

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Nervous System

PNS

CNS

Autonomic Nervous System

Introduction and Neurotransmitters

By

DR. Muhammad Sarwar

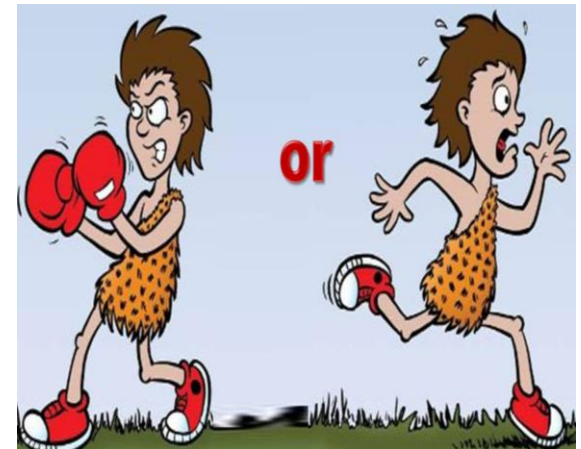
Autonomic Nervous System

Sympathetic Nervous System

Parasympathetic Nervous System

Sympathetic Nervous System;

- **Thoraco-lumbar** part of the spinal cord.
- **Ergotropic** – leading to energy expenditure.
- **Trauma, Fear, Cold, Hypoglycemia, or Exercise.**
- Helping in the
“**Fight, Flight & Fright**”.



Parasympathetic Nervous System;

- **Cranio – sacral part of ANS.**
 - Cranial nerves (III, VII, IX and X)
 - sacral part of the spinal cord (S₂-S₄).
- **Trophotropic --- leading to growth.**
- Helping to **“Rest & Digest”**.
- **Enteric Nervous System (3rd division of ANS).**
 - Control motility & secretions.

What organs/ tissues are supplied by

Somatic NS?

Skeletal muscles

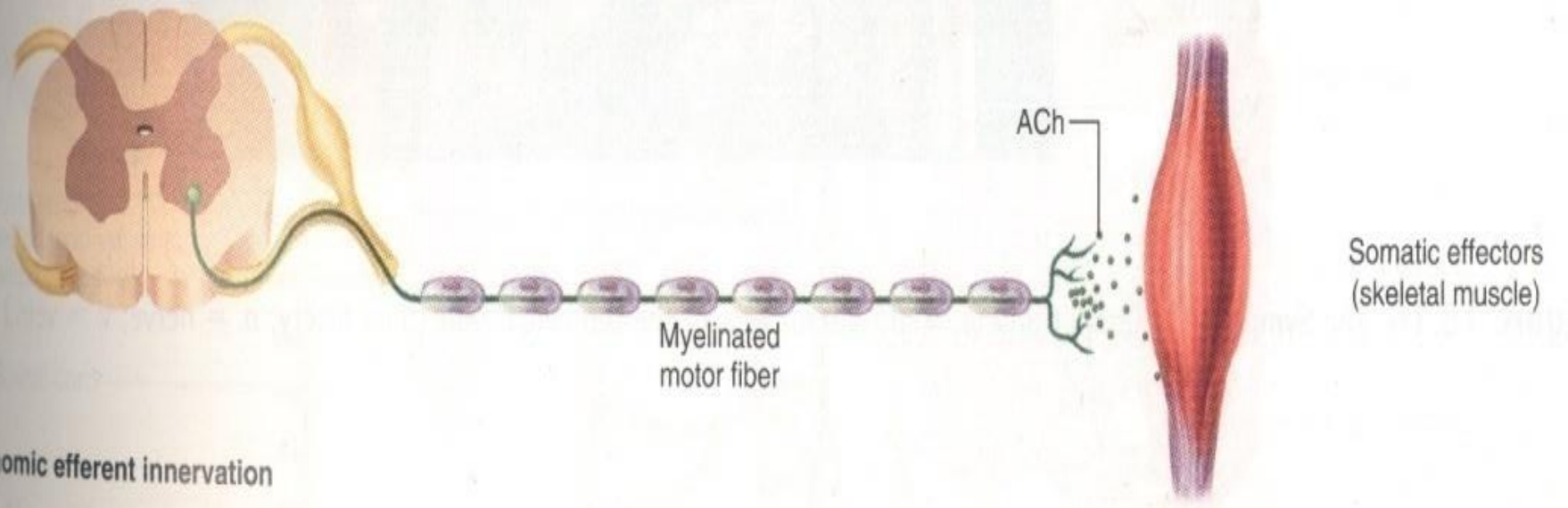
ANS?

