

Autonomic Nervous System

Chapter

12

Answer Key: Textbook page references are provided as a guide for answering these questions. A complete answer key was provided for your instructor.

OBJECTIVES

- Describe the function and pathway of autonomic (visceral) reflexes.
- Do the following regarding the autonomic nervous system:
 - Describe the function of the autonomic nervous system.
 - Identify the two divisions of the autonomic nervous system.
 - State the anatomical and functional differences between the sympathetic and parasympathetic nervous systems.
 - Define autonomic terminology used in pharmacology.
 - Differentiate between autonomic tone and vasomotor tone.
- Discuss autonomic nervous system neurons, including:
 - Define *cholinergic* and *adrenergic* fibers.
 - Name the major neurotransmitters of the autonomic nervous system.
 - Name and locate the cholinergic and adrenergic receptors.
- Explain the terms used to describe the effects of neurotransmitters and drugs on autonomic receptors.

Part I: Mastering the Basics

MATCHING

Autonomic Nervous System

Directions: In the spaces provided, indicate whether the following describe sympathetic (S) or parasympathetic (P) nervous system effects. See text, pp. 219-220.

- _____ Thoracolumbar outflow
- _____ Feed-and-breed
- _____ Paravertebral ganglia
- _____ Stressed-out and uptight
- _____ Craniosacral outflow
- _____ Paradoxical fear, "bradying down"
- _____ Adrenergic
- _____ Vasomotor tone
- _____ Fight-or-flight

READ THE DIAGRAM

Directions: Refer to Figure 12-2 in the textbook and indicate if the statement is true (T) or false (F). See text, p. 222.

- _____ The paravertebral ganglia are present in both the parasympathetic nervous system (PNS) and sympathetic nervous system (SNS).
- _____ The preganglionic fibers of the PNS and SNS are cholinergic.
- _____ The postganglionic fibers of the PNS and SNS are cholinergic.
- _____ The postganglionic fibers of the PNS and SNS are adrenergic.
- _____ The preganglionic fibers of the SNS exit the spinal cord at the thoracolumbar region.
- _____ The transmitter for the postganglionic fibers of the SNS is norepinephrine (NE).
- _____ The transmitter for the postganglionic fibers of the PNS is acetylcholine (ACh).
- _____ The preganglionic and postganglionic fibers associated with the craniosacral outflow are cholinergic.
- _____ The transmitter of the preganglionic fibers of both the PNS and SNS is ACh.

10. _____ Fibers colored green are cholinergic.
11. _____ Fibers colored red are adrenergic.
12. _____ All autonomic fibers are colored red.
13. _____ Preganglionic fibers of the parasympathetic nervous system are longer than the preganglionic fibers of the sympathetic nervous system.
14. _____ Drugs that block the effects of ACh affect both the sympathetic and parasympathetic nervous systems.
15. _____ Drugs that block the effects of NE affect both the sympathetic and parasympathetic nervous systems.
11. _____ Muscarinic and nicotinic receptors are cholinergic receptors.
12. _____ Alpha and beta receptors are adrenergic receptors.
13. _____ Cholinergic fibers are found only in the autonomic nervous system.
14. _____ A drug that affects the N_N receptors affects both the PNS and SNS.
15. _____ Nicotinic receptors within the neuromuscular junction are activated by ACh.
16. _____ Nicotinic receptors are located in both the PNS and SNS.
17. _____ A drug that blocks the N_M receptors within the neuromuscular junction causes skeletal muscle paralysis.

READ THE DIAGRAM

Autonomic Receptors

Directions: Refer to Figure 12-3 in the textbook and indicate if the statement is true (T) or false (F). See text, p. 225.

1. _____ The postganglionic receptors for the PNS are muscarinic.
2. _____ Muscarinic receptors are activated by norepinephrine (NE).
3. _____ Alpha (α) and beta (β) receptors are activated by NE.
4. _____ The postganglionic receptors for the SNS are called alpha and beta receptors.
5. _____ Fibers that are colored green secrete ACh as their transmitter.
6. _____ Fibers that are colored red secrete NE as their transmitter.
7. _____ Nicotinic receptors are found only in the autonomic nervous system.
8. _____ The transmitter of the preganglionic fibers of both the PNS and SNS activates nicotinic receptors.
9. _____ A drug that blocks muscarinic receptors diminishes the parasympathetic response.
10. _____ A drug that blocks alpha or beta receptors diminishes a sympathetic response.

DRAW IT

Receptor Shapes and Fit

Directions: Refer to Figure 12-3 in the textbook and draw the following shapes.

