Amerman Active-Learning Workbook: Chapter 17 Answers

Key Concept: What are the key differences between the right side and left side of the heart?
Functionally, the right side of the heart pumps blood to the lungs (the pulmonary pump), whereas the left side of the heart pumps blood to the rest of the body (the systemic pump). The pressure generated is also higher on the left side due to the need to pump blood to the entire body.

Key Concept: How does the serous pericardium envelop the heart? What is its function?
The serous pericardium has two continuous layers: the parietal pericardium that is fused to the inner surface of the fibrous pericardium, and the visceral pericardium (aka epicardium) which lies directly on the heart as the most superficial layer of the heart wall.

Key Concept: What happens when blood flow through one or more of the coronary arteries is blocked? What can cause blockage of coronary arteries?
Because of anastomoses and collateral circulation, blockage of only one coronary artery may allow alternate routes of blood flow. However blockage of more and/or larger coronary arteries may cause myocardial infarction (MI), or heart attack. This often follows when plaques in the coronary arteries rupture and a clot forms that obstructs blood flow to the myocardium.

Key Concept: How is the right side of the heart different structurally from the left side? Why?
The right ventricle is wider and has thinner walls than the left ventricle. This is because of the pressure differences in the pulmonary and systemic circuits; the right ventricle has less resistance to overcome, and the left ventricle pumps against much greater resistance. Also, the right ventricle is shorter and crescent-shaped in cross-section.

Key Concept: Why is it important to prevent backflow of blood in the heart? Which structures prevent backflow, and how do they function?
Blood flow through the heart must occur in only one direction so that deoxygenated blood goes to the pulmonary circuit and oxygenated blood goes to the systemic circuit. Valves with overlapping flaps close when pressure increases on one side such that blood cannot flow back where it came from.

Key Concept: Why can the heart continue beating even when the brain has ceased most of its functions?

Cardiac muscle has the property of autorhythmicity and it sets its own rhythm without a need for input from the nervous system. Specialized pacemaker cells generate action potentials that trigger the other cardiac muscle cells to contract.

Key Concept: What is the importance of the intercalated discs to heart function? Why do skeletal muscle fibers lack intercalated discs?
Intercalated discs join pacemaker cells to contractile cells, and join contractile cells to one another. They contain gap junctions which provide for electrical synapses between cells for easy spread of action potentials.

Key Concept: What causes the plateau phase of the contractile cardiac cell action potential? Why is the plateau phase so important to the electrophysiology of the heart?
Calcium ion channels open and Ca^{++} enters as K^{+} exits, prolonging the depolarization. These calcium ion channels are also slow to close, which allows the plateau phase to last much longer than the initial depolarization phase. The plateau phase lengthens the cardiac action potential to about 200–300 msec, which slows the heart rate, providing the time required for the heart to fill with blood.

Key Concept: Why is there a delay at the AV node? What would happen if the delay were too short? What would happen if it were too long?
The AV node delay allows extra time for the action potential to spread from the SA node to the AV bundle, which allows the atria to depolarize (and contract) before the ventricles. This gives the ventricles time to fill with blood before they contract. Too long a delay might allow time for the atria to start to relax and pull blood back in their direction before the ventricles could contract and force closure of the AV valves.

Key Concept: What part of the heart has an anomaly if the P wave is abnormal on an ECG? Explain.
The P wave represents the depolarization of the cells within the atria (except the SA node). So, P wave anomalies would point to atrial abnormalities such as atrial fibrillation.

Key Concept: How do pressure gradients drive blood flow through the heart? How do pressure gradients influence the functioning of the heart valves?
Contraction of the heart muscle increases pressure in the chambers. Blood fills the heart when pressure is low during relaxation (diastole), and blood moves from ventricles to the great arteries

during contraction (systole). High pressure in the ventricles during systole causes blood flow that pushes the semilunar valves open (and causes the AV valves to close). Higher pressure from the blood in the ventricles closes the semilunar valves during diastole.

Key Concept: You notice that a patient has QRS waveforms on his ECG, indicating that his ventricles are undergoing electrical activity. Does this finding always mean that a heart is actually pumping blood? Explain.

In the normal functioning of the heart, electrical activity in the ventricles should lead to a physical contraction. However, pumping blood is most directly related to pressure-volume changes, so there can be electrical activity with no heartbeat.

Key Concept: If a person has a stroke volume of 55 ml and a heart rate of 80 beats per minute, what is his or her cardiac output? Is this a normal value? If not, how is it abnormal?

The person would have a cardiac output of 4400 ml/min (4.4 liters/min). Although this is a little lower than the 5+ liters/min often considered average, there are numerous normal factors that affect cardiac output (e.g. body temperature, gender, size), as well as abnormal factors (e.g. high blood pressure, reduced stroke volume) which could account for this value.

Complete It: Factors that Influence Stroke Volume

Fill in the blanks to complete the following paragraphs that describe the factors that influence stroke volume.

The preload refers to the amount a ventricular cell is stretched before contracting. Generally, as it increases, stroke volume also increases due to a phenomenon known as the Frank- Starling law. This law states that cells contract forcefully when their sarcomeres are stretched prior to contraction. One of the major determinants of preload is venous return, or the amount of blood veins deliver to the heart.

The heart's contractility is its inherent ability to pump. As this increases, the stroke volume also increases and the end-systolic decreases volume.

A final factor that influences stroke volume is afterload, which is the force against which the heart must pump. It is largely determined by the pressure of the circuit. When afterload increases, stroke volume generally decreases and end-systolic volume increases.

Key Concept: Does a high ESV signify a high stroke volume or a low stroke volume? What could cause a high