Autonomic Nervous System

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Neurotransmitters & Receptors Of Autonomic NS

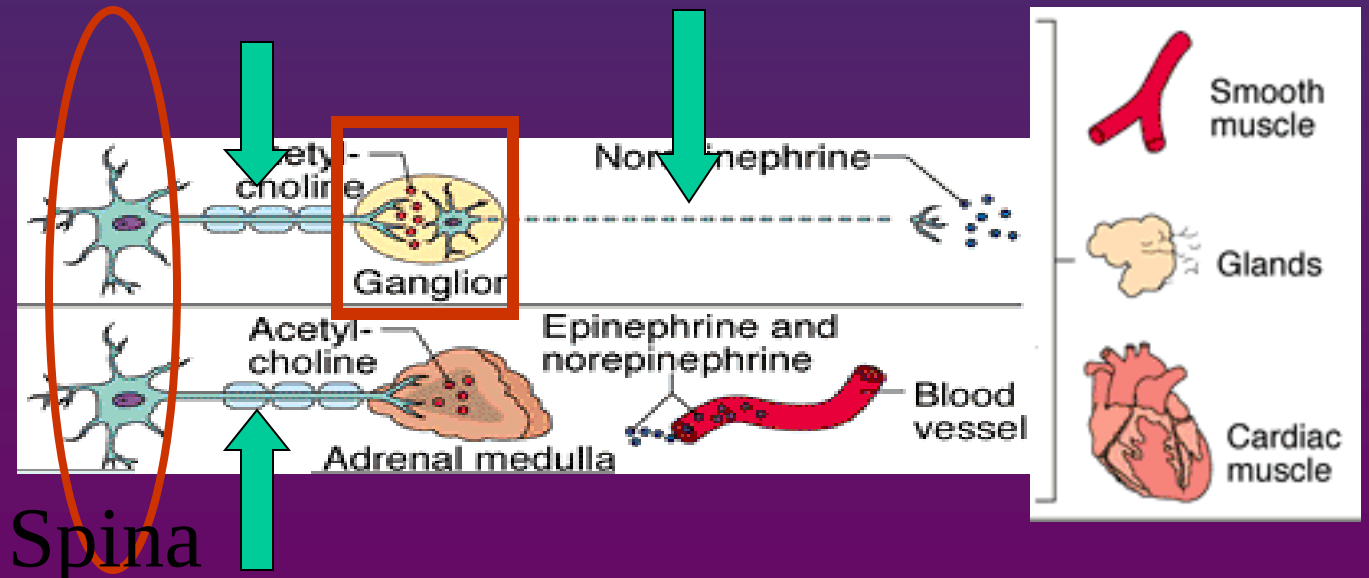
Introduction

- 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

Sympathetic

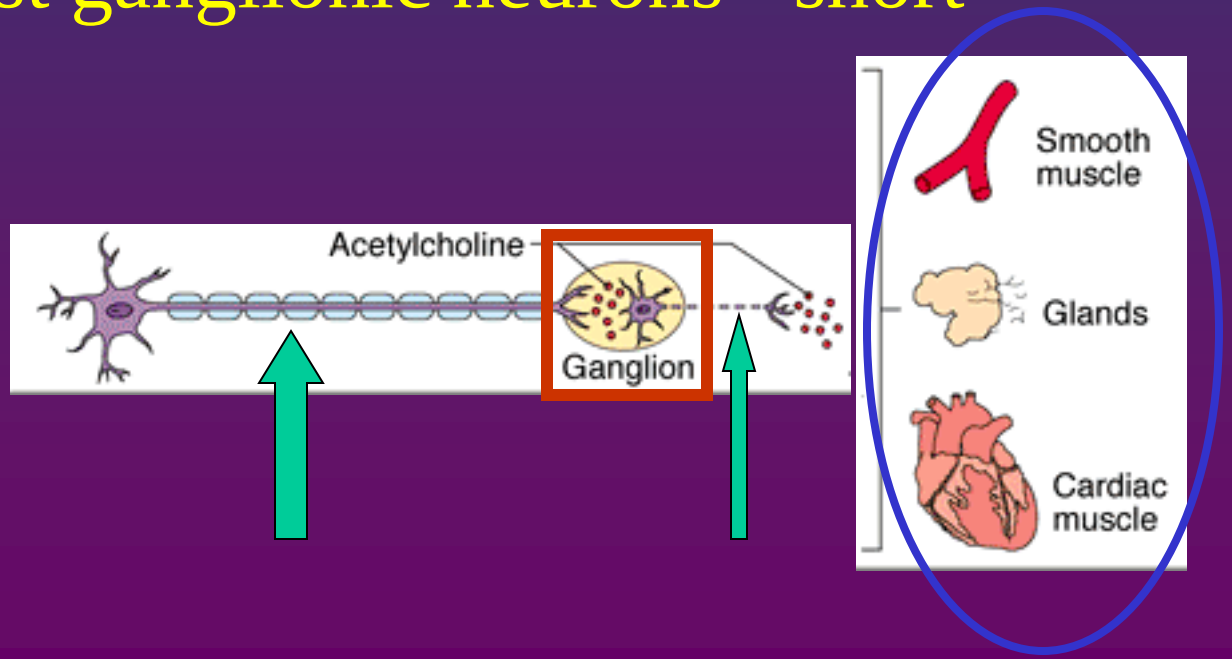
Innervation of Visceral Targets

