

A close-up photograph of several vibrant pink roses in full bloom, set against a background of green leaves and some blurred blue flowers. The roses are the central focus, with their petals showing various shades of pink and red.

Autonomic Nervous System

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THE NERVOUS SYSTEM

INTRODUCTION•

The Central Nervous System (CNS): Includes the brain •
and spinal cord.

The Peripheral Nervous System (PNS): Formed by •
neurons & their process present in all the regions of the
body.

It consists of cranial nerves arises from the brain & •
spinal nerves arising from the spinal cord.

The peripheral NS is divided into•

Somatic Nervous system•

Autonomic nervous system•

Functional
Anatomy &
Physiology of
Autonomic NS

OBJECTIVES

Anatomy and physiology ► of Autonomic Nervous System

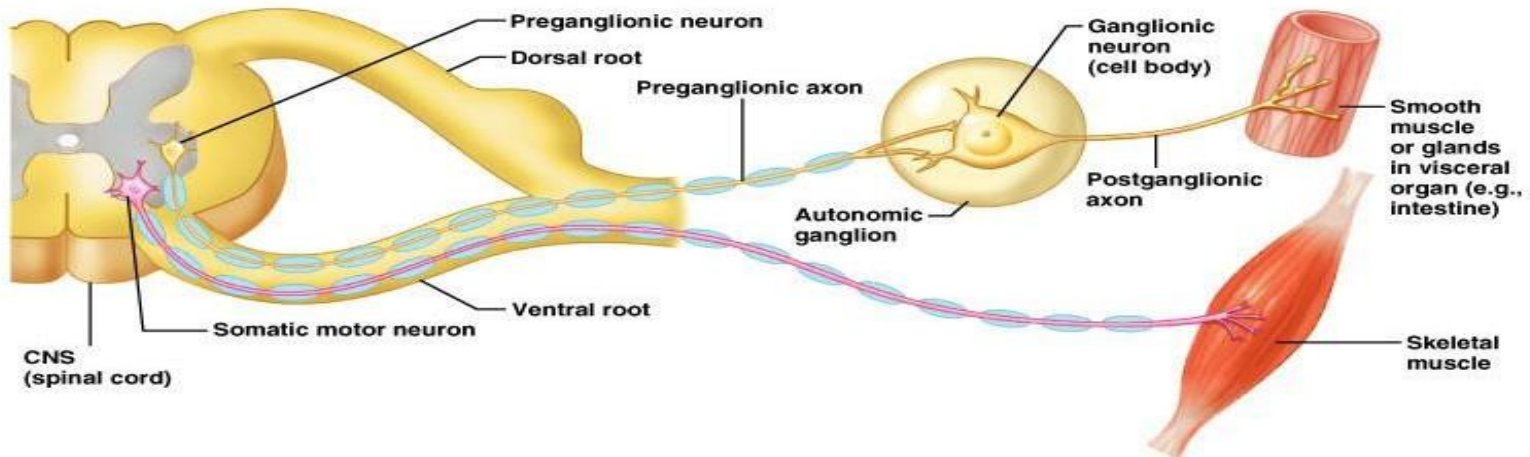
At the end of this ►
lectute the student should be able to:-

the anatomy of -appreciate ►
sympathetic &
parasympathetic nervous
system.

physiological functions of -explain ►
Sympathetic & parasympathetic
nerves in
head & neck, chest, abdomen and
pelvis

**FUNCTIONAL
ANATOMY OF THE
AUTONOMIC
NERVOUS SYSTEM**

Basic anatomical difference between the motor pathways of the voluntary somatic nervous system (to skeletal muscles) and those of the autonomic nervous system



Basic anatomical difference between the motor pathways of the voluntary somatic nervous system⁸ (to skeletal muscles) and those of the autonomic nervous system

Somatic division:▶

Cell bodies of motor neurons reside in CNS ▶
(brain or spinal cord)

Their axons (sheathed in spinal nerves) extend all▶
the way to their skeletal muscles

Autonomic system: chains of two motor neurons▶

1st = preganglionic neuron (in brain or cord)▶

2nd = ganglionic neuron (cell body in▶
ganglion outside CNS)

- ▶ ANS is the subdivision of the peripheral nervous system that regulates body activities that are generally **not under conscious control**

Visceral motor innervates **non-skeletal** ▶
(non-somatic) muscles

Composed of a special group of ▶
neurons serving:

Cardiac muscle (the heart) ▶

Smooth muscle (walls of viscera and ▶
blood vessels)