Smooth muscles

Cardiac muscles

Glands

Somatic efferent innervation



Autonomic efferent innervation

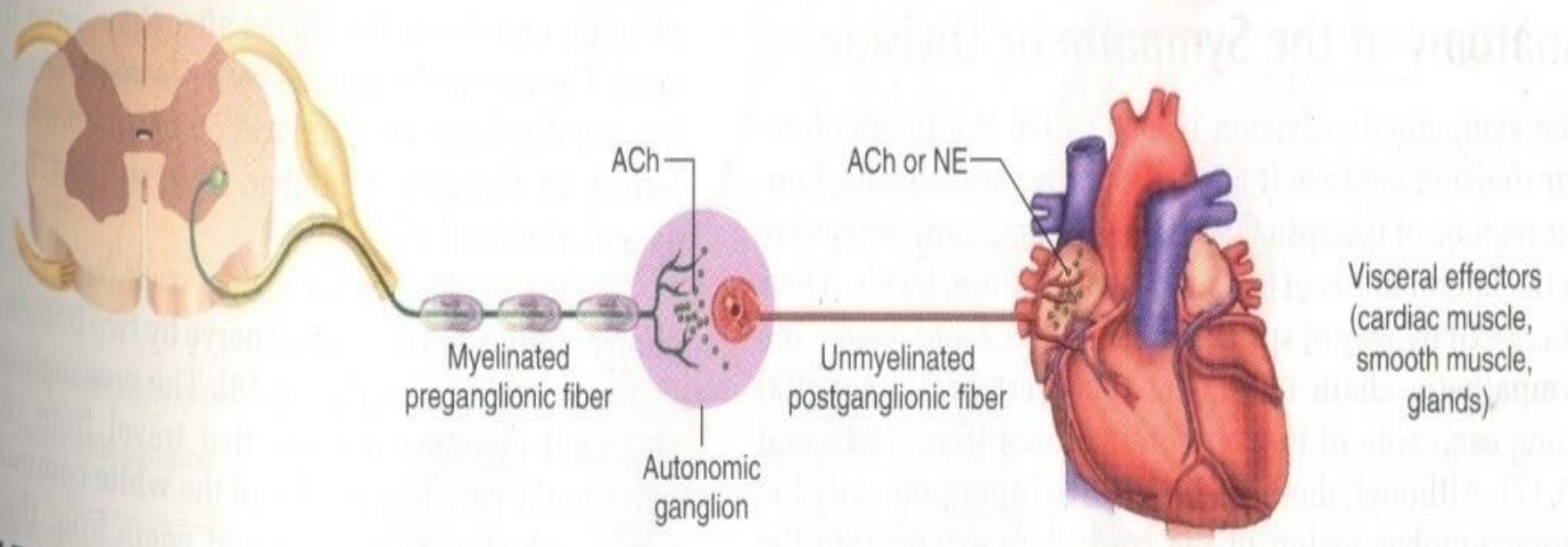


Figure 15.1

Neurotransmitters secreted ?

Somatic NS;

- **Acetylcholine (Ach).**

ANS;

- **Acetylcholine**
- **Noradrenaline (NA, NE)**

Somatic

Organ supplied;

- Skeletal muscles.

Effect of denervation;

- Paralysis & atrophy.

Effect on target cells;

- Always excitatory.

Distal most synapse;

- Within CNS

Nerve fibers;

- myelinated

Neurotransmitters;

