L3

CNS

Autonomic Nervous System

Objectives

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

References

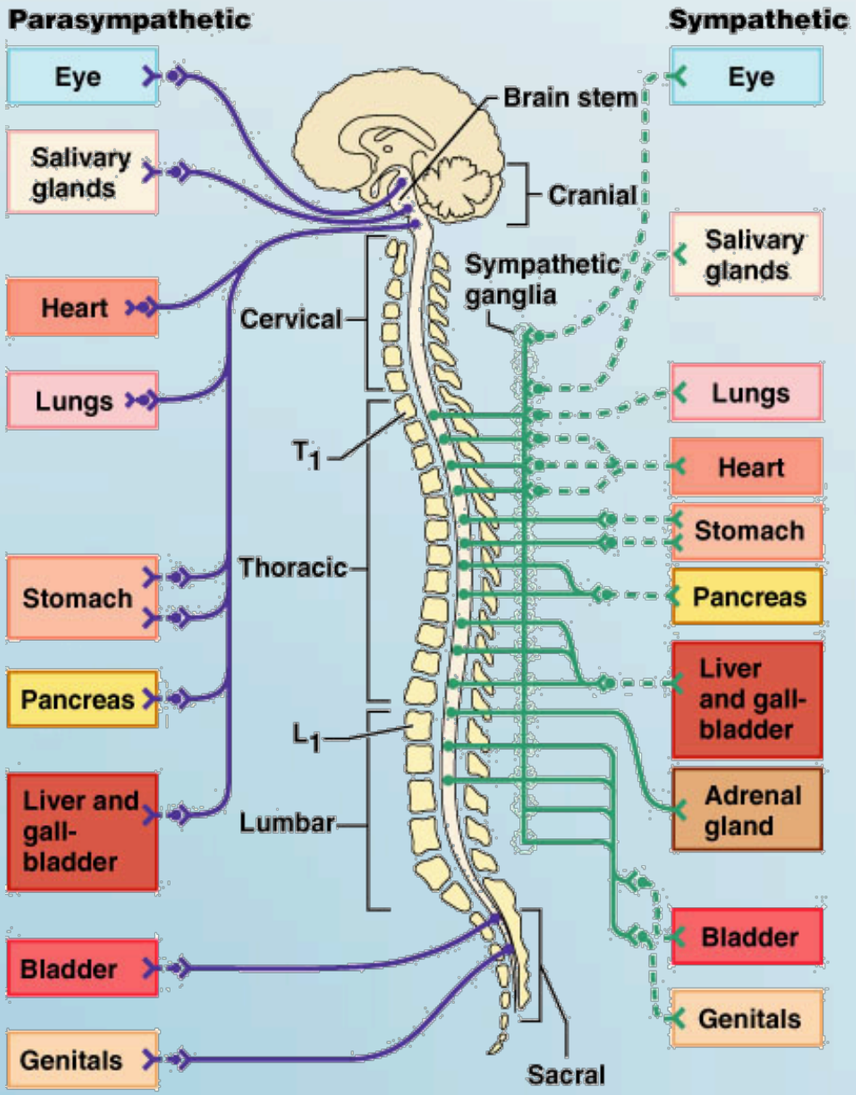
- Females slides
- L2-SNS PHYSIOLOGY (respiratory block) by Prof. Omnia done by pharmacology team
- Males slides
- Physiology (Linda s. Costanzo) Tables chapter 2 page 54, 57

Abbreviations

Ach	Acetylcholine
NE	Norepinephrine
EPI	Epinephrine
ADRs	Adrenoceptors

Overview to the ANS

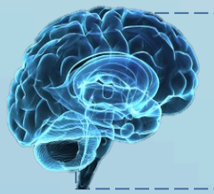
Autonomic Nervous System



- subdivision of the peripheral nervous system
- regulates body activities that are generally not under conscious control
  - visceral motor innervates non-skeletal muscles
- Composed of a special group of neurons serving
  - Cardiac muscle
  - Smooth muscles
  - Internal organs
  - Skin
- Divided into:
  - Sympathetic
  - Parasympathetic