Internal organs ▶

Skin ▶

Higher control of the autonomic Nervous System

Sympathetic NS is regulated by neurons in the **Posterior** part of the **hypothalamus**. ►

Parasympathetic NS is regulated by neurons in the **Anterior** part of the **hypothalamus**. ►

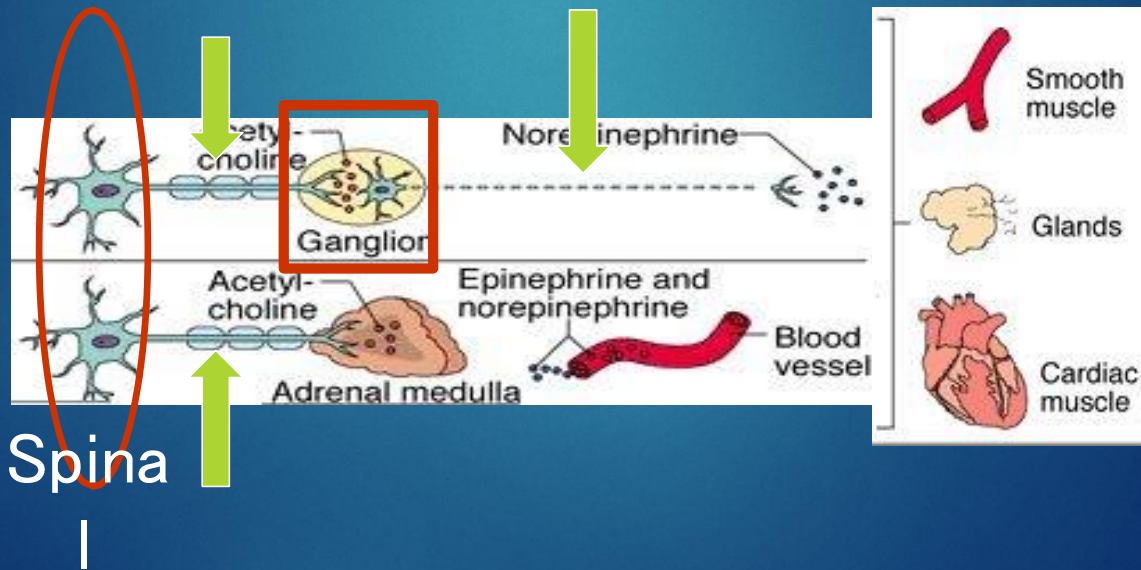
Sympathetic

Innervation of Visceral Targets

Short, lightly myelinated preganglionic neurons •

Long, unmyelinated postganglionic neurons •

