NBEO General Physiology Practice Exam (Sample)

Study Guide

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Questions

1. Which of the following effectively decreases blood glucose levels?

A. Glucagon

B. Adrenaline

C. Insulin

D. Cortisol

2. What compensatory mechanism does metabolic alkalosis typically cause?

A. Hyperventilation

B. Hypoventilation

C. Increased metabolic rate

D. Decreased oxygen demand

3. Receptors in the body responsible for monitoring blood pressure are known as what?

A. Mechanoreceptors

B. Chemoreceptors

C. Baroreceptors

D. Thermoreceptors

4. Which type of nephrons are found in the outer 2/3 of the renal cortex?

A. Cortical nephrons

B. Juxtamedullary nephrons

C. Medullary nephrons

D. Subcapsular nephrons

5. Which receptors are known to increase IP3, thus increasing intracellular Ca2+ levels?

A. Alpha 1

B. Alpha 2

C. Beta 1

D. Beta 2

6. Which factor is primarily responsible for increasing cardiac output?

A. Increased blood viscosity

B. Increased stroke volume

C. Decreased heart rate

D. Decreased end diastolic volume

7. Which of the following will NOT shift the oxygen dissociation curve to the right?

A. Increase in pH (more basic)

B. Decrease in pH (more acidic)

C. Increase in temperature

D. Increase in CO2 levels

8. What is the primary role of calcium ions (Ca2+) in muscle contraction?

A. To bind to myosin

B. To activate ATP production

C. To bind to Troponin

D. To remove actin from tropomyosin

9. Which of the following factors decreases Glomerular Filtration Rate (GFR)?

A. Increased renal blood flow

B. Efferent arteriolar constriction

C. Afferent arteriolar constriction

D. Increased mean arterial pressure (MAP)

10. Which valve separates the right atrium from the right ventricle?

A. Aortic valve

B. Pulmonary valve

C. Tricuspid valve

D. Mitral valve

Answers

1. C
2. B
3. C
4. A
5. A
6. B
7. A
8. C
9. C
10. C

Explanations

1. Which of the following effectively decreases blood glucose levels?

A. Glucagon

B. Adrenaline

C. Insulin

D. Cortisol

Insulin is the hormone that effectively decreases blood glucose levels. It is produced by the beta cells of the pancreas in response to elevated blood glucose levels, such as after eating a meal. Insulin facilitates the uptake of glucose into the body's cells, particularly in muscle and adipose (fat) tissues, where it can be utilized for energy or stored as glycogen. Additionally, insulin inhibits hepatic glucose production, further contributing to the reduction of glucose levels in the bloodstream. The action of insulin is crucial for maintaining glucose homeostasis. In individuals with insulin resistance or diabetes, this process can be impaired, leading to elevated blood glucose levels. Understanding the role of insulin helps to clarify why it is the primary hormone involved in lowering blood glucose, distinguishing its function from other hormones like glucagon, adrenaline, and cortisol, which are more associated with raising blood glucose levels or responding to stress.

2. What compensatory mechanism does metabolic alkalosis typically cause?

A. Hyperventilation

B. Hypoventilation

C. Increased metabolic rate

D. Decreased oxygen demand

Metabolic alkalosis is a condition characterized by an elevated blood pH due to an excess of bicarbonate or a loss of hydrogen ions. The body has several mechanisms to compensate for changes in pH, and in the case of metabolic alkalosis, hypoventilation is a typical compensatory response. When the blood becomes more alkaline, the body attempts to restore homeostasis by retaining carbon dioxide (CO_2). This is achieved through hypoventilation, where breathing slows down, leading to decreased exhalation of CO_2. As CO_2 levels increase, it combines with water in the body to form carbonic acid, which helps to lower the pH back toward normal. This compensatory mechanism is essential because, in chronic metabolic alkalosis, if hypoventilation occurs, it leads to a mild respiratory acidosis, counteracting the effects of the alkalosis. Thus, the body's effort to compensate through hypoventilation directly addresses the imbalance created by the metabolic alkalosis, making this response critical in maintaining acid-base balance.