Comparison between sympathetic and parasympathetic

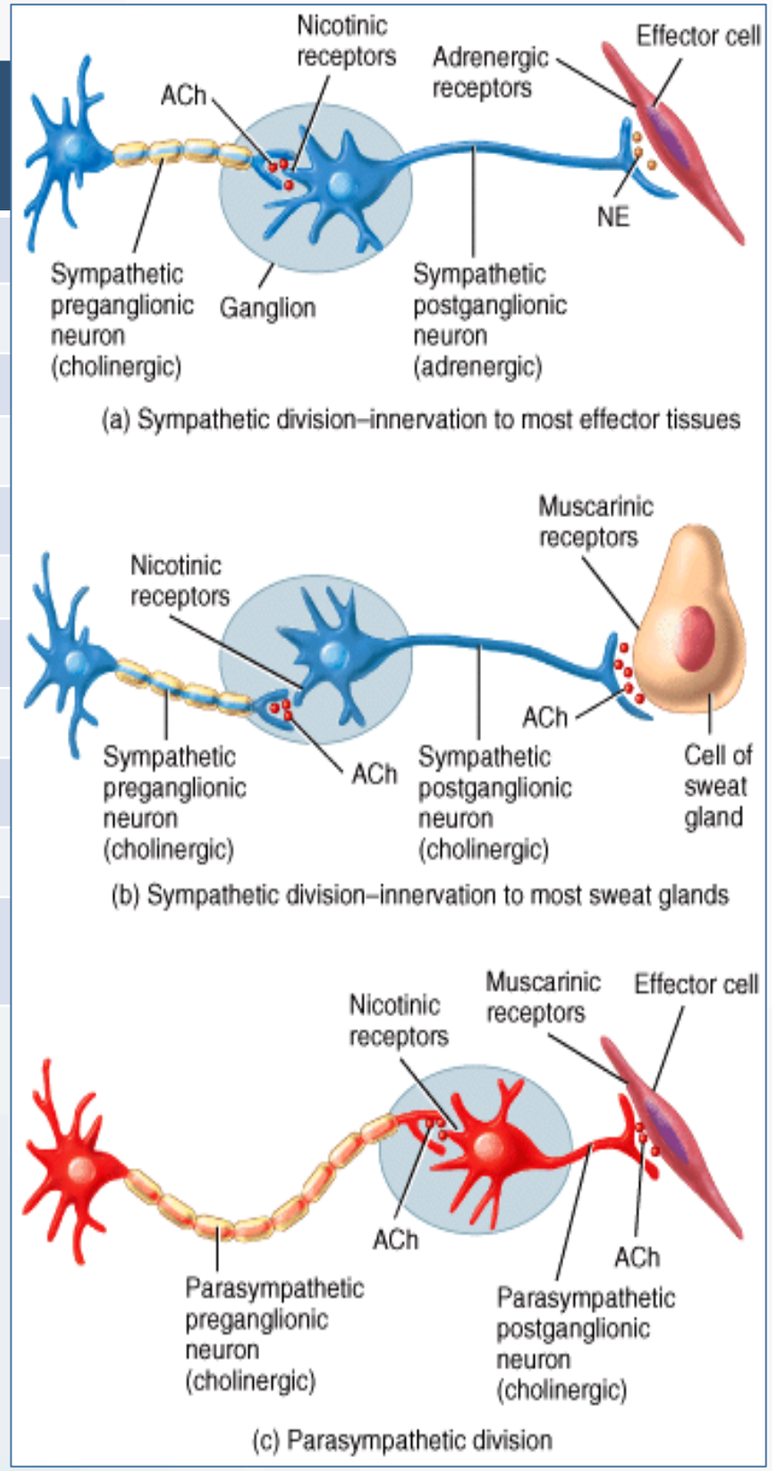
Points of differentiation	Sympathetic	Parasympathetic
Origin	Thoracolumbar lateral horns of the spinal segments T1-L2.	Craniosacral • cranial nerves III, VII, IX and X in the brain stem • Sacral segments of the spinal cord (S2-S3-S4)
preganglionic neurons	Short, myelinated	Long, myelinated
postganglionic neurons	Long, unmyelinated	Short, unmyelinated
Ganglia	close to spinal cord	close to or on target organs
PHYSIOLOGICAL FUNCTIONS (1)	Fight or flight	Rest and digest
Neurotransmitters (2)		
preganglionic neurons	Cholinergic -release acetylcholine at Postganglionic neurons	Cholinergic -release acetylcholine
Postganglionic neurons	• Adrenergic -release norepinephrine at target organs • Except sweat glands & blood vessels to skeletal muscles Cholinergic (4)	Cholinergic -release acetylcholine
Receptors (3)		
In the postganglionic neurons	nicotinic cholinergic (stimulated by Ach) receptors (5)	nicotinic cholinergic (stimulated by Ach) receptors
receptors of the target organ.	Adrenoceptors [ADRs] • 2 α (α_1 , α_2) • 3 β (β_1, β_2, β_3)	Muscarinic cholinergic receptors Three types (M1,M2&M3)



(1),(2),(3) will be discussed further in the next slides
(4) Next slide picture B illustrate it :)
(5) Note that the type of receptors in the postganglionic neurons is the receptor in the cell body of the neuron delivering impulses to the organ not the receptors on the organ its self, that is why it's nicotinic not Muscarinic