Ganglia close to spinal cord ►

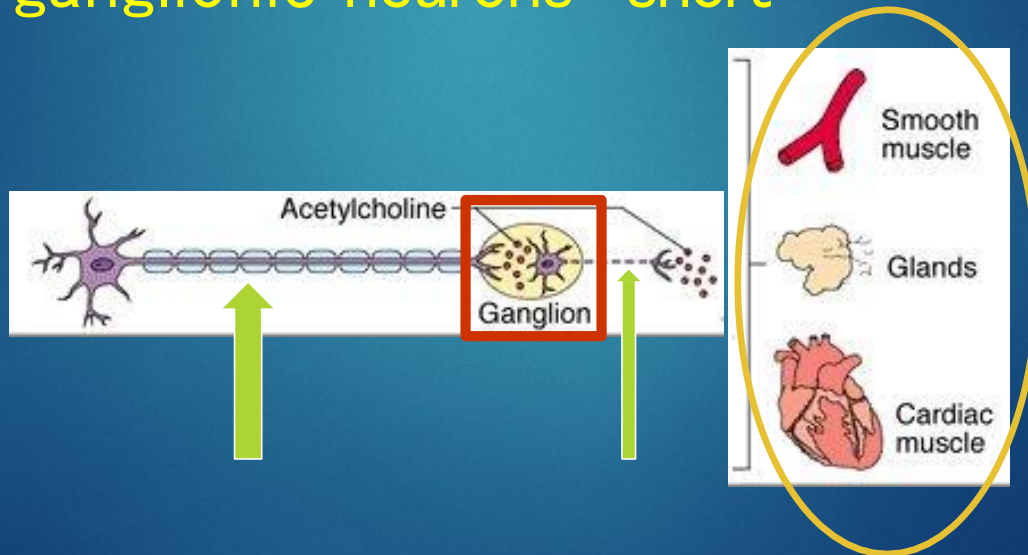


Parasympathetic Innervation of Visceral Targets

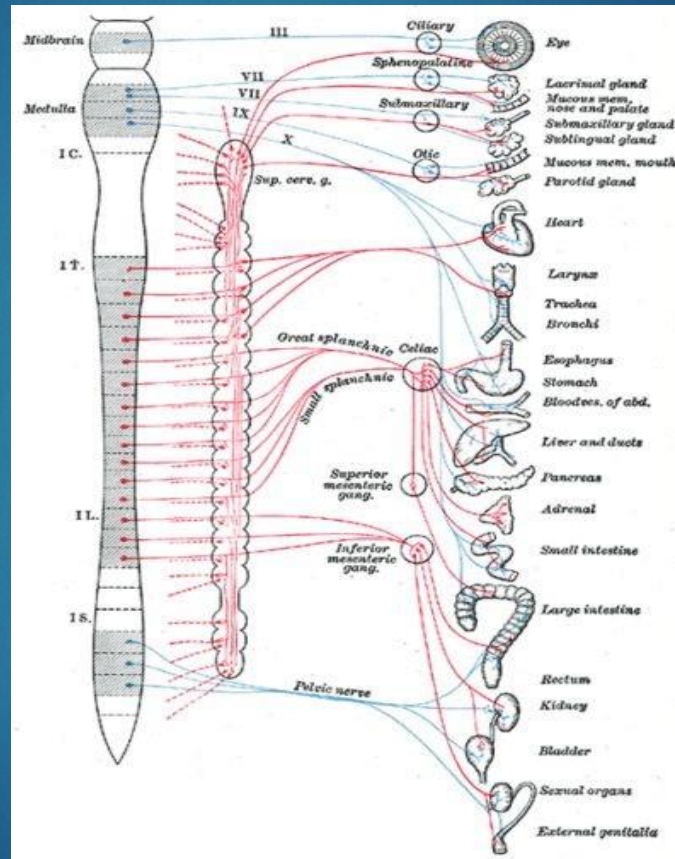
Ganglia close to or on target organs ►

Preganglionic neurons –long ·

Post ganglionic neurons –short ·



SYMPATHETIC & PARASYMPATHETIC NERVOUS SYSTEM ORIGIN

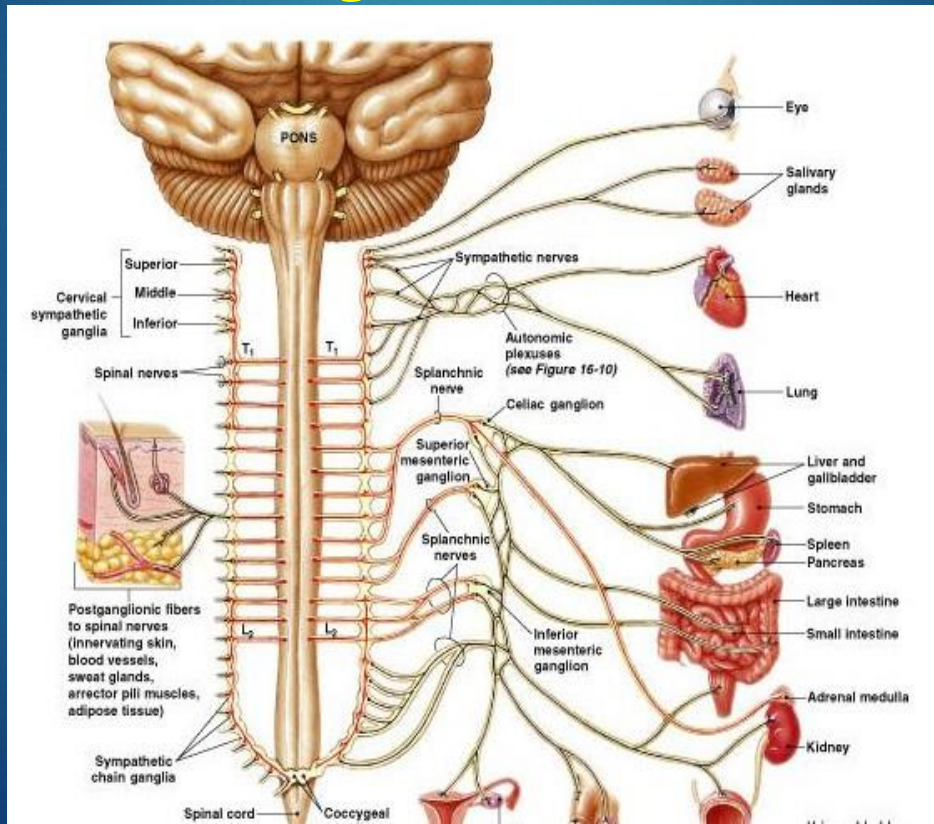


Blue= Para symp; Red symp

Sympathetic - Origin

Thoracolumbar lateral horns of the ►
spinal segments T1-L2.

