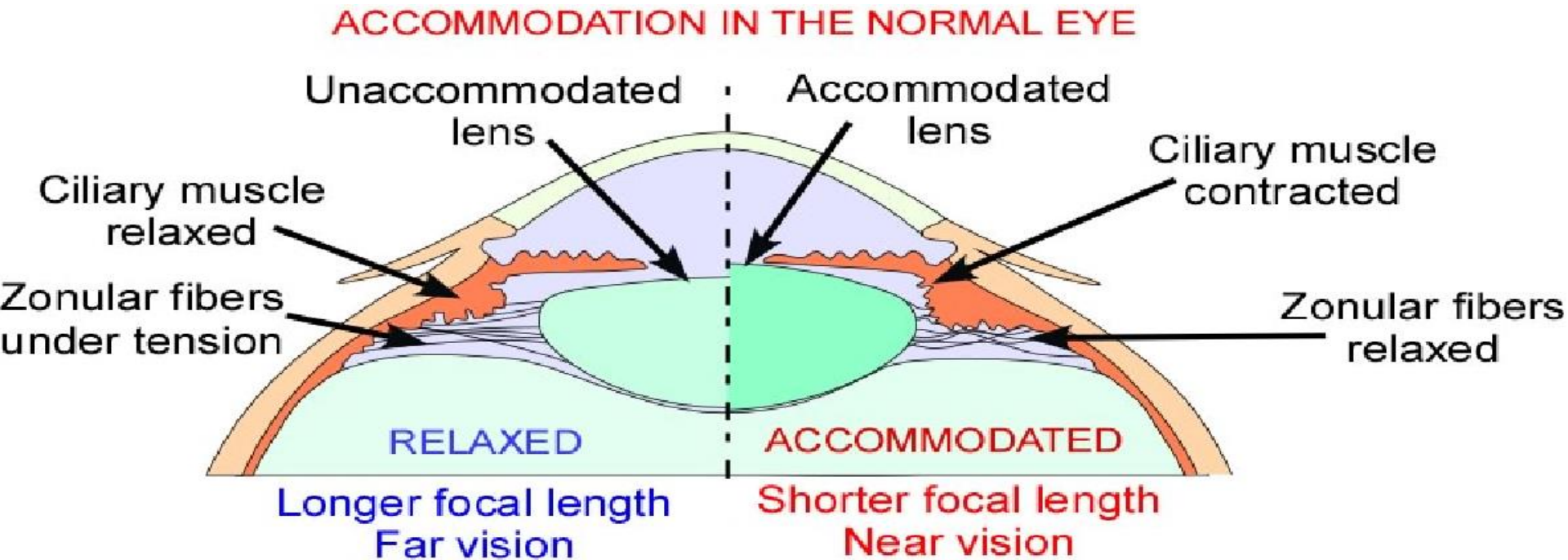
# **Distribution & Functions of Parasympathetic Nervous System**

# I- Cranial Parasympathetic Outflow:

It is present in cranial nerves (III, VII, IX and X).

## 1- The Oculomotor (3<sup>rd</sup> Cranial, III) Nerve:

- Motor to the constrictor pupillae muscle → **constriction of the pupil (miosis)**.
- Motor to ciliary muscle → contraction → relaxation of suspensory ligament → ↑ lens curvature and power → accommodation to near vision (= accommodation reflex).