3. Receptors in the body responsible for monitoring blood pressure are known as what?

A. Mechanoreceptors

B. Chemoreceptors

C. Baroreceptors

D. Thermoreceptors

Baroreceptors are specialized mechanoreceptors that detect changes in blood pressure by sensing the stretch of arterial walls. These receptors are primarily located in the carotid sinus and aortic arch, where they monitor the pressure of the blood flowing through these major arteries. When blood pressure rises, the walls are stretched more, and this increased stretch signals the baroreceptors to send information to the central nervous system. The body then initiates reflexive responses to either decrease heart rate or dilate blood vessels, thereby helping to regulate and maintain blood pressure within a normal range. This physiological process is crucial because it allows the body to maintain homeostasis and adapt to changes in blood flow and pressure that occur with various activities, such as exercise or changes in posture. Baroreceptors play a significant role in cardiovascular health, enabling rapid adjustments to maintain optimal blood pressure levels and ensuring adequate blood perfusion to vital organs.

4. Which type of nephrons are found in the outer 2/3 of the renal cortex?

A. Cortical nephrons

B. Juxtamedullary nephrons

C. Medullary nephrons

D. Subcapsular nephrons

Cortical nephrons are indeed the type of nephrons predominantly found in the outer two-thirds of the renal cortex. These nephrons are characterized by a shorter loop of Henle that extends only slightly into the medulla, primarily functioning in the filtration of blood and the production of urine. Their location in the outer cortex allows them to efficiently filter blood and return reabsorbed substances to the bloodstream. In contrast, juxtamedullary nephrons, which are located closer to the junction between the cortex and medulla, have longer loops of Henle that extend deep into the medulla. This configuration plays a vital role in establishing a concentration gradient for urine concentration, but they are not as prevalent in the outer portion of the cortex. Medullary nephrons is a less commonly used term and may confuse with juxtamedullary nephrons, as it suggests a focus on the medulla rather than the cortex. Subcapsular nephrons could imply nephrons that are located directly beneath the capsule or at the outermost region of the cortex, but this is not a standard classification used in nephrology, as all nephrons are essentially categorized as either cortical or juxtamedullary based on

5. Which receptors are known to increase IP3, thus increasing intracellular Ca2+ levels?

A. Alpha 1

B. Alpha 2

C. Beta 1

D. Beta 2

The receptors that are known to increase inositol trisphosphate (IP3), leading to an increase in intracellular calcium levels, are the alpha-1 adrenergic receptors. These receptors are coupled primarily through Gq proteins, which activate phospholipase C (PLC). When PLC is activated, it catalyzes the breakdown of phosphatidylinositol 4,5-bisphosphate (PIP2) into IP3 and diacylglycerol (DAG). IP3 then diffuses through the cytoplasm and binds to IP3 receptors located on the endoplasmic reticulum, which triggers the release of calcium ions into the cytosol. The increase in intracellular calcium can lead to various cellular responses, including muscle contraction and neurotransmitter release. In contrast, the other receptor types (alpha-2, beta-1, and beta-2) have different signaling pathways and do not primarily lead to increased levels of IP3 or intracellular calcium in the same way that alpha-1 receptors do. Alpha-2 adrenergic receptors are generally inhibitory and tend to decrease cyclic AMP (cAMP) levels, while beta-1 and beta-2 adrenergic receptors primarily act through Gs proteins, leading

6. Which factor is primarily responsible for increasing cardiac output?

A. Increased blood viscosity

B. Increased stroke volume

C. Decreased heart rate

D. Decreased end diastolic volume

Increasing cardiac output is primarily influenced by stroke volume, which is defined as the amount of blood pumped by the heart in one contraction. Cardiac output is calculated using the formula: Cardiac Output (CO) = Stroke Volume (SV) × Heart Rate (HR). When stroke volume increases, assuming the heart rate remains constant, there is a direct, proportional increase in cardiac output. This increase in stroke volume can be due to a variety of factors, such as enhanced venous return, increased contractility of the heart muscle, or improved filling of the ventricles. In contrast, higher blood viscosity can lead to increased resistance in the circulatory system, which generally decreases cardiac output rather than increasing it. A decreased heart rate would also result in a lower cardiac output because it would reduce the number of times the heart pumps in a given time frame. Additionally, decreased end diastolic volume typically means that there is less blood available to be pumped out of the heart, which would lower stroke volume and thereby decrease cardiac output. Thus, the primary factor responsible for increasing cardiac output is indeed an increase in stroke volume.