Nerve fibers originate between T1 & L2 ►►



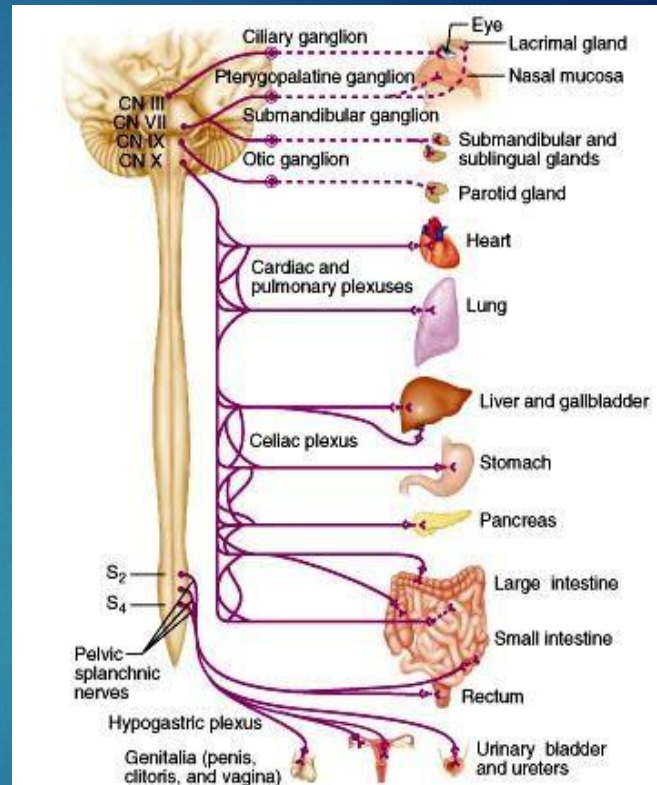
Parasympathetic - Origin

Craniosacral Cell bodies of the motor nuclei of the cranial nerves III, VII, IX and X in the brain stem

Second, third and fourth [S2-S4] sacral segments of the spinal cord

Nerve fibers emerge from brain &

sacrum cranio-sacral outflow



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THE AUTONOMIC NERVOUS SYSTEM

Subdivision
Employed

Location of
Ganglia

Chemical
Messenger

General
Function

Sympathetic
Thoracolumbar

Alongside
vertebral
column

Norepinephrine
Fight or
flight

Parasympathetic
Craniosacral

On or near
an effector
organ

Acetylcholine
Conservation
of body
energy

PHYSIOLOGICAL FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM

The Autonomic Nervous System

Parasympathetic Stimulation Structure Sympathetic Stimulation

Iris (eye muscle)

Pupil constriction Pupil dilation

Salivary Glands

Saliva production reduced

Saliva production increased

Oral/Nasal Mucosa

Mucus production reduced

Mucus production increased

Heart

Heart rate and force increased

Heart rate and force decreased

Lung

Bronchial muscle relaxed Bronchial muscle contracted

The Autonomic Nervous System

Structure

Parasympathetic Stimulation Sympathetic Stimulation

Stomach	Peristalsis reduced	Gastric juice secreted; motility increased
Small Intes	Motility reduced	Digestion increased
Large Intes	Motility reduced	Secretions and motility increased
Liver	Increased conversion of glycogen to glucose	
Kidney	Decreased urine secretion	Increased urine secretion
Adrenal medulla	Norepinephrine and epinephrine secreted	
Bladder	Wall relaxed Sphincter closed	Wall contracted Sphincter relaxed