(1) PHYSIOLOGICAL FUNCTIONS

Structure	Sympathetic Stimulation	Parasympathetic Stimulation
Iris (eye muscle)	Pupil dilation (Mydriasis)	Pupil constriction
Salivary Glands	Saliva production ↓	Saliva production ↑
Oral/Na Mucosa	Mucus production ↓	Mucus production ↑
Heart	Heart rate and force ↑	Heart rate and force ↓
Lung	Bronchial muscle relaxed	Bronchial muscle contracted
Stomach	Peristalsis ↓	motility ↑
Intestines	Motility ↓	motility ↑
Liver	conversion of glycogen to glucose	
Kidney	↓ urine secretion	↑ urine secretion
Adrenal medulla	Norepinephrine and epinephrine secreted	Ach
Bladder	• Wall relaxed • Sphincter closed	• Wall contracted • Sphincter relaxed



(2) Types of Neurotransmitters

based upon the neurotransmitter released

- Adrenergic → NE &EPI
- Cholinergic → Ach

(3) Receptors

First; Parasympathetic NS receptors

MUSCARINIC RECEPTORS

Types	Location	Effect
M1	neural system	
M2	heart	1. slowing down the HR 2. reducing contractile forces of the atrial cardiac muscle (1) 3. reducing conduction velocity of the SA and AV node
M3	smooth muscles of blood vessels	Vasoconstriction
	lung	Bronchoconstriction
	smooth muscles of GIT	increasing intestinal motility and dilating sphincters
	many glands	stimulate secretion in salivary glands and other glands of the body

(1) they have no effect on the contractile forces of the ventricular muscle

(3) Receptors

Second; Sympathetic NS receptors

ALPHA-ADRENERGIC RECEPTOR

Types	Location	Effect
Alpha-1 α_1	Most of blood vessels	vasoconstriction
	GIT and Bladder	Contraction of the sphincter Relaxation of intestine Uterus contraction
	Eye	pupillary dilation (Mydriasis)
Alpha-2 α_2	platelets	platelet aggregation
	At some VSMCs & N-VSMC [GIT motility]	Vasoconstriction
	Nerve termini	Inhibition of norepinephrine
	Pancreatic islets	Inhibition of insulin secretion

respond to:

- Norepinephrine
- Phenylephrine

Blocked by

Phenoxybenzamine.

Beta -ADRENERGIC RECEPTOR

Types	Location	Effect
β 1	Heart **Mainly**	• **Increase** HR ,AV node conduction , Contractility
	Kidneys	Stimulates releasing of Renin
β 2	lungs,	Bronchodilatation
	GIT	decrease motility
	liver	Gluconeogenesis
	Skeletal and cardiac vascular muscles	Coronary arteries dilatation vasodilatation of smooth muscles
β 3	fat cells	Lipolysis

respond to:

particularly to epinephrine

Blocked by

propranolol

Summary

Q1	**What makes the somatic system faster in conducting impulses than autonomic?**	**Q4**	**Q4.What's the location of Ganglia in each subdivision of the ANS**
	Because the axons in the somatic system is well myelinated and it's One motor neuron extends from the CNS to skeletal muscle not like ANS		• Sympathetic NS : Alongside vertebral column • Parasympathetic : On or near an effector organ
Q2	**What is the origin of each autonomic subdivisions?**	**Q5**	**Q5.What is the affect of Sympathetic Stimulation in the following structures: eye, lungs, heart**
	• Sympathetic NS : Thoracolumbar (T1-L2) • Parasympathetic : Craniosacral (III-VII-IX-X-S2-S3-S4)		• Eye: Pupil dilation (Mydriasis) • Lungs: Bronchodilation • Heart: Heart rate and force increased
Q3	**Describe the two motor neurons of the Sympathetic & Parasympathetic NS?**	**Q6**	**Q6. What are the types of Neurotransmitters ?**
	• Sympathetic NS : Short, Lightly myelinated preganglionic neuron and Long unmyelinated post ganglionic neuron • Parasympathetic NS : Long, Lightly myelinated preganglionic neuron and short unmyelinated post ganglionic neuron		Adrenergic & cholinergic

Summary

Q7	**What is the Neurotransmitters released in all preganglionic neurons?**
	Ach
Q8	**What is the type of receptor in the sweat glands?**
	muscarinic cholinergic receptor
Q9	**What is the effect of Ach in M2 receptor ?**
	1.slowing down the HR 2.reducing contractile forces of the atrial cardiac muscle (1) 3.reducing conduction velocity of the SA and AV node
Q10	**What are the Neurotransmitters that stimulate ADRs?**
	NE & EPI
Q11	**What is the MAIN neurotransmitter released in sympathetic NS?**
	NE
Q12	**Mention on blocking agents to NE & EPI ?**
	• Phenoxybenzamine blocking agent to NE • Propranolol blocking agent to EPI
Q13.	**Why people become incontinent when frightened?**
	Paradoxical fear when there is no escape route cause massive activation of parasympathetic division loss of control over urination and defection.

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CNS Block