- Short, lightly myelinated preganglionic neurons
- Long, unmyelinated postganglionic neurons
- Ganglia close to spinal cord

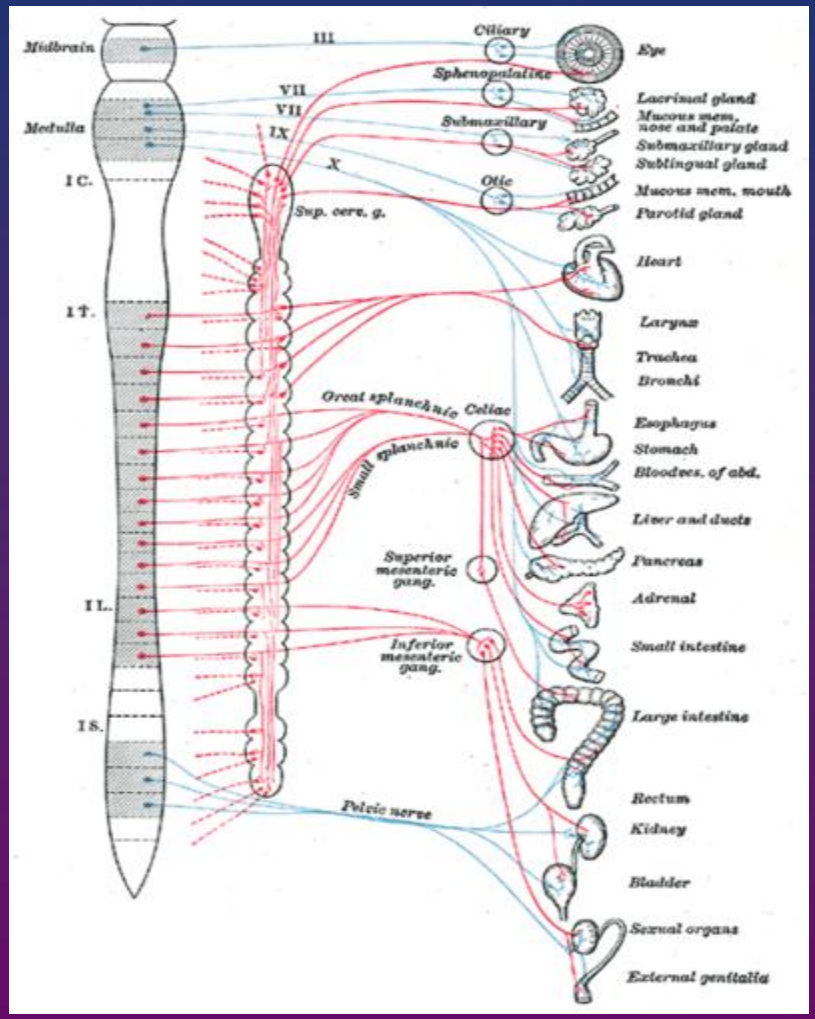


Parasympathetic
Innervation of Visceral Targets

- Ganglia close to or on target organs
- Preganglionic neurons - long
- Post ganglionic neurons - short