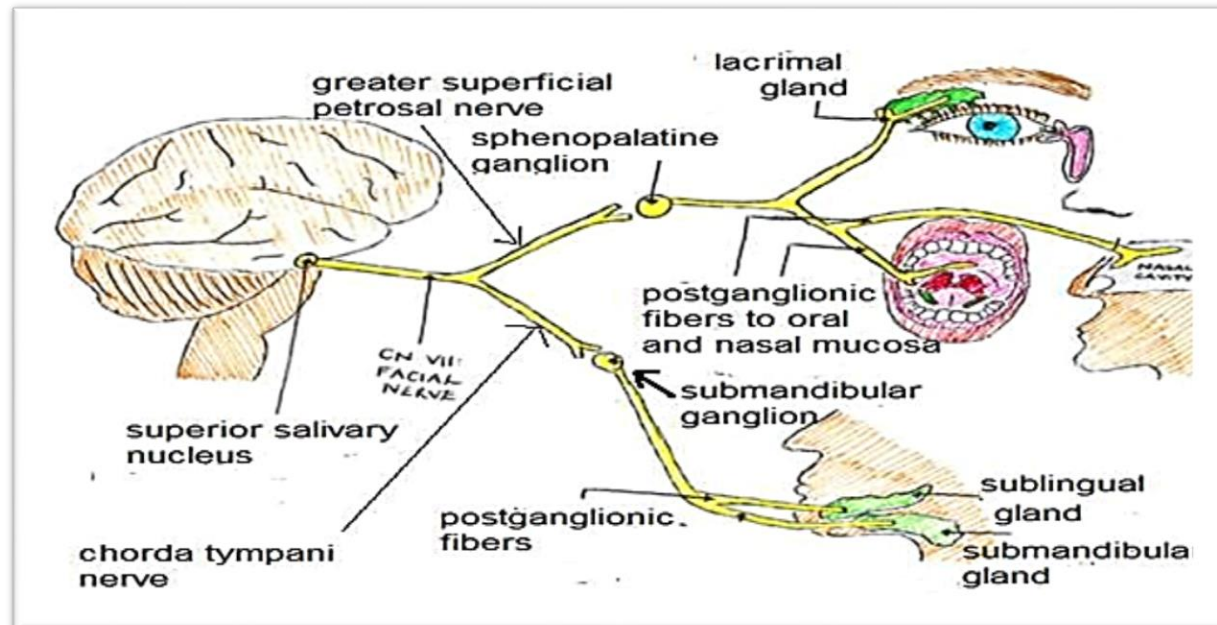
## 2- The Facial (7<sup>th</sup> Cranial, VII) Nerve:

### Postganglionic fibers supply:

- Sublingual and submandibular salivary glands.
- Anterior 2/3 of tongue.
- Nasal and lacrimal glands.

### Functions:

- Vasodilatation (V.D.)
- Secretion: It is true secretion i.e. watery, large in amount (profuse) and little in enzymes.



### **3- The Glossopharyngeal (9<sup>th</sup> Cranial, IX) Nerve Functions:**

**The post ganglionic parasympathetic fibers supply:**

- Parotid gland.
- Posterior 1/3 of the tongue.

#### **Functions:**

- Vasodilatation (V.D.).
- Secretion: ↑ profuse (true) watery salivary secretion (large volume).

## 4- The Vagus (10<sup>th</sup> Cranial, X) Nerve:

- It constitutes 75 % of parasympathetic fibers in the body.
- Supply the thoracic and abdominal viscera.

### Functions:

#### A-Thorax:

##### 1-Heart:

- It acts on the atria only ↓ all properties of cardiac muscle:
- decrease heart rate and force of atrial muscles contraction (**no supply to ventricles**).
- ↓ **cardiac metabolism** and decrease oxygen consumption by the heart → ↓ **metabolites** → **coronary V.C.** → decrease of coronary blood flow.

N.B. parasympathetic stimulation produces V.D. all over the body except in coronary blood vessels (V.C.).

##### 2-Lungs:

- Constriction of bronchi muscles (bronchoconstriction) → narrowing of air passages → ↓ air entry.
- Increase mucous secretion.
- Pulmonary vasodilatation.