MECHANISM OF ACTIONS

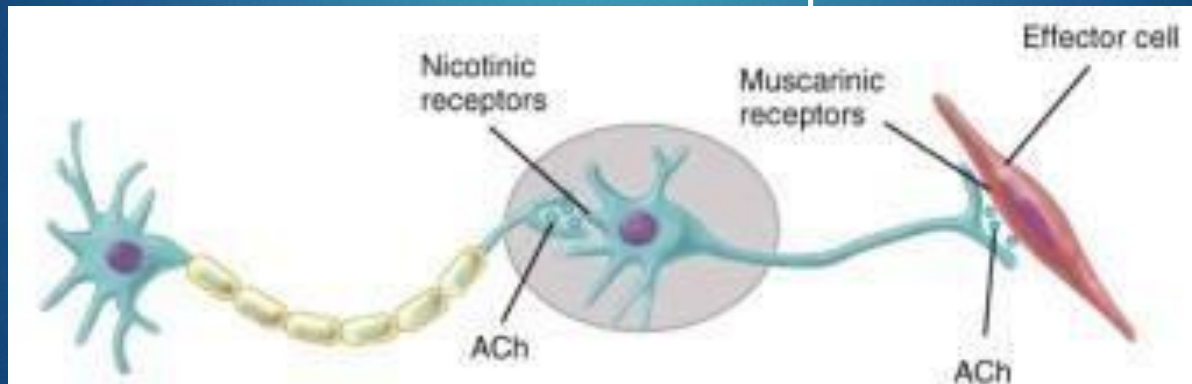
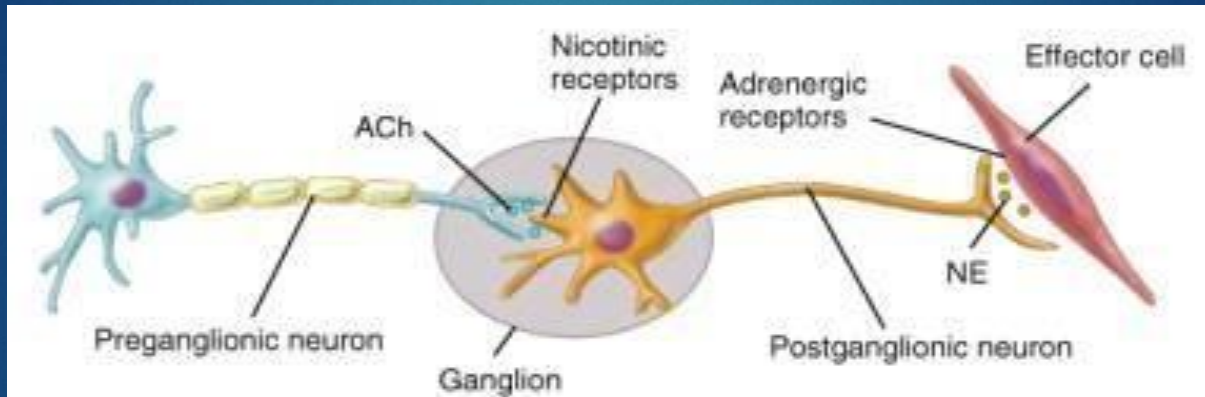
The neurotransmitters
& receptors of
Autonomic NS

OBJECTIVES

describe **neurotransmitters** ►
that can release at pre and
post ganglionic of
Autonomic NS.

Describe Autonomic NS ►
receptors.

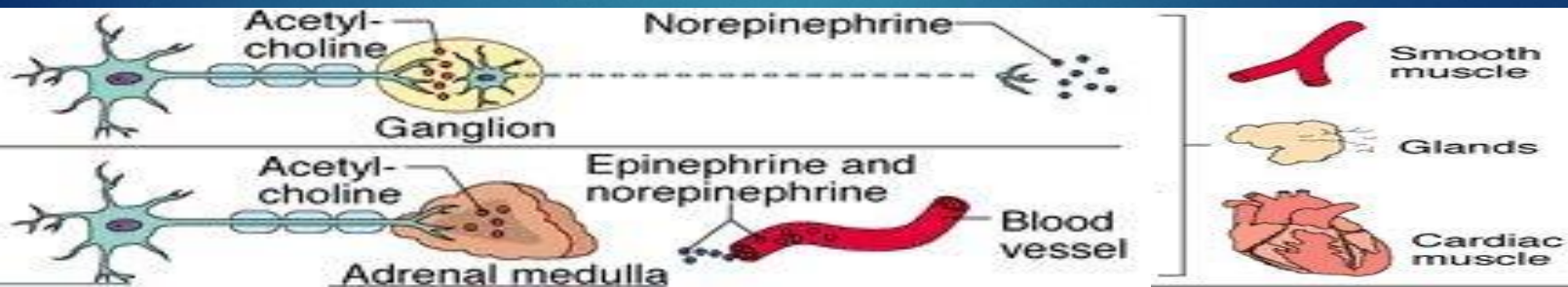
ANS Neurotransmitters: Classified as either cholinergic or adrenergic neurons based upon the neurotransmitter released



