



Physiology

OF THE CARDIOVASCULAR SYSTEM

I-Contractile mechanism in cardiac muscle

1. In which phase of the ventricular muscle action potential is the potassium permeability the highest?

- A) 0
- B) 1
- C) 2
- D) 3
- E) 4

2. Which of the following statements about cardiac muscle is most accurate?

- A) *The T-tubules of cardiac muscle can store much less calcium than T-tubules in skeletal muscle*
- B) *The strength and contraction of cardiac muscle depends on the amount of calcium surrounding cardiac myocytes*
- C) *In cardiac muscle the initiation of the action potential causes an immediate opening of slow calcium channels*
- D) *Cardiac muscle repolarization is caused by opening of sodium channels*
- E) *Mucopolysaccharides inside the T-tubules bind chloride ions*

3. Which of the following conditions will result in a dilated, flaccid heart?

- A) *Excess calcium ions in the blood* B) *Excess potassium ions in the blood*
- C) *Excess sodium ions in the blood*
- D) *Increased sympathetic stimulation*
- E) *Increased norepinephrine concentration in the blood*

4. A 25-year-old, well-conditioned athlete weighs 80 kg (176 lb). During maximal sympathetic stimulation, what is the plateau level of his cardiac output function curve?

- A) 3 L/min
- B) 5 L/min
- C) 10 L/min
- D) 13 L/min
- E) 25 L/min

5. Sympathetic stimulation of the heart

- A) Releases acetylcholine at the sympathetic endings
- B) Decreases sinus nodal discharge rate
- C) Decreases excitability of the heart
- D) Releases norepinephrine at the sympathetic endings
- E) Decreases cardiac contractility

6. Sympathetic stimulation of the heart normally causes which of the following conditions?

- A) Acetylcholine release at the sympathetic endings
- B) Decreased heart rate
- C) Decreased rate of conduction of the cardiac impulse
- D) Decreased force of contraction of the atria
- E) Increased force of contraction of the ventricles

7. According to cardiac muscle, Which one of the following separates cells from one another:

- A) *Intercalated disc*
- B) *Cytoplasm*
- C) *T tubules*
- D) *Sarcoplasmic reticulum*

8. In cardiac action potential, the plateau phase occurs when:

- A) *When sodium-calcium channels open*
- B) *When potassium channels open*
- C) *When sodium channels open*
- D) *None of the above*

9. Which one of the factors has a positive inotropic effect?

- A) *Acetylcholine*
- B) *Vagal stimulation*
- C) *Sympathetic stimulation*
- D) *Parasympathetic stimulation*

Answers:

Q1: D During phase 3 of the ventricular muscle action potential, the potassium permeability of ventricular muscle greatly increases, which causes a more negative membrane potential.

Q2: B The cardiac muscle stores much more calcium in its tubular system than skeletal muscle and is much more dependent on extracellular calcium than the skeletal muscle. An abundance of calcium is bound by the mucopolysaccharides inside the T-tubule. This calcium is necessary for contraction of cardiac muscle, and its strength of contraction depends on the calcium concentration surrounding the cardiac myocytes. At the initiation of the action potential, the fast sodium channels open first, followed later by the opening of the slow calcium channels.

Q3: B Excess potassium ions in the blood and extracellular fluid cause the heart to become dilated and flaccid as well as slowing the heart. This effect is important due to a more positive resting membrane potential in the cardiac muscle fibers. As the membrane potential becomes more positive, the intensity of the action potential decreases, which makes the contraction of the heart progressively weaker. Excess calcium ions in the blood and sympathetic stimulation and increased norepinephrine concentration of the blood all cause the heart to contract vigorously.

Q4: E The normal plateau level of the cardiac output function curve is 13 L/min. This level decreases in any kind of cardiac failure and increases markedly during sympathetic stimulation.

Q5: D Increased sympathetic stimulation of the heart increases heart rate, atrial contractility, and ventricular contractility and also increases norepinephrine release at the ventricular sympathetic nerve endings. It does not release acetylcholine. It does cause an increased sodium permeability of the A-V node, which increases the rate of upward drift of the membrane potential to the threshold level for self-excitation, thus increasing heart rate.

Q6: E Sympathetic stimulation of the heart normally causes an increased heart rate, increased rate of conduction of the cardiac impulse and increased force of contraction in the atria and ventricles. However, it does not cause acetylcholine release at the sympathetic endings because they contain norepinephrine. Parasympathetic stimulation causes acetylcholine release. The sympathetic nervous system firing increases the permeability of the cardiac muscle fibers, the S-A node, and the A-V node to sodium and calcium.

Q7: A

Q8: A

Q9: C