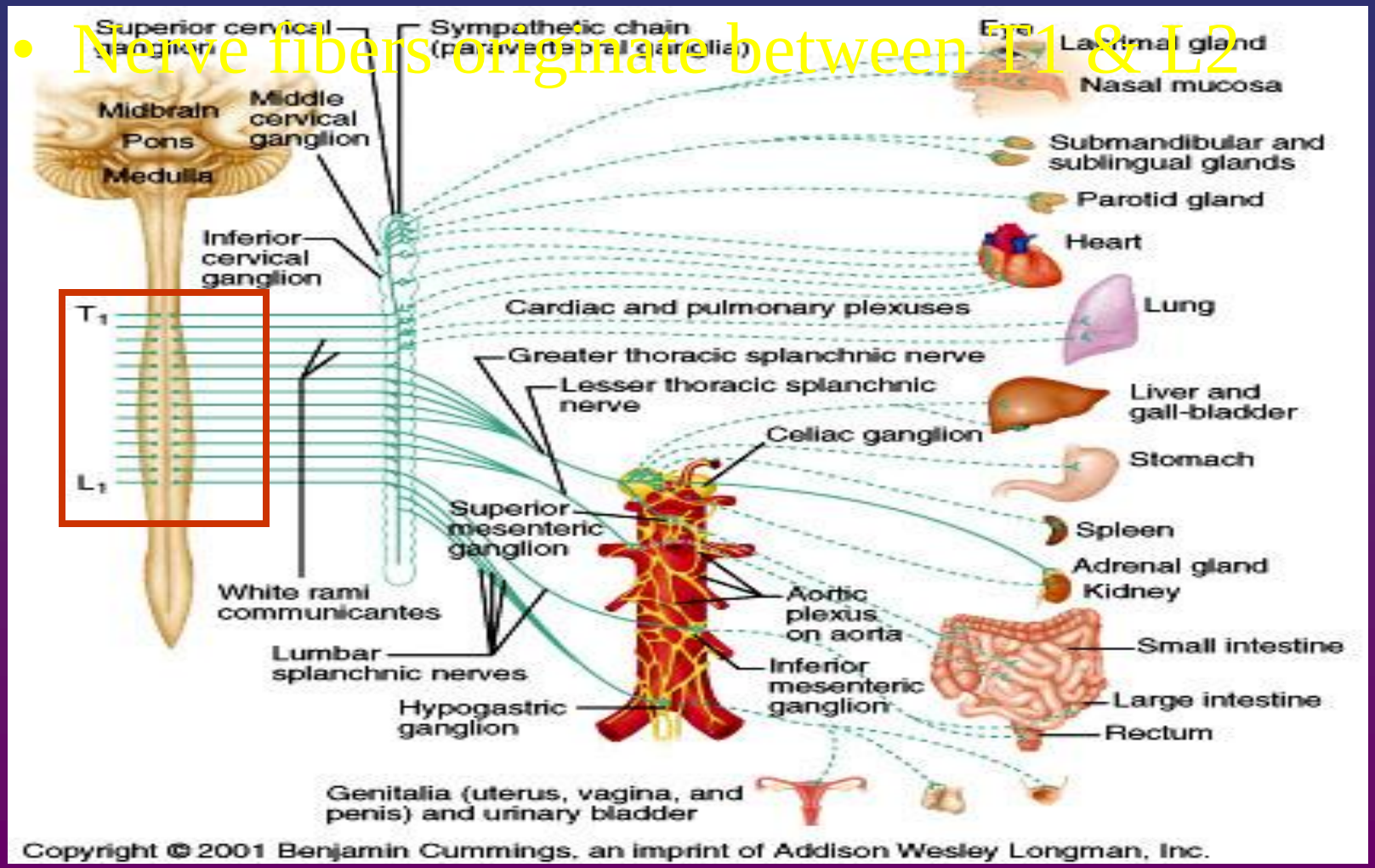
SYMPATHETIC & PARASYMPATHETIC NERVOUS SYSTEM ORIGIN



Blue= Para symp; Red symp

Sympathetic - Origin