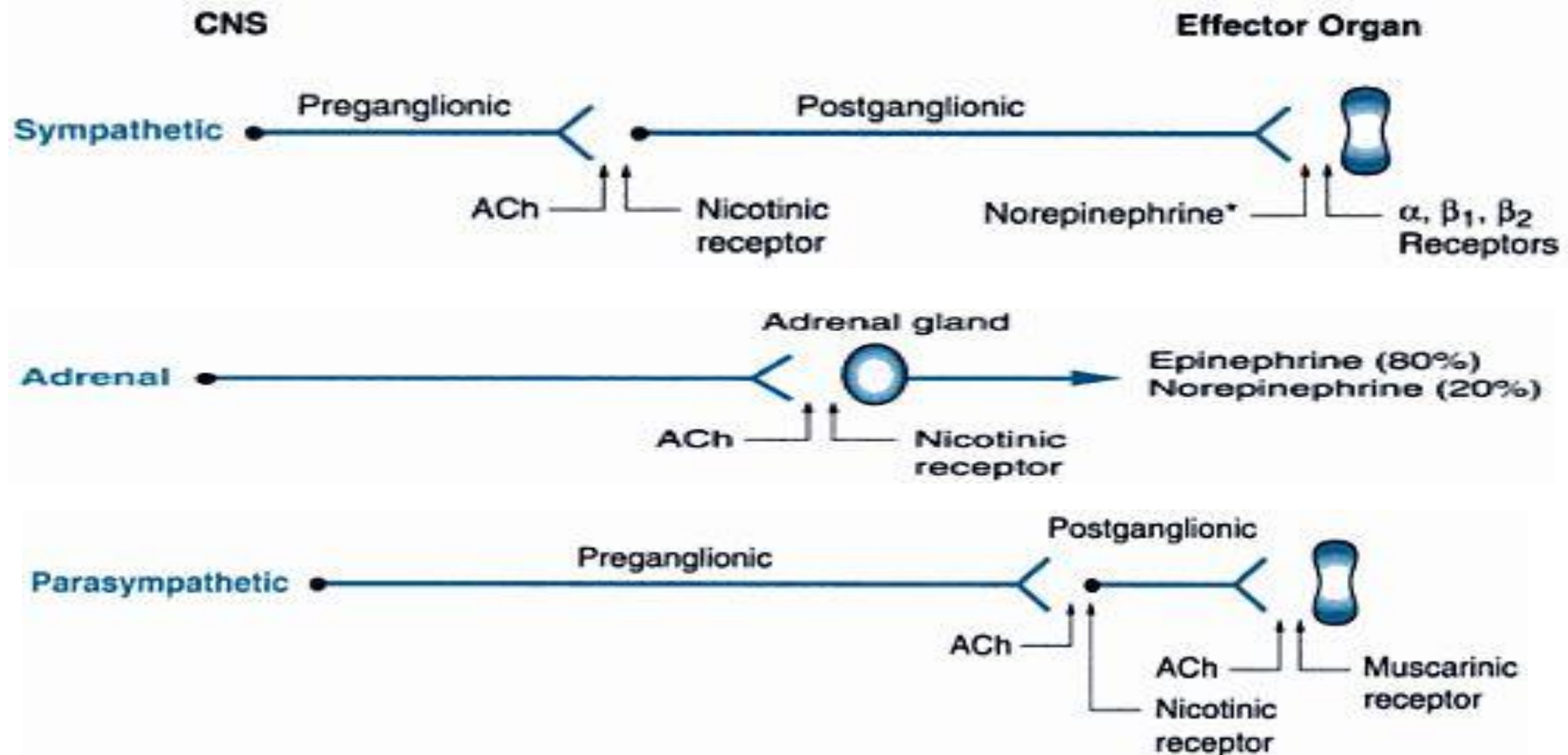
- Acetylcholine

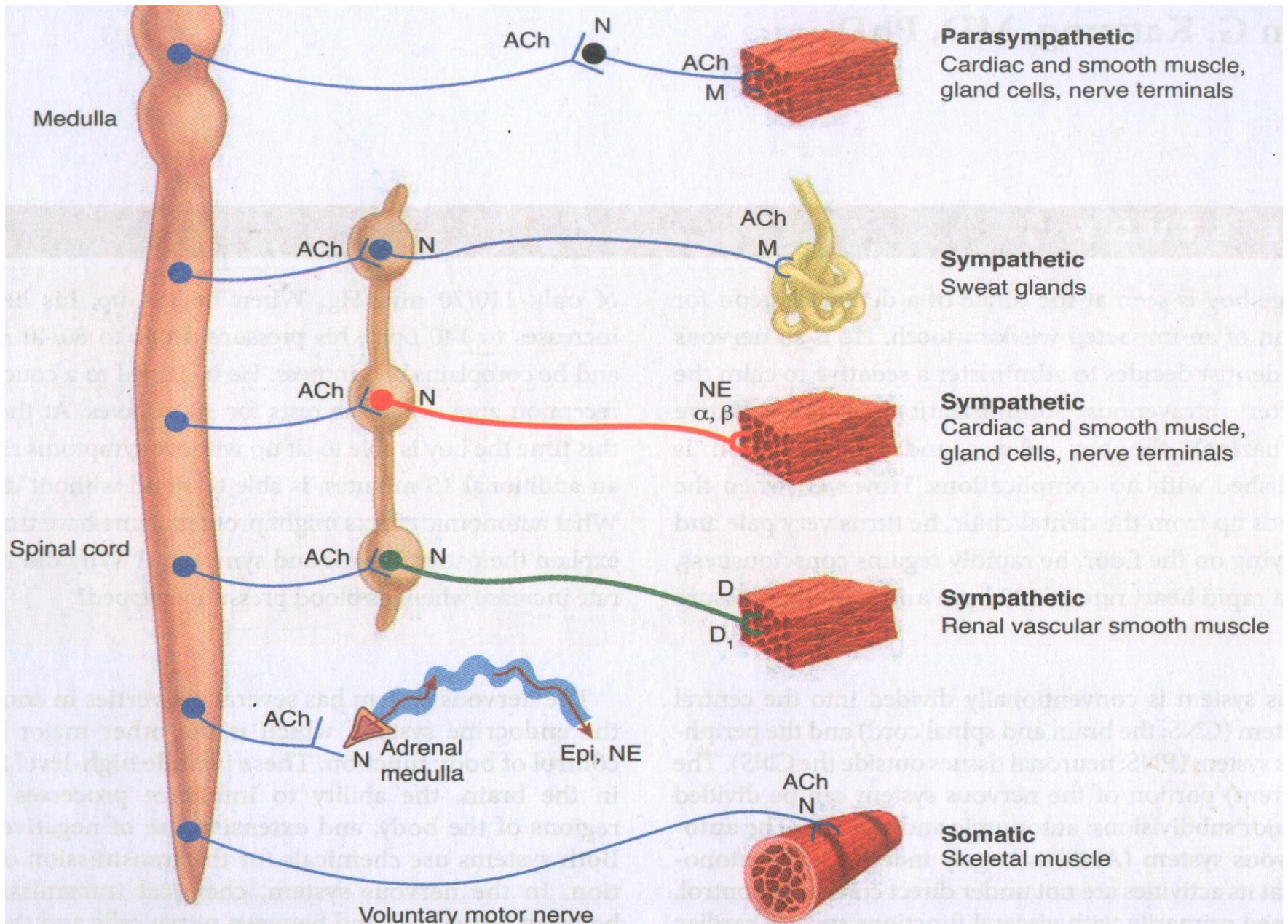
ANS

- Smooth muscles, Cardiac muscles & Glands.
- **Activity maintained, no atrophy.**
- Excitatory or inhibitory.
- **Outside CNS (in ganglia).**
- **Preganglionic myelinated
Postganglionic non-myelinated.**
- **Acetylcholine, Noradrenaline.**