7. Which of the following will NOT shift the oxygen dissociation curve to the right?

A. Increase in pH (more basic)

B. Decrease in pH (more acidic)

C. Increase in temperature

D. Increase in CO2 levels

The oxygen dissociation curve illustrates the relationship between the partial pressure of oxygen and the hemoglobin saturation with oxygen. A rightward shift in this curve indicates a decreased affinity of hemoglobin for oxygen, which facilitates the release of oxygen to tissues. An increase in pH, which corresponds to a more basic environment (alkaline conditions), stabilizes the hemoglobin structure in a way that enhances its affinity for oxygen. As a result, it does not contribute to a rightward shift of the curve; instead, it tends to shift it to the left. This means that under more basic conditions, hemoglobin holds onto oxygen more tightly, making it less available for tissues. In contrast, a decrease in pH (more acidic), an increase in temperature, and an increase in CO2 levels all promote a rightward shift of the curve, which helps facilitate oxygen unloading to tissues that are metabolically active and producing acid and heat as byproducts. Thus, the choice that identifies a condition that will not shift the curve to the right is an increase in pH.

8. What is the primary role of calcium ions (Ca2+) in muscle contraction?

A. To bind to myosin

B. To activate ATP production

C. To bind to Troponin

D. To remove actin from tropomyosin

The primary role of calcium ions (Ca2+) in muscle contraction is to bind to troponin. When a muscle is stimulated to contract, calcium is released from the sarcoplasmic reticulum into the cytosol. The binding of calcium to troponin induces a conformational change in the troponin-tropomyosin complex. Troponin is a regulatory protein that, when bound to calcium, causes tropomyosin to shift away from the actin binding sites. This shift enables myosin heads to attach to actin filaments, leading to the crossbridge cycling fundamental for muscle contraction. This process is crucial because, without calcium binding to troponin, the muscle fibers would remain in a relaxed state since the binding sites on actin would still be covered by tropomyosin, preventing interaction with myosin. Thus, calcium's role in this context is central to initiating the contraction process in muscle fibers.

9. Which of the following factors decreases Glomerular Filtration Rate (GFR)?

A. Increased renal blood flow

B. Efferent arteriolar constriction

C. Afferent arteriolar constriction

D. Increased mean arterial pressure (MAP)

Afferent arteriolar constriction leads to a decrease in glomerular filtration rate (GFR) because it reduces the blood flow into the glomeruli, which are the filtering units of the kidneys. When the afferent arterioles constrict, the resistance to inflow increases, causing less blood to enter the glomeruli. This reduction in blood flow results in a decreased hydrostatic pressure within the glomerular capillaries, which is essential for the process of filtration. In essence, GFR is influenced by the balance between the pressures in the glomerular capillaries and the tubular system. Any factor that reduces blood flow into the glomeruli, such as afferent arteriolar constriction, decreases the filtration pressure, thereby leading to a reduction in GFR. This principle is vital in understanding renal physiology, as the regulation of glomerular pressure is crucial for maintaining proper kidney function and homeostasis in bodily fluids.

10. Which valve separates the right atrium from the right ventricle?

A. Aortic valve

B. Pulmonary valve

C. Tricuspid valve

D. Mitral valve

The valve that separates the right atrium from the right ventricle is the tricuspid valve. This valve plays a crucial role in the heart's function by ensuring that blood flows in the correct direction during the cardiac cycle. When the right atrium contracts, the tricuspid valve opens, allowing deoxygenated blood to flow into the right ventricle. When the right ventricle contracts, the tricuspid valve closes to prevent blood from flowing back into the atrium, directing it instead into the pulmonary artery toward the lungs for oxygenation. In contrast, the aortic valve is located between the left ventricle and the aorta, playing a role in directing oxygenated blood out of the heart. The pulmonary valve, situated between the right ventricle and the pulmonary artery, controls blood flow from the heart to the lungs. The mitral valve separates the left atrium from the left ventricle, managing the flow of oxygen-rich blood from the lungs to the body. Understanding the specific roles of these valves helps in comprehending the overall functioning of the cardiac system.