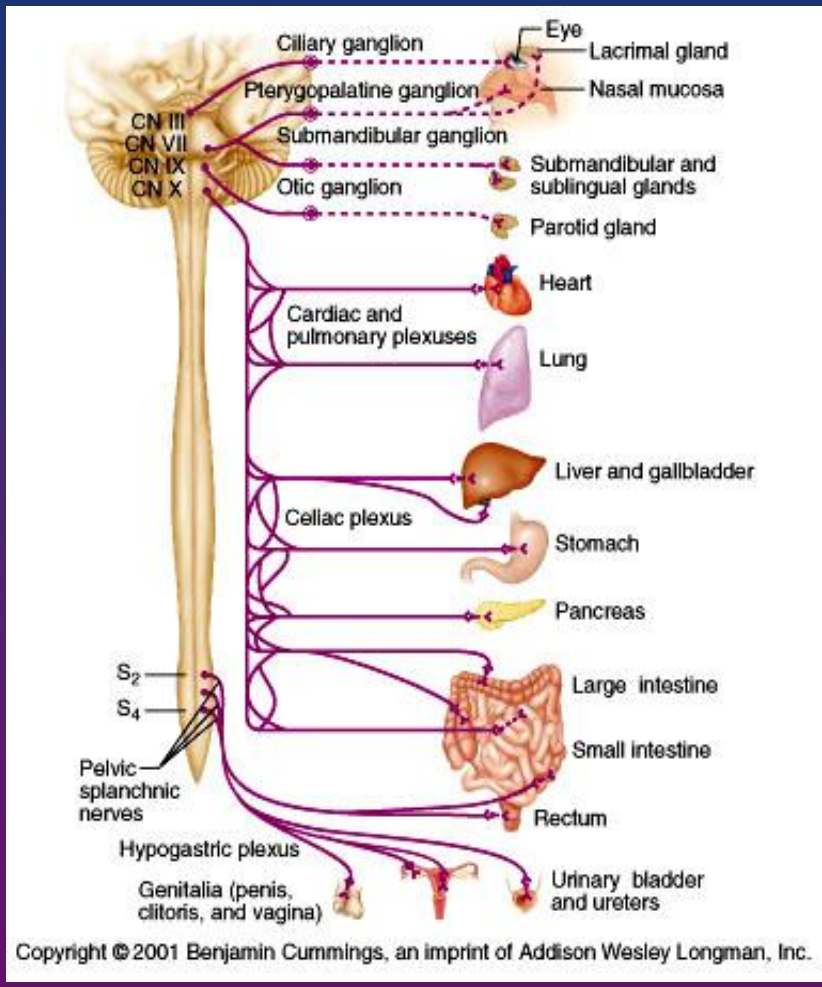
- Thoracolumbar **lateral horns of the spinal segments T1-L2.**
- Nerve fibers originate between T1 & L2