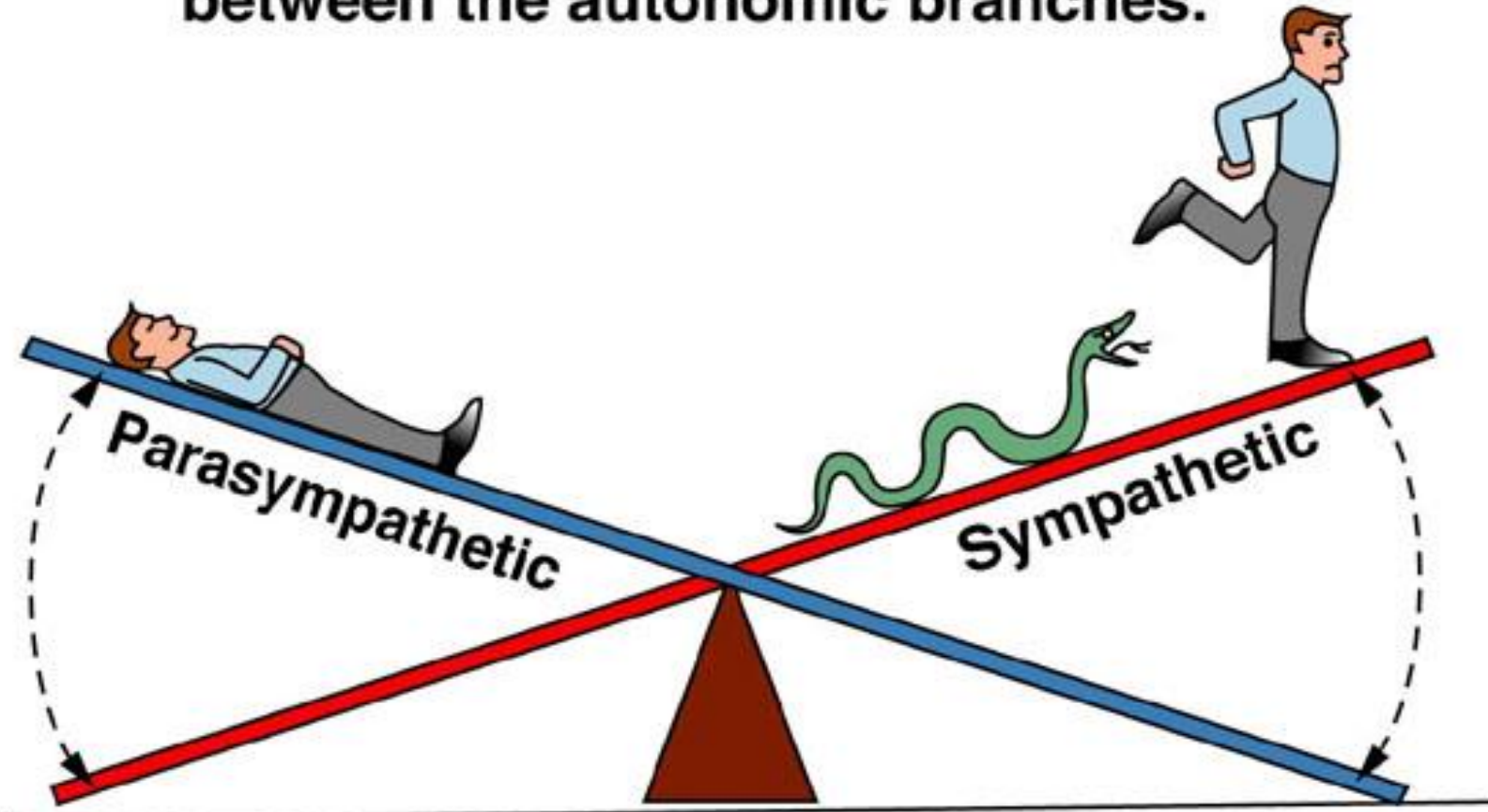
A typical autonomic effector pathway;

- Preganglionic neuron --- cell body in CNS --- myelinated axon --- ganglion -----non myelinated postganglionic cell --- effector organ.





Homeostasis is a dynamic balance between the autonomic branches.