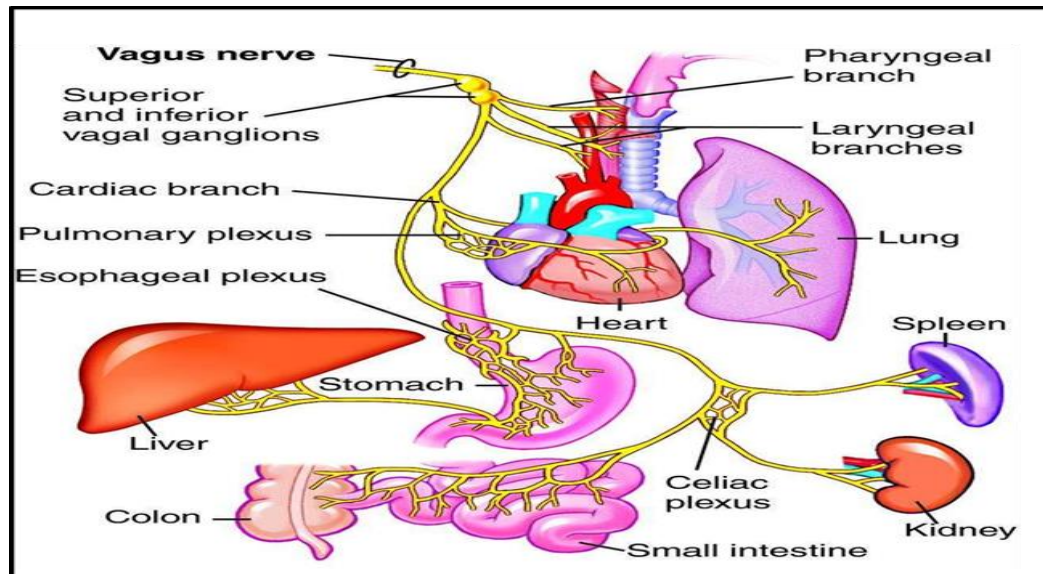
## B - Abdomen:

- Gastrointestinal tract (GIT):

(esophagus, stomach, small intestine, and proximal half of large intestine).

- Motor to wall of esophagus, stomach, small intestine and proximal part of large intestine and relaxation of sphincters → **accelerates emptying of GIT.**
- Vasodilator to GIT vessels → ↑ all GIT secretions (Stomach, liver, pancreas and duodenum).
- Gall bladder:

Stimulates Gall bladder contraction and inhibits the sphincter of Oddi → gall bladder emptying → ↑ bile flow (cholagogue).





## II- Sacral Parasympathetic Outflow (= Pelvic Nerve; S2,3,4):

- Contraction of the wall of the rectum and anal canal and relaxation of the internal anal sphincter leading to defecation.

Contraction of the wall of the urinary bladder and relaxation of the internal urethral sphincter leading to micturition.

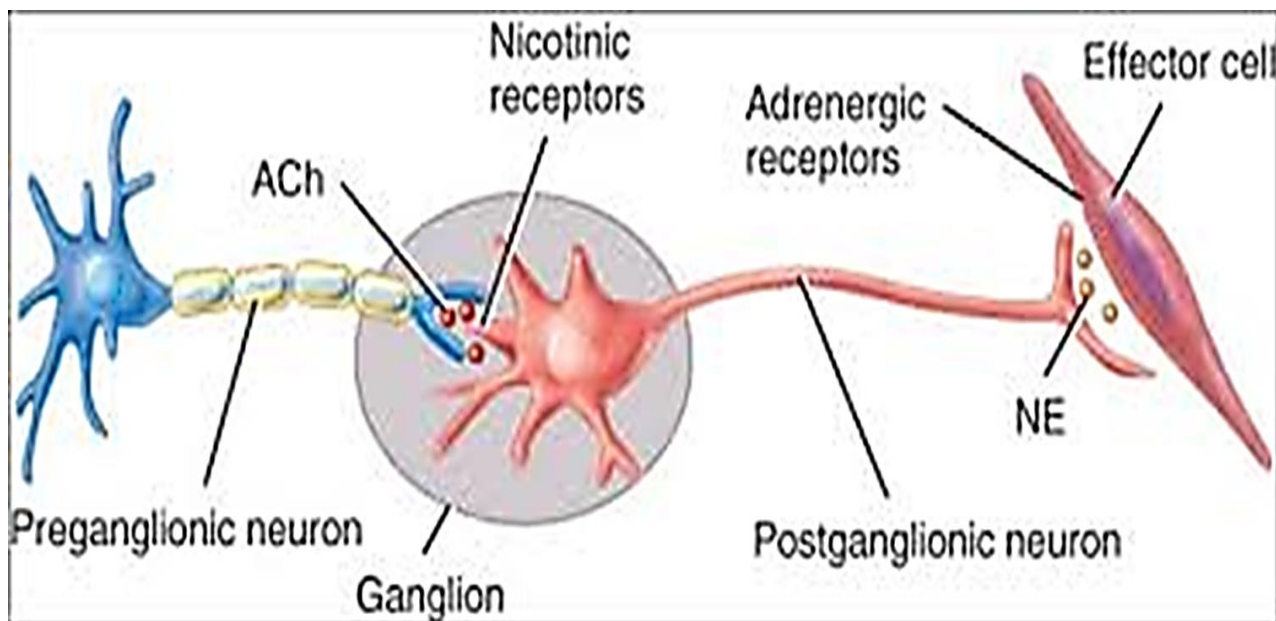
- Secretory to the seminal vesicles and prostate.
- Vasodilatation of the blood vessels of external genital organs leading to erection of penis (male) and clitoris (female).