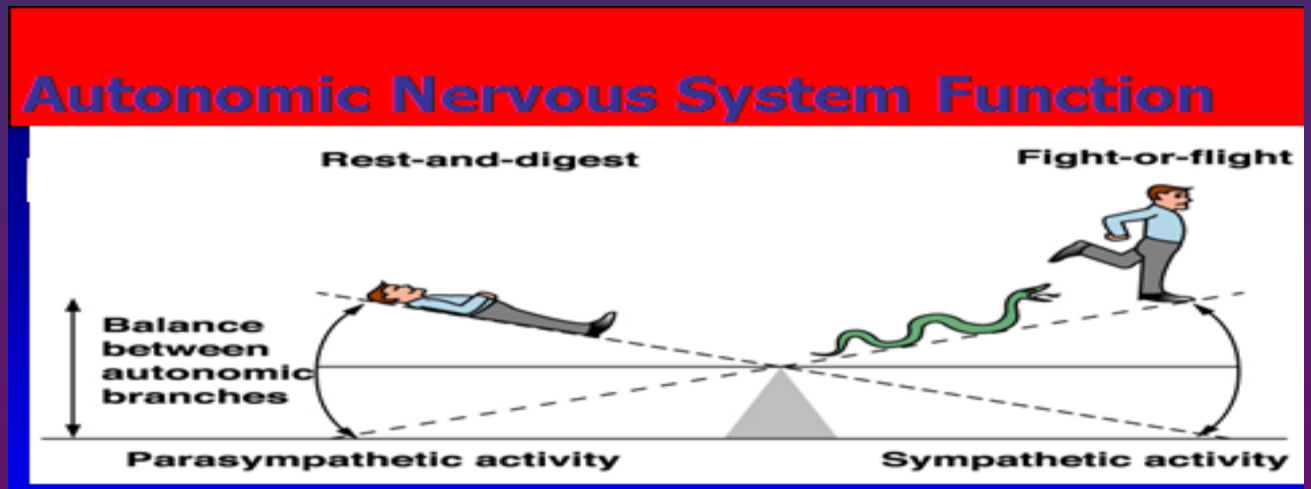
Parasympathetic - Origin

- 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



PHYSIOLOGICAL FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM



These 2 systems are antagonistic.

Typically, we balance these 2 to keep ourselves in a state of dynamic balance.

We'll go further into the difference btwn these 2 later!

THE AUTONOMIC NERVOUS SYSTEM

Subdivision	Nerves 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

Structure	Sympathetic Stimulation	Parasympathetic Stimulation
Iris (eye muscle)	Pupil dilation	Pupil constriction
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	Sympathetic Stimulation	Parasympathetic 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