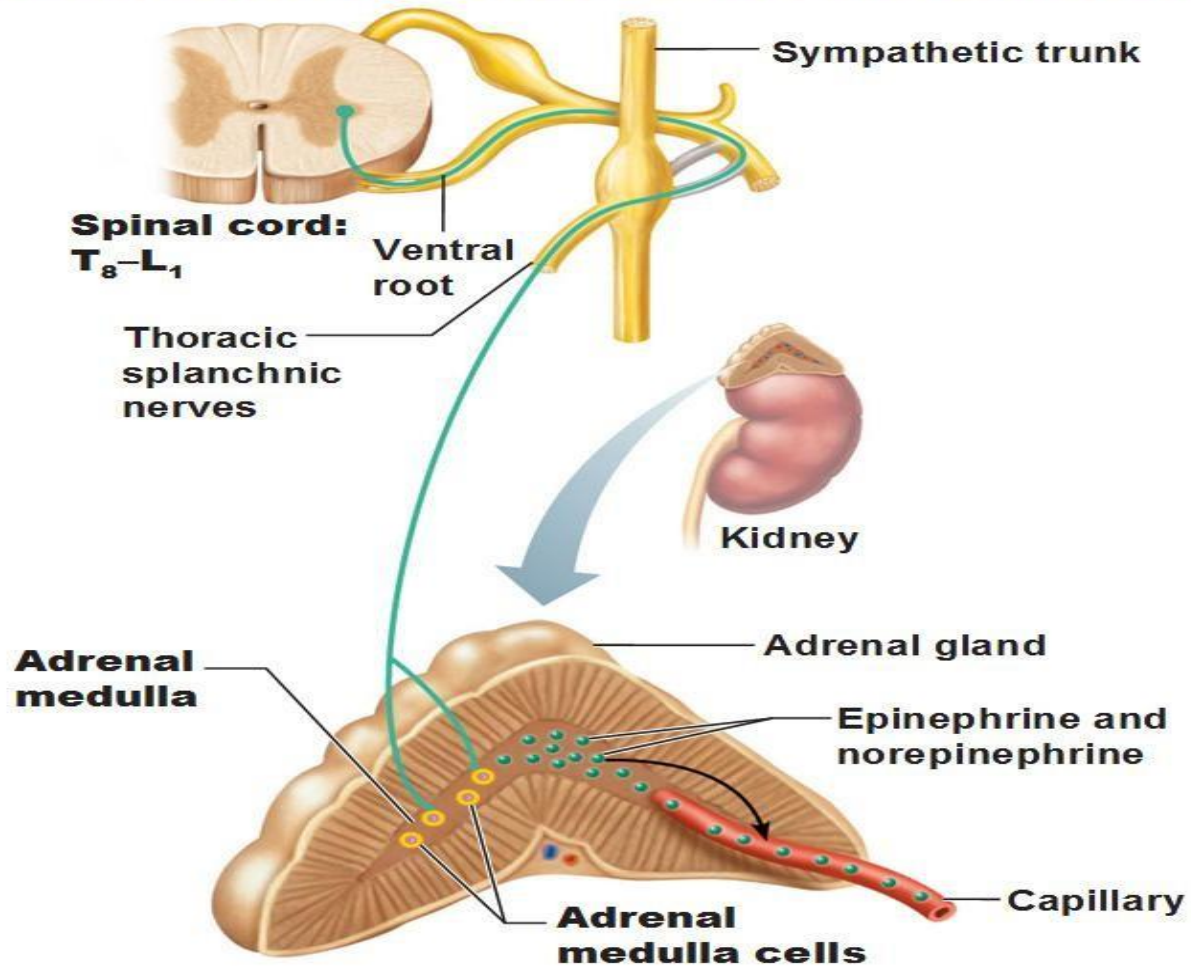
Sympathetic Neurotransmitters

Preganglionic neurons

- ▶ Preganglionic neurones
- ▶ Are Cholinergic = (release acetylcholine)
- ▶ Postganglionic neurons:
 - ▶ release norepinephrine at target organs . All sympathetic postganglionic release noradrenalin except sweatglands & bl vessels to skeletal muscles



The Adrenal Medulla of the Adrenal Gland



Response to adrenergic stimulation

The adrenergic neurotransmitters

```
graph TD; A["The adrenergic neurotransmitters"] --> B["Norepinephrine  
From all post-ganglionic sympathetic nerve fibres except that for:  
Sweat glands, blood vessels of the skeletal muscles, piloerector muscle of hair cells"]; A --> C["Epinephrine  
From adrenal medulla which acts as modified sympathetic ganglia"];
```

