

Introduction To Autonomic Nervous System

SOURCES:

- BERTRAM G. KATZUNG BASIC & CLINICAL PHARMACOLOGY 15TH EDITION
- GOODMAN AND GILMAN'S THE PHARMACOLOGICAL BASIS OF THERAPEUTICS 13TH EDITION.



Motto And Vision



To impart evidence based research oriented medical education

To provide best possible patient care

To inculcate the values of mutual respect and ethical practice of medicine



Prof. Umar's Model of Teaching Strategy

- Self Directed Learning Assessment Program
- **Objectives** : To cultivate critical thinking, analytical reasoning, and problem-solving competencies.
- To instill a culture of self-directed learning, fostering lifelong learning habits and autonomy.
- How to Assess?
- Ten randomly selected students will be evaluated within the **first 10 minutes of the lecture** through 10 multiple-choice questions (MCQs) based on the PowerPoint presentation shared on Students Official WhatsApp group, one day before the teaching session.
- The number of MCQs from the components of the lecture will follow the guidelines outlined in the **Prof. Umar model of Integrated Lecture**.

Component of LGIS	Core Knowledge	Horizontal Integration	Vertical Integration	Spiral Integration
No of MCQs	6-7	1-2	1	1



1.	Drugs acting on sympathetic nervo		
	system:		
a)	Increases heart rate		
b)	Decreases heart rate		
c)	Maintain stability		
d)	a and b		

- e) Both c and d
- 2. Cholinergic muscarinic receptor stimulation produces the following effects EXCEPT:
- a) Sweating
- b) Rise in B.P
- c) Bradycardia
- d) urination
- e) Miosis

CORE KNOWLEDGE

- 3. What neurotransmitter will result in constriction of the pupil?
- a) norepinephrine
- b) acetylcholine
- c) epinephrine
- d) Serotonin
- e) Histamine
- 4. Which signaling molecule is most likely responsible for an increase in digestive activity?
- a) epinephrine
- b) norepinephrine
- c) acetylcholine
- d) Adrenaline
- e) noradrenaline

SDL ASSESSMENT PROGRAM

- 5. Which of the following is a typical effect of the drugs stimulating parasympathetic nervous system activation?
- A) Increased heart rate
- B) Dilation of bronchioles
- C) Pupil dilation
- D) Increased digestion
- E) urinary retention
- 6. What is the primary effect of alpha-1 receptor activation?
- A) Vasodilation
- B) Decreased heart rate
- C) Vasoconstriction
- D) Increased cardiac output

CORE KNOWLEDGE

E) autoregulation

- 7. What is the primary neurotransmitter deficiency associated with Parkinson's disease?
- a) Serotonin
- b) Dopamine
- c) Acetylcholine
- d) Norepinephrine
- e) epinephrine
- 8. Which part of the nervous system is
 - primarily affected by Dysautonomia?
- a) Central nervous system
- b) Peripheral nervous system
- c) Autonomic nervous system
- d) Somatic nervous system
- e) Both autonomic and somatic nervous system

SDL ASSESSMENT PROGRAM Horizontal integration





- 9. Beta blockers are contraindicated in patients with which condition?
- A) Asthma
- B) Diabetes mellitus
- C) Hypertension
- D) Rheumatoid arthritis
- E) Osteoarthritis

- 10. Which type of fiber could be considered the longest?
- a) preganglionic parasympathetic
- b) preganglionic sympathetic
- c) postganglionic parasympathetic
- d) postganglionic sympathetic
- e) Both a and b

SDL ASSESSMENT PROGRAM



Learning Objectives

- To recall anatomy of ANS
- To discuss branches of ANS
- To recall Cholinergic and adrenergic transmission
- To recall functional organization of ANS with receptors and neurotransmitters

Peripheral Nervous System





Autonomic Nervous System







Spiral.....Anatomy & Physiology



Cholinergic Transmission

- Neurotransmitter
- Almost all efferent fibres leaving CNS
- All Preganglionic efferent autonomic & Somatic motor fibres to skeletal muscles
- Most parasympathetic postganglionic
- Few sympathetic post ganglionic

Spiral.....Anatomy & Physiology

Cholinergic Transmission



Adrenergic Transmission



REGULATION OFANS



- Presynaptic Regulation
- Autoreceptors
- Heteroreceptors
- Postsynaptic Regulation
- Upregulation/Downregulation
- modulation of the primary transmitter-receptor event e.g ganglionic transmission