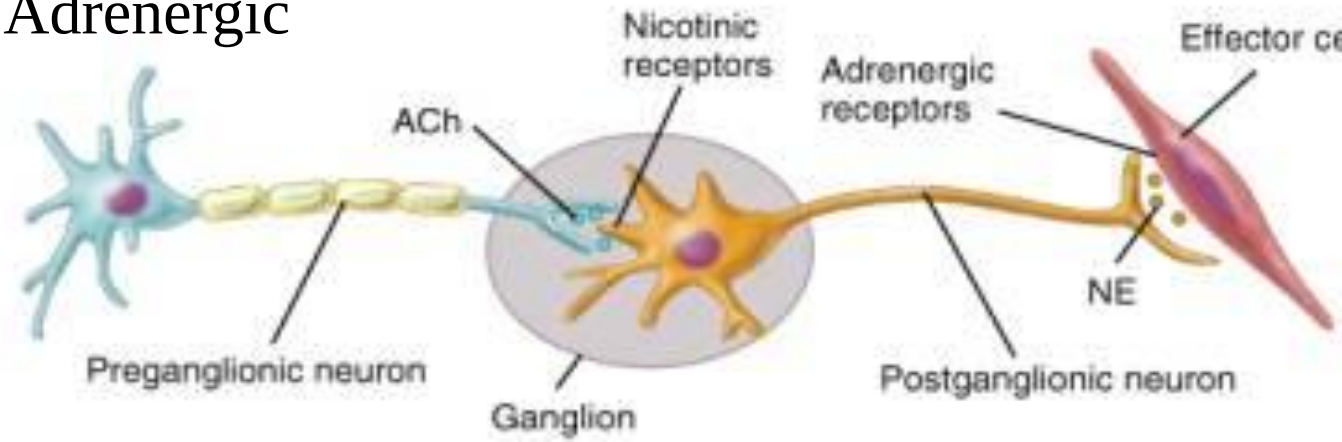
OBJECTIVES

OBJECTIVES

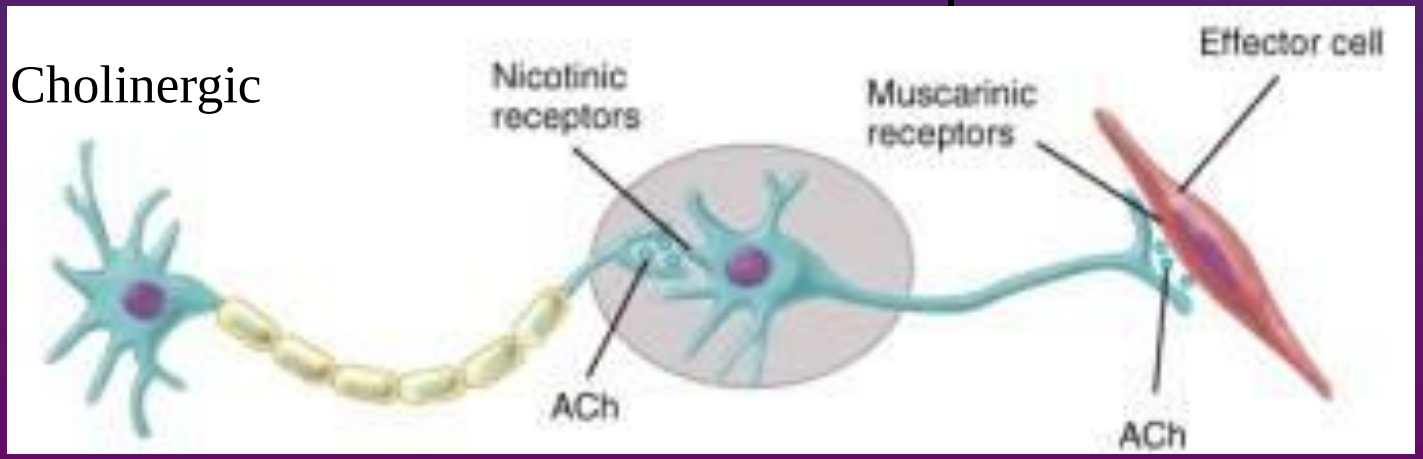
- describe neurotransmitters that can release at pre and post ganglionic of Autonomic NS.
- Describe Autonomic NS receptors.