1. Draw the shape of the muscarinic receptor. Draw the shape of ACh that fits into this receptor.
2. Draw the shape of the alpha or beta receptor. Draw the shape of the NE that fits into this receptor.
3. Draw the shape of the nicotinic N_M receptor. Draw the shape of the ACh that fits into the receptor.

MATCHING

Sympathetic or Parasympathetic Effects

Directions: Indicate if the following is a sympathetic effect (S) or a parasympathetic effect (P). See text, pp. 219, 224-225.

1. _____ Increased heart rate
2. _____ Dilation of the pupils of the eyes
3. _____ Dilation of the breathing passages
4. _____ Stimulation of urination
5. _____ Increased blood pressure
6. _____ Vasoconstriction
7. _____ Decreased heart rate

8. _____ Stronger heart muscle contraction
9. _____ Constriction of the pupil of the eye
10. _____ Increased perspiration
11. _____ Pounding heart and sweaty palms
12. _____ Anxiety and tremors
13. _____ Vagal discharge

SIMILARS AND DISSIMILARS

Directions: Circle the word in each group that is least similar to the others. Indicate the similarity of the three words on the line below each question.

- | | |
|---|--|
| 1. feed-and-breed
thoracolumbar | parasympathetic
resting and digesting |
| <hr/> | |
| 2. cholinergic
parasympathetic | norepinephrine
craniosacral |
| <hr/> | |
| 3. thoracolumbar
muscarinic | sympathetic
fight-or-flight |
| <hr/> | |
| 4. alpha receptors
adrenergic fibers | beta receptors
ACh |
| <hr/> | |
| 5. norepinephrine
muscarinic | cholinergic
nicotinic |
| <hr/> | |
| 6. craniosacral | sympathetic cholinergic ACh |
| <hr/> | |
| 7. N _M N _N | muscarinic alpha, beta |
| <hr/> | |
| 8. muscarinic | norepinephrine adrenergic alpha, beta |

Part II: Putting It All Together

MULTIPLE CHOICE

Directions: Choose the correct answer.

1. Sympathetic and parasympathetic nerves
 - a. are somatic motor neurons.
 - b. supply the voluntary skeletal muscles.
 - c. include the phrenic, sciatic, and brachial nerves.
 - d. innervate the viscera.
2. Which of the following is least true of the sympathetic nervous system?
 - a. fight-or-flight
 - b. Preganglionic fibers are cholinergic.
 - c. Postganglionic fibers are adrenergic.
 - d. The postganglionic receptor is muscarinic.
3. Which of the following is most descriptive of the parasympathetic nervous system?
 - a. fight-or-flight
 - b. Preganglionic fibers are adrenergic.
 - c. Postganglionic fibers are adrenergic.
 - d. The postganglionic receptor is muscarinic.
4. Stimulation of the SNS causes the heart to beat stronger and faster. A drug that also causes the heart to beat stronger and faster is described as
 - a. parasympatholytic.
 - b. vagomimetic.
 - c. sympathomimetic.
 - d. sympatholytic.
5. Vasomotor tone is
 - a. a vasoconstrictor effect caused by background firing of the sympathetic nerves.
 - b. a vagally induced vasoconstriction.
 - c. a response to activation of the muscarinic receptors on the blood vessels.
 - d. caused by a beta-adrenergic antagonist.
6. What is the clinical consequence of loss of vasomotor tone?
 - a. urticaria and pruritus
 - b. lethargy and jaundice
 - c. severe decline in blood pressure and shock
 - d. elevation in blood pressure and hemorrhage
7. Paravertebral ganglia
 - a. contain beta-adrenergic receptors that are activated by NE.
 - b. are part of the craniosacral outflow.
 - c. are located within the sympathetic nervous system.
 - d. are located within the effector organs.