# **CHEMICAL TRANSMITTERS in ANS**

- Transmission of nerve impulses between pre- and postganglionic neurons and between postganglionic neurons and effector organs occurs by releasing a chemical transmitter at the nerve terminal.

There are **two** types of chemical transmitters in the autonomic nervous system:

- **Acetylcholine**: and the neurons releasing it are known as **cholinergic fibers**.
- **Noradrenaline**: and the neurons secreting it are known as **adrenergic fibers**.



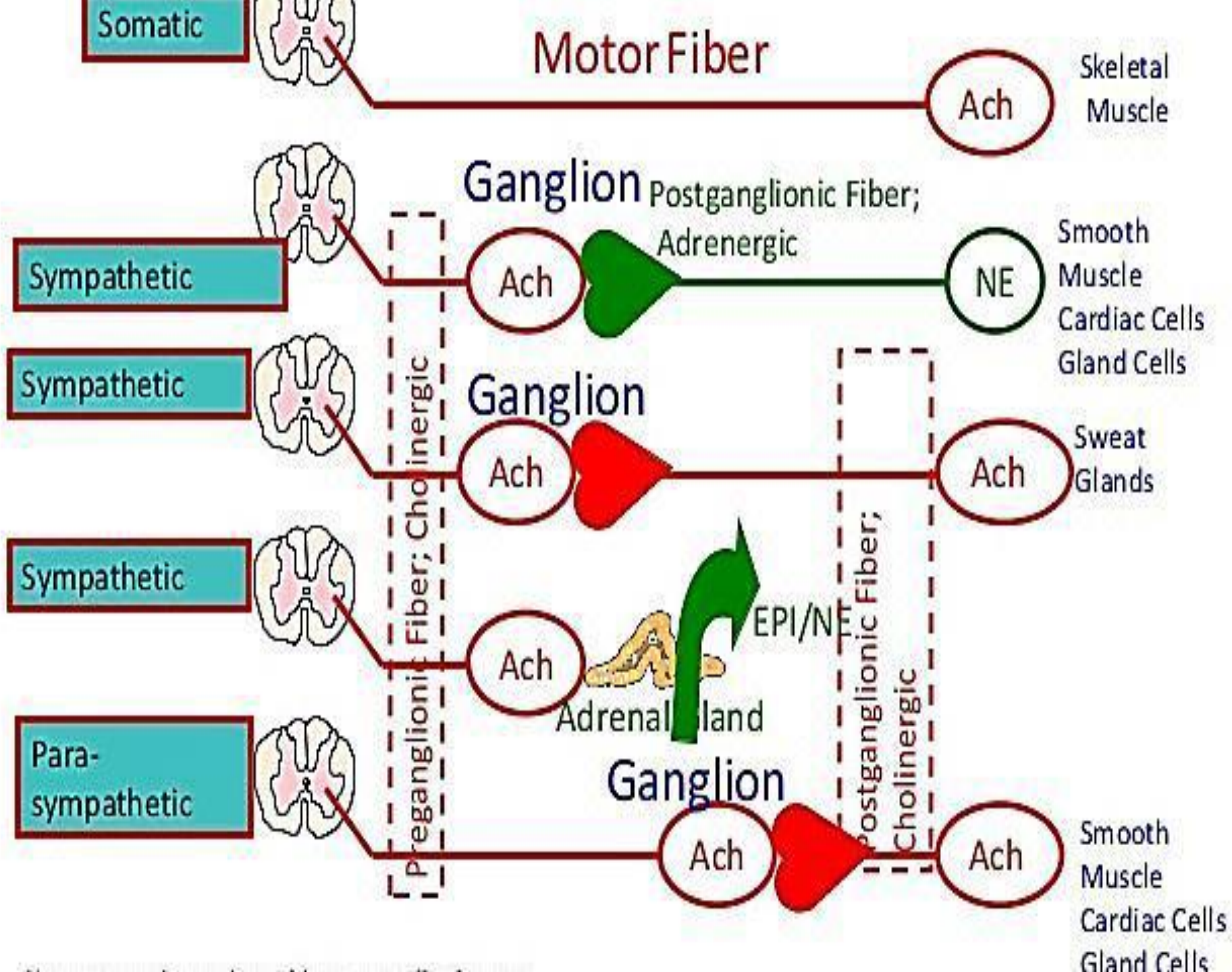
# ACETYLCHOLINE

## *Acetylcholine (ACh):*

- It is the chemical transmitter of parasympathetic nervous system (both preganglionic and postganglionic fibers).
- It exists, largely enclosed in synaptic vesicles in high concentration in the terminal buttons of neurons (cholinergic nerve fibers).

## • *Sites of acetylcholine release (cholinergic fibers);*

- At the nerve terminals of all fibers that arise from the C.N.S:
  - ✓ All preganglionic fibers of A.N.S (sympathetic and parasympathetic) → all autonomic ganglia.
  - ✓ Motor end plate (motor nerve to skeletal muscle; NMJ).
  - ✓ Preganglionic sympathetic fibers to adrenal medulla (modified autonomic (sympathetic) ganglia).
  
- At the nerve terminals of all parasympathetic postganglionic nerve fibers.
  
- At the nerve terminals of some postganglionic sympathetic fibers:
  - ✓ Secretory fibers to **sweat gland**.
  - ✓ Vasodilator sympathetic fibers (**skeletal muscle blood vessels**).
  
- Some fibers inside the CNS.



## Fate of acetylcholine after release:

- Acetylcholine is rapidly hydrolyzed by an enzyme choline esterase into acetic acid and choline, choline is then reabsorbed by nerve terminal and is used for re-synthesis of new acetylcholine molecule.

### □ Two types of cholinesterase are present:

- True cholinesterase: present near cholinergic nerve endings.
- Pseudo-cholinesterase: present in the plasma.