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

Adrenergic

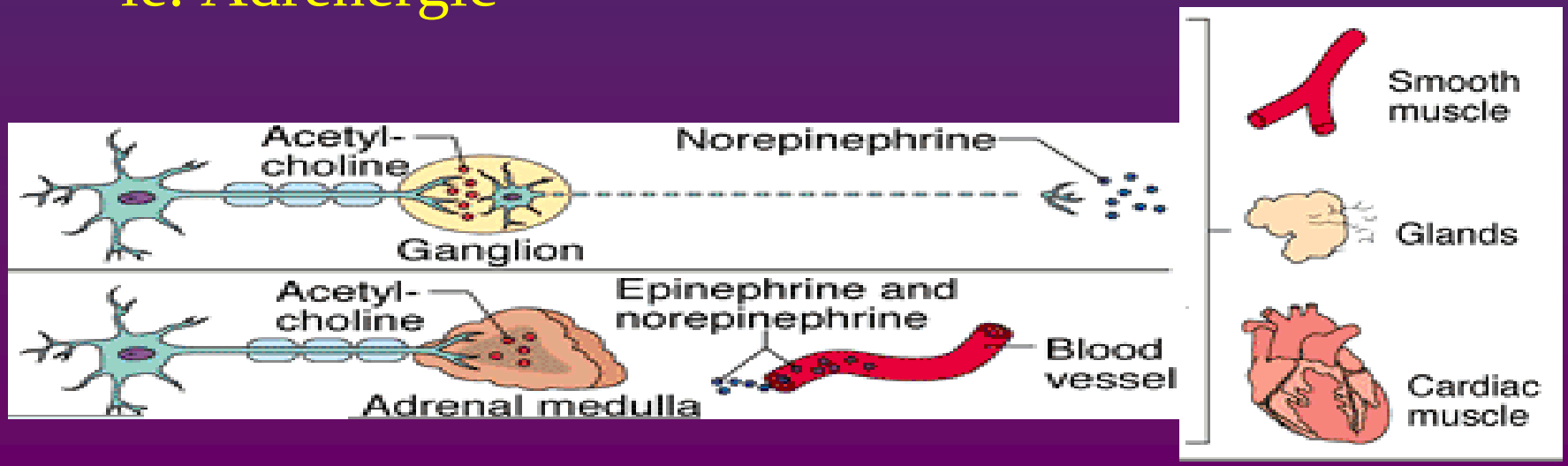


Cholinergic



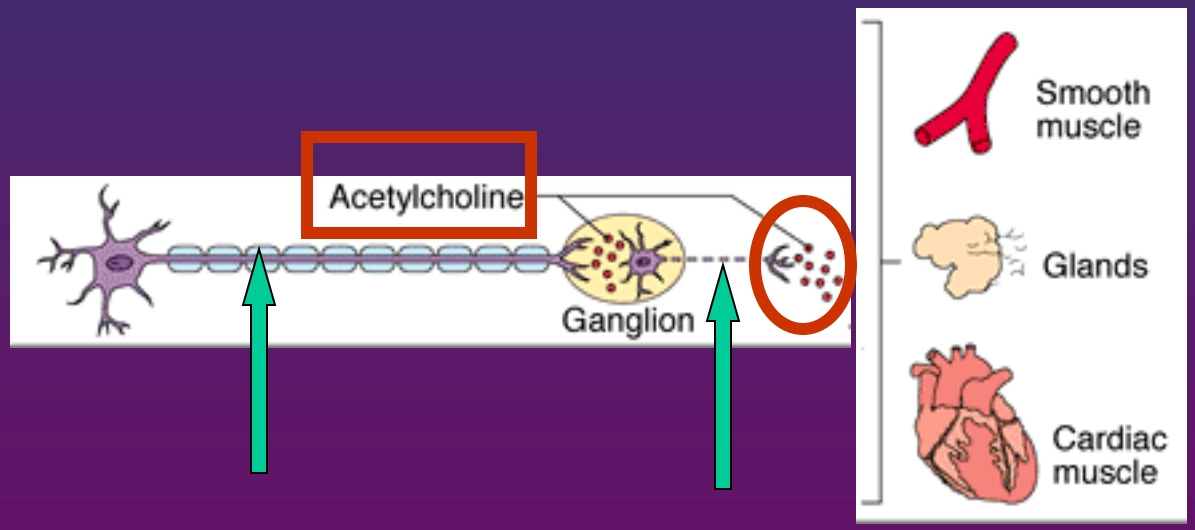
Sympathetic Neurotransmitters

- Preganglionic neurons -
- Cholinergic = (release acetylcholine)
- Postganglionic neurons:
  - release norepinepherine at target organs
  - ie. Adrenergic