8. Which of the following is least descriptive of the thoracolumbar outflow?
 - a. fight-or-flight
 - b. muscarinic and nicotinic receptors
 - c. sympathetic nervous system
 - d. paravertebral ganglia
9. Alpha- and beta-adrenergic receptors are
 - a. associated with the parasympathetic nervous system.
 - b. associated with craniosacral outflow.
 - c. located on the paravertebral ganglia.
 - d. activated by norepinephrine.
10. The adrenal medulla secretes epinephrine and norepinephrine; the effects of the hormones are best described as
 - a. vagolytic.
 - b. sympathomimetic.
 - c. parasympathomimetic.
 - d. sympatholytic.
11. Which of the following fibers secretes norepinephrine (NE)?
 - a. preganglionic sympathetic
 - b. preganglionic parasympathetic
 - c. postganglionic sympathetic
 - d. postganglionic parasympathetic
12. Which of the following is least descriptive of monoamine oxidase (MAO)?
 - a. enzyme that degrades NE
 - b. found within all cholinergic fibers
 - c. associated with sympathetic activity
 - d. associated with adrenergic fibers
13. A beta₁-adrenergic agonist
 - a. increases heart rate.
 - b. causes the release of acetylcholine.
 - c. blocks the effects of NE at its receptor site.
 - d. lowers blood pressure.
14. Atropine is classified as a muscarinic blocker and therefore is
 - a. parasympathomimetic.
 - b. sympatholytic.
 - c. vagolytic.
 - d. sympathomimetic.
15. Muscarinic receptors are located on
 - a. the paravertebral ganglia.
 - b. the effector organs—postganglionic parasympathetic.
 - c. the effector organs—postganglionic sympathetic.
 - d. all autonomic ganglia.
16. Sympathetic nervous system stimulation causes vasoconstriction of the blood vessels, thereby elevating blood pressure. Which of the following drugs lowers blood pressure?
 - a. vagolytic
 - b. sympathomimetic
 - c. alpha₁-adrenergic blocker
 - d. beta₂-adrenergic agonist
17. Sympathetic nervous system stimulation causes relaxation of the breathing passages (i.e., bronchodilation). Which of the following drugs achieves this effect?
 - a. beta₂-adrenergic agonist
 - b. alpha₁ blocker
 - c. muscarinic antagonist
 - d. vagomimetic
18. A patient received an antimuscarinic drug (atropine) preoperatively. What drug-related postoperative consequence is he or she likely to experience?
 - a. slow heart rate
 - b. inability to urinate
 - c. excess salivation
 - d. pinpoint pupils

CASE STUDY

A patient has had a heart attack and is experiencing a very slow heart rate because of intense parasympathetic discharge.

1. Which of the following drugs will increase his heart rate?
 - a. antimuscarinic
 - b. beta₁-adrenergic blocker
 - c. beta₁-adrenergic antagonist
 - d. vagomimetic
2. Restate the answer in question 1.
 - a. sympatholytic
 - b. vagolytic
 - c. parasympathomimetic
 - d. muscarinic agonist
3. What would happen if a muscarinic agonist were administered?
 - a. The heart rate would increase to normal.
 - b. The heart rate would become too rapid.
 - c. Breathing would cease.
 - d. The heart rate would decrease further.

Student Name _____

Part III: Challenge Yourself!

GROUPS AND PUZZLE

1. Indicate which group is incorrect.
 - a. adrenergic receptors: alpha and beta
 - b. cholinergic receptors: nicotinic and muscarinic
 - c. sympathetic terms: paravertebral ganglia, fight-or-flight, craniosacral outflow
 - d. parasympathetic terms: craniosacral outflow, feed-and-breed, muscarinic, nicotinic

2. Indicate which group is incorrect.
 - a. adrenergic receptors: alpha and beta
 - b. cholinergic receptors: nicotinic, muscarinic, dopaminergic
 - c. sympathetic terms: paravertebral ganglia, fight-or-flight, thoracolumbar outflow
 - d. parasympathetic terms: craniosacral outflow, feed-and-breed, muscarinic, nicotinic

PUZZLE

Hint: An Autonomic Blood Pressure Event

Directions: Perform the following functions on the Sequence of Words that follows. When all the functions have been performed, you are left with a word or words related to the hint. Record your answer in the space provided.

Functions: Remove the following:

1. Neurotransmitter for cholinergic fibers

2. An "outflow" name for the sympathetic nervous system

3. Name of the sympathetic ganglia that run parallel to the spinal cord

4. Neurotransmitter for adrenergic fibers

5. Name of a cholinergic receptor

6. An "outflow" name for the parasympathetic nervous system

7. Name of the parasympathetic nerve that innervates the heart

8. Name of two adrenergic receptors

9. Name of a drug that is classified as a beta₁-adrenergic blocker

10. Name of a drug that is classified as a muscarinic blocker (anticholinergic)

Sequence of Words

PARAVERTEBRALALPHAPROPRANO
 LORBETANOREPINEPHRINEVAGUS
 ACETYLCHOLINEBARORECEPTORR
 EFLEXMUSCARINICATROPINETHO
 RACOLUMBARCRANIOSACRAL

Answer: _____