Norepinephrine

From all post-ganglionic sympathetic nerve fibres except that for:
Sweat glands, blood vessels of the skeletal muscles, piloerector muscle of hair cells

Epinephrine

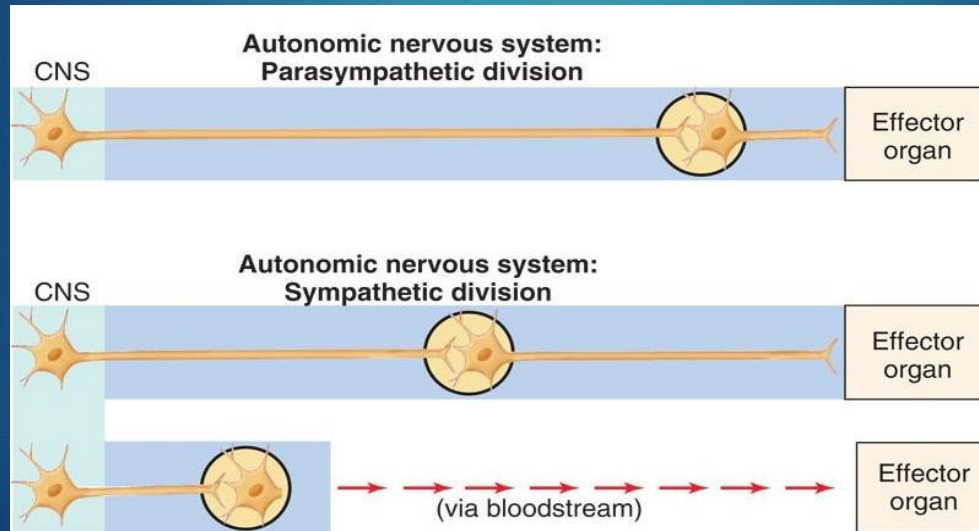
From adrenal medulla which acts as modified sympathetic ganglia

Autonomic nervous system: neurotransmitters

	preganglionic	postganglionic
parasympathetic	acetyl choline	acetyl choline
sympathetic	acetyl choline	norepinephrine*

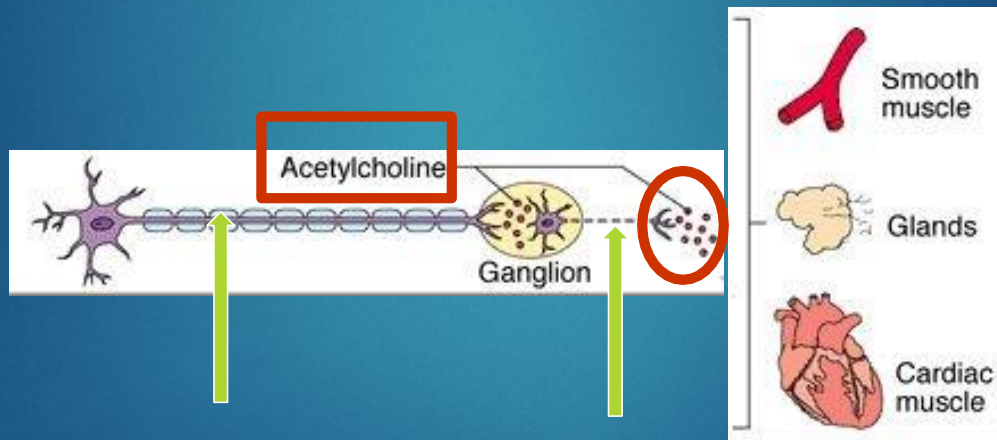
adrenal medulla: preganglionic –acetyl choline

postganglionic (chromaffin cell) –80% epi, 20% norepi



Parasympathetic Neurotransmitters

Pre & Postganglionic neurons
release acetylcholine = Cholinergic



Chemical or neural transmitter

All **preganglionic** fibers release ►
acetylcholin (Ach).