Parasympathetic Neurotransmitters

- Pre & Postganglionic neurons release acetylcholine = Cholinergic



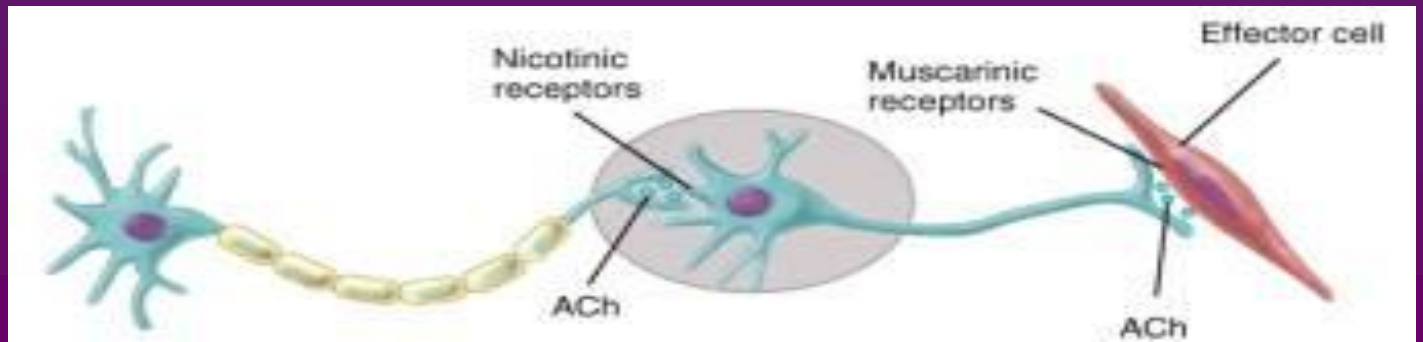
RECEPTORS

- **Parasympathetic nervous system**

acts on two types of receptors:

muscarinic and nicotonic choloinergic receptors.

- **Most transmissions occur in two stages: When stimulated, the preganglionic nerve releases ACh at the ganglion, which acts on nicotinic receptors of the postganglionic nerve.**
- **The postganglionic nerve then releases ACh to stimulate the muscarinic receptors of the target organ.**



TYPES OF MUSCARINIC RECEPTORS

Three main types of muscarinic receptors:M1,M2&M3

- **M1 at neural system.**
- **M2 at heart .**
- **act to bring the heart back to normal after the actions of the sympathetic nervous system: slowing down the heart rate, reducing contractile forces of the atrial cardiac muscle, and reducing conduction velocity of the SA and AV node.**
- **Note, they have no effect on the contractile forces of the ventricular muscle.**

TYPES OF MUSCARINIC RECEPTORS

- **M3 at many places in the body, such as**
- **smooth muscles of the blood vessels> cause vasoconstriction**
- **lungs> cause bronchioconstriction**
- **smooth muscles of the GIT > help in increasing intestinal motility and dilating sphincters.**
- **many glands that help to stimulate secretion in salivary glands and other glands of the body.**

- **The Sympathetic NS Acts on tow types of receptors :**
  - α and β.

Types of α-adrenergic receptor

- Two types:

- **α1**, found in smooth muscle, heart, and liver, with effects including vasoconstriction, intestinal relaxation, uterine contraction and pupillary dilation,

- **α2**

- platelets >platelet aggregation
- vascular smooth muscle > vasoconstriction
- nerve termini > inhibition of norepinephrine
- pancreatic islets > inhibition of insulin secretion.

- **α-adrenergic receptors** >respond to norepinephrine and to blocking agents as phenoxybenzamine.

β-receptor types

- There are three known types of beta receptor, designated β_1, β_2 and β_3.
- β_1-Adrenergic receptors are located mainly in the heart.
- β_2-Adrenergic receptors are located mainly in the lungs, gastrointestinal tract, liver, uterus, vascular smooth muscle, and skeletal muscle.
- β_3-receptors are located in fat cells.

β-adrenergic receptors respond particularly to epinephrine and to such blocking agents as propranolol.

Summary

- Most of viscera receive nerve fibers from both parasympathetic and sympathetic divisions
- Both divisions do not normally innervate an organ equally

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**

Adrenergic Receptors

- The two types of adrenergic receptors are alpha and beta
- Effects of NE binding to:
  - α receptors is generally stimulatory
  - β receptors is generally inhibitory
- A notable exception – NE binding to β receptors of the heart is stimulatory

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

Activation of **β_2 receptors** leads to smooth muscle relaxation

Activation of **β_1 receptors** leads to smooth muscle contraction (especially in heart)

Cholinergic Receptors

- The two types of receptors that bind ACh are nicotinic and muscarinic
- These are named after drugs that bind to them and mimic ACh effects

THANK YOU