Autonomic Receptors

- 1. Cholinoceptors muscarinic
 - nicotinic
- 2. Adrenoceptors
 - alpha
 - beta
- 3. Dopamine receptors

Receptor Name	Typical Locations	Result of Ligand Binding	
Cholinoceptors			
Muscarinic M ₁	CNS neurons, sympathetic postganglionic neurons, some presynaptic sites	Formation of IP3 and DAG, increased intracellular calcium	
Muscarinic M ₂	Myocardium, smooth muscle, some presynaptic sites; CNS neurons	Opening of potassium channels, inhibition of adenylyl cyclase	
Muscarinic M ₃	Exocrine glands, vessels (smooth muscle and endothelium); CNS neurons	Like M ₁ receptor-ligand binding	
Muscarinic M ₄	CNS neurons; possibly vagal nerve endings	Like M ₂ receptor-ligand binding	
Muscarinic M _s	Vascular endothelium, especially cerebral vessels; CNS neurons	Like M _t receptor-ligand binding	
Nicotinic N _N	Postganglionic neurons, some presynaptic cholinergic terminals; receptors typically contain two α 3 and one β 4 type subunits in addition to γ and δ subunits	Opening of Na ⁺ , K ⁺ channels, depolarization	
Nicotinic N _M	Skeletal muscle neuromuscular end plates; receptors typically contain two α 1 and β 1 type subunits in addition to γ and δ subunits	Opening of Na ⁺ , K ⁺ channels, depolarization	
Adrenoceptors			
Alphat	Postsynaptic effector cells, especially smooth muscle	Formation of IP ₂ and DAG, increased intracellular calcium	
Alpha ₂	Presynaptic adrenergic nerve terminals, platelets, lipocytes, smooth muscle	Inhibition of adenylyl cyclase, decreased cAMP	
Beta ₁	Postsynaptic effector cells, especially heart, lipocytes, brain; presynaptic adrenergic and cholinergic nerve terminals, juxtaglomerular apparatus of renal tubules, ciliary body epithelium	Stimulation of adenylyl cyclase, increased cAMP	
Beta ₂	Postsynaptic effector cells, especially smooth muscle and cardiac muscle	Stimulation of adenylyl cyclase and increased cAMP. Activates cardiac G, under some conditions.	
Beta ₃	Postsynaptic effector cells, especially lipocytes; heart	Stimulation of adenylyl cyclase and increased cAMP ¹	
Dopamine recept	tors		
D1 (DA1), D3	Brain; effector tissues, especially smooth muscle of the renal vascular bed	Stimulation of adenylyl cyclase and increased cAMP	
D ₂ (DA ₂)	Brain; effector tissues, especially smooth muscle; presynaptic nerve terminals	Inhibition of adenylyl cyclase; increased potassium conductance	
D ₃	Brain	Inhibition of adenylyl cyclase	
D ₄	Brain, cardiovascular system	Inhibition of adenylyl cyclase	



Cholinoceptors (Muscarinic)

- Muscarinic 1(M₁)
- Muscarinic 2(M₂)
- Muscarinic 3(M₃)
- Muscarinic 4(M₄)
- Muscarinic 5(M₅)



Cholinoceptors (nicotinic)

• Nicotinic N_N

• Nicotinic N_M





Adrenoceptors

- Alpha₁
- Alpha₂
- Beta₁
- Beta₂
- Beta₃



Dopamine Receptors

- **D**₁
- D₂
- D₃
- D₄
- **D**₅

Core ---Pharmacology







AND MEDICAL ST

Dysautonomia

horizontal integration



Bioethics and research

 Axelrod FB. Familial dysautonomia. Muscle & nerve. 2004 Mar;29(3):352-63. <u>https://doi.org/10.1002/mus.10499</u>



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FURTHER READING

- Carrara, M., Ferrario, M., Bollen Pinto, B. and Herpain, A., 2021. The autonomic nervous system in septic shock and its role as a future therapeutic target: a narrative review. Annals of intensive care, 11(1), p.80.
- Herring, N., Kalla, M. and Paterson, D.J., 2019. The autonomic nervous system and cardiac arrhythmias: current concepts and emerging therapies. *Nature Reviews Cardiology*, 16(12), pp.707-726.