**Rest-and-digest:
Parasympathetic
activity dominates.**

**Fight-or-flight:
Sympathetic activity
dominates.**

Both these systems usually oppose or balance each other at majority sites,

BUT

➤ Sympathetic is **dominant** on

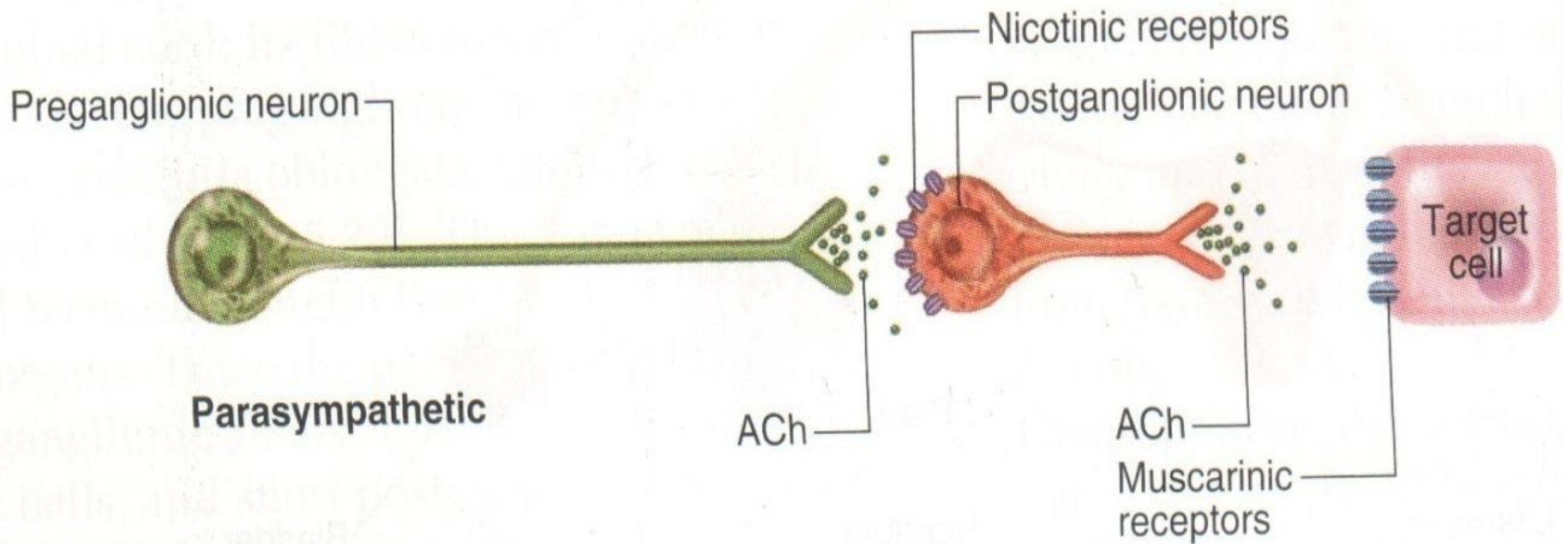
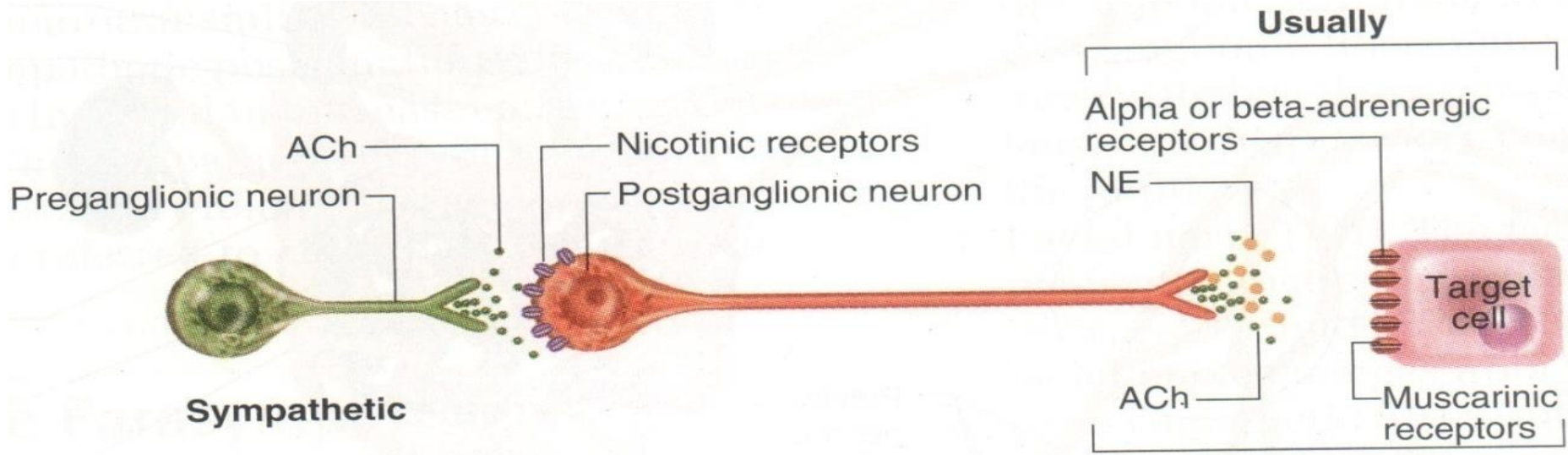
- **CVS**

➤ While Parasympathetic on

- **GIT & EYE** and

selective on **Secretory Glands**

(except sweat glands).



Neurotransmitter chemistry of ANS;

- **Primary neurotransmitters;**

- Acetylcholine – Cholinergic fibers.
- Norepinephrine – Adrenergic (Noradrenergic) **fibers.**