## ***Cholinergic receptors:***

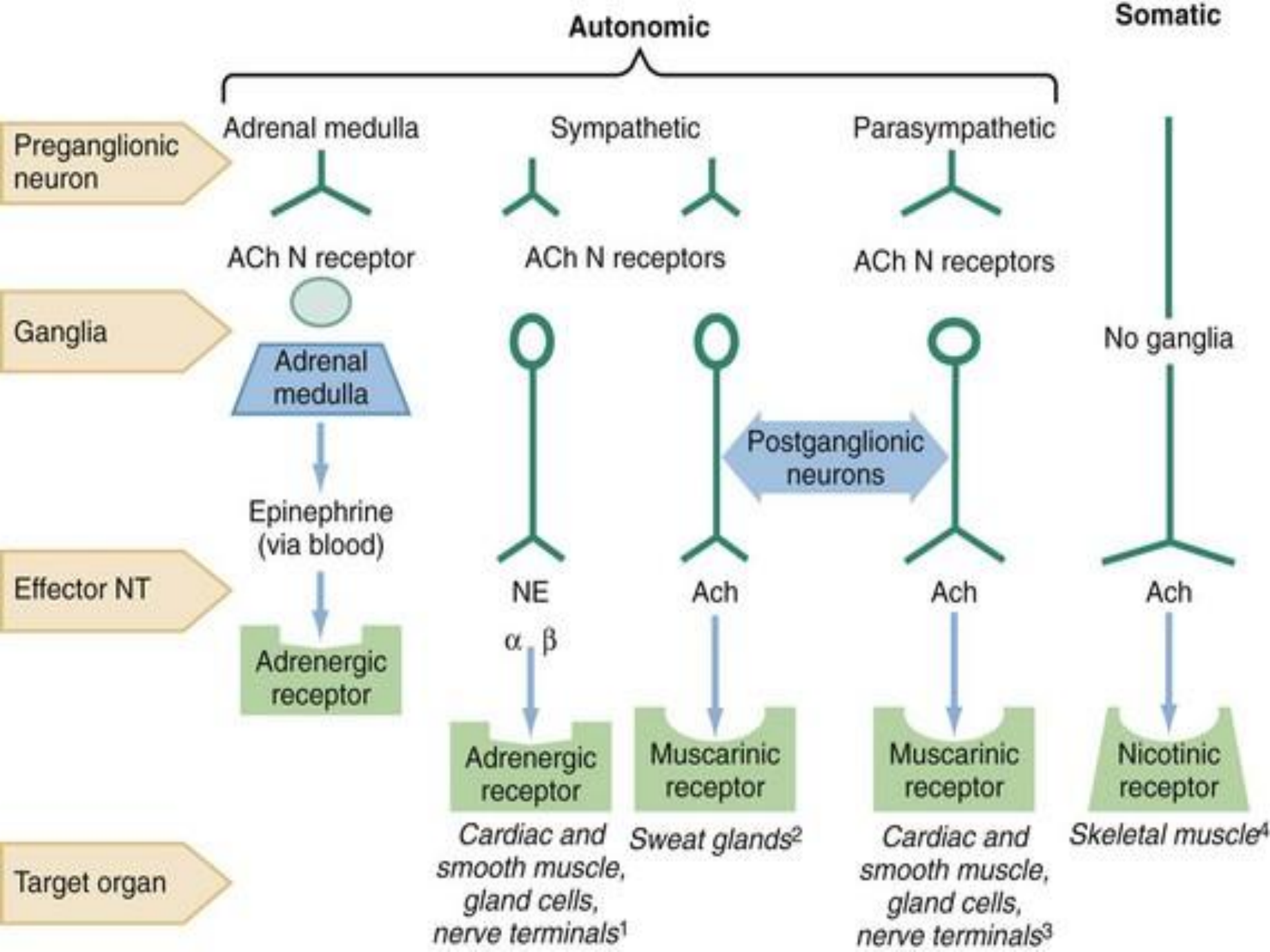
There are two types of receptors at which acetylcholine bind to produce its effects:

### ➤ **Muscarinic (M) receptors:**

- The effector organs receiving parasympathetic postganglionic fibers.
- The effector organs receiving sympathetic postganglionic cholinergic fibers.

### ➤ **Nicotinic (N) receptors:**

- Autonomic ganglia.
- On the cells of adrenal medulla.
- Motor end plate.



# NORADRENALINE (NA)

The autonomic fibers that secrete NA are known as adrenergic fibers.

## Catecholamines (CA):

They include noradrenaline, adrenaline and dopamine.

### ✓ *Site of catecholamines release:-*

- Noradrenaline is the chemical transmitter of all sympathetic postganglionic fibers except sympathetic postganglionic to sweat gland and skeletal muscle blood vessels (cholinergic).
- Catecholamines (adrenaline 80% and noradrenaline 20%) are also secreted by adrenal medulla in emergency conditions.

## ✓ *Adrenergic receptors :*

They are of two types: **alpha and beta receptors.**

- Stimulation of  **$\alpha$ -receptors** produces mainly excitatory effects except in GIT while  **$\beta$ -receptors** produces inhibitory effects except on the heart.
- **Adrenaline** stimulates both  $\alpha$ ,  $\beta$  receptors, **predominantly  $\beta$ -receptors** while **Noradrenaline** **predominantly  $\alpha$ -receptors.**

## Adrenaline

- Contain methyl group.
- Released mainly from adrenal medulla.
- Have more affinity to  $\beta$  receptors.
- Strong metabolic (glycogenolysis) and cardiac actions.

## Noradrenaline

- Devoid from methyl group.
- Released from **sympathetic postganglionic adrenergic fibers**.
- Have more affinity to  $\alpha$  receptors.
- Vascular action mainly (vasoconstriction)

**THANK YOU**

THANK YOU