All **parasympathetic postganglionic** ►
release **Ach.**

All **sympathetic postganglionic** ►
release **noradrenalin** except sweat
glands & bl vessels to skeletal
muscles

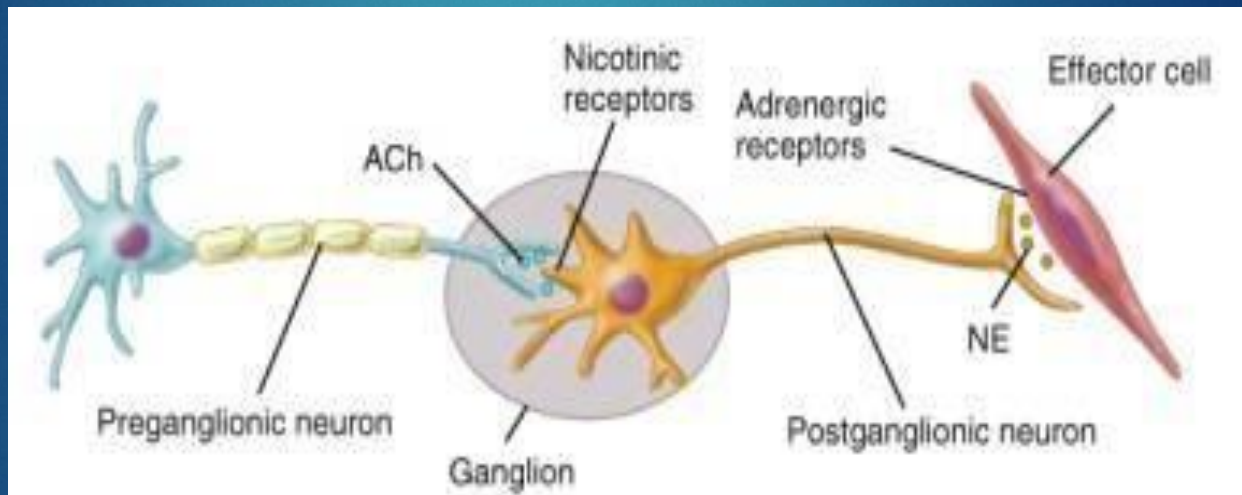
RECEPTORS

autonomic preganglionic All \square are receptors
nicotonic

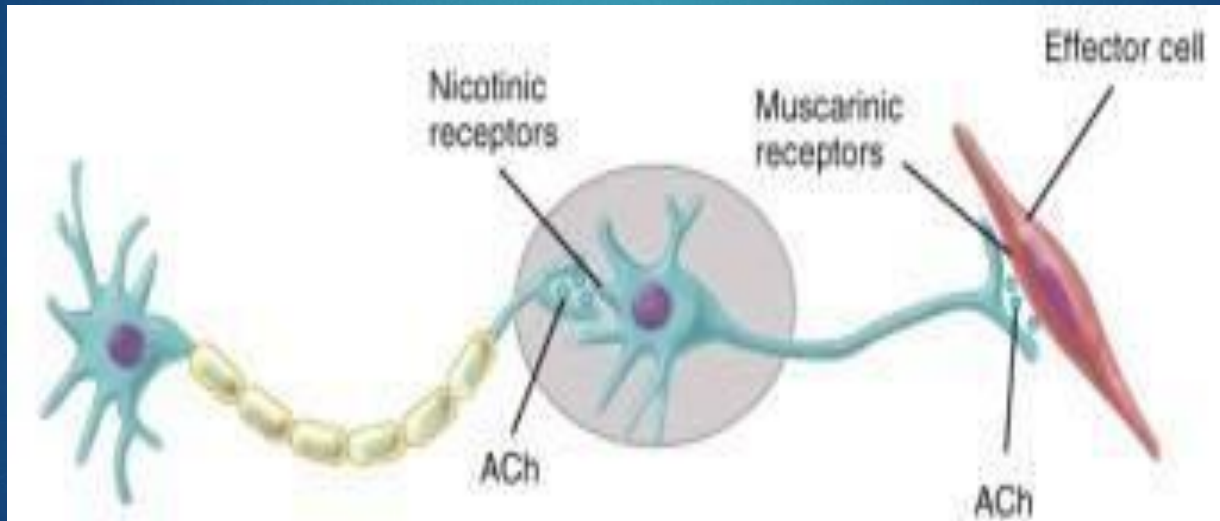
of type α and β on postganglionic
adrenergic receptors : α and β Acts NS Sympathetic The \square

on muscarinic receptors postganglionic
Acts NS Parasympathetic The \square

Sympathetic Adrenergic Receptors



Parasympathetic **muscarinic** receptors



The Sympathetic NS Acts on two types of receptors
: α and β .

What do the receptors do?

Activation of **α receptors** leads to smooth muscle contraction

receptors leads to smooth muscle relaxation Activation of **β**
2

receptors leads to smooth muscle Activation of **β**
contraction (especially in heart)

THANK YOU