- **Cotransmitters;**

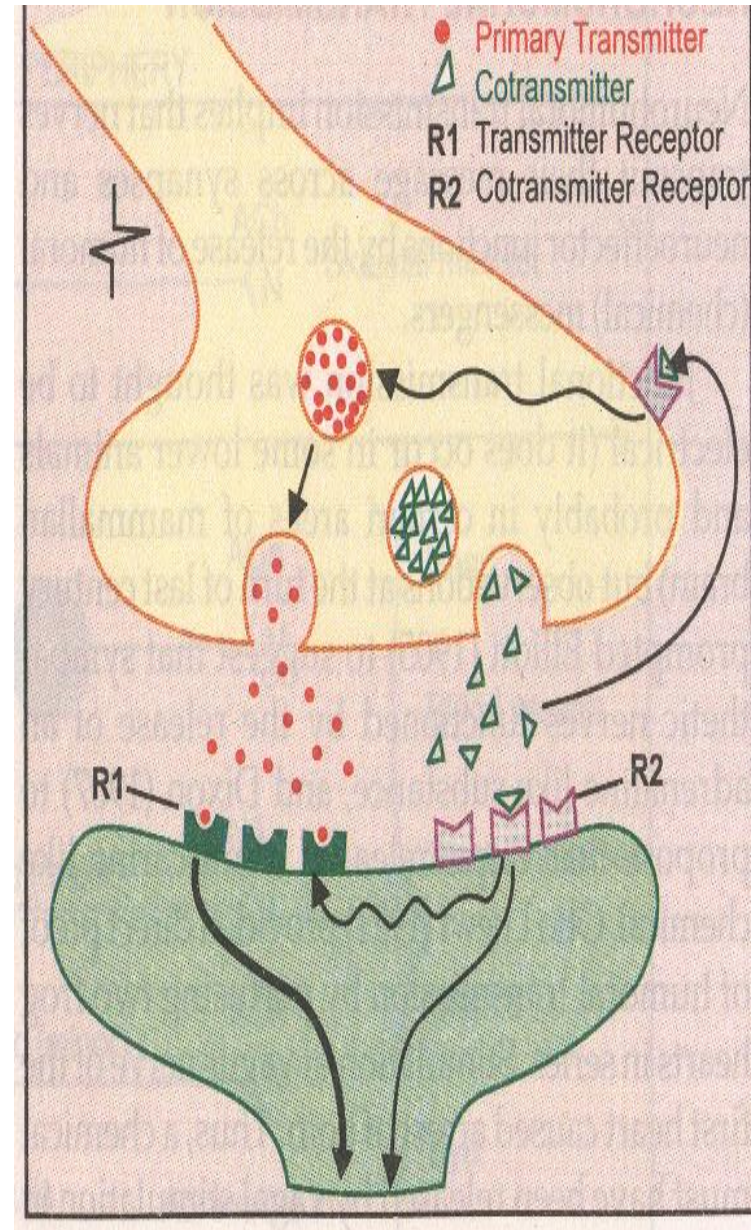
Released With Ach & NE., Or

Act as Primary transmitters in some cholinergic & adrenergic nerves (Non adrenergic, Noncholinergic transmission (NANC))

- *Dopamine -- Released by postganglionic fibers in renal blood vessels.*
- *Serotonin (5-HT).*
- *Gama aminobutyric acid (GABA).*
- *Adenosine triphosphate (ATP).*
- *Nitric oxide (NO).*
- *Calcitonin gene-related peptide (CGRP).*
- *Cholecystokinin (CCK).*
- *Enkephalins and related opioid peptides.*
- *Gastrin releasing peptide.*
- *Neuropeptide Y (NYP).*
- *Substance P (and related tachykinins).*
- *Vasoactive intestinal peptide (VIP).*

Where are Neurotransmitters stored?

- Membrane bound **vesicles** in the terminals of neurons.
 - **Terminals of Cholinergic neuron;**
 - **Small clear vesicles** (large numbers) – most of Ach.
 - **Large dense cored vesicles** (smaller number)--high concentration of peptide **cotransmitters**.
 - **Cotransmitters** are stored in
 - **Same vesicle with the primary neurotransmitters. e.g.,**
 - ATP with both Ach and NA, while
 - VIP is associated with Ach.
 - **Nerve impulse releases both the transmitters concurrently.**
 - **Separate vesicles.**



□ ***Cotransmitters*** Supplement or modulate the effects of the primary transmitter.

– **Modifies responsiveness** of the effector to primary transmitter by acting on its own (cotransmitter) receptors.

– **Modulates release of transmitters;**

- **Feedback inhibitory** effect by acting on prejunctional receptors.

A landscape photograph featuring rolling green hills in the foreground and middle ground. The foreground is dominated by a field of bright yellow wildflowers. The sky is a deep blue, filled with soft, white, wispy clouds. The overall scene is bright and cheerful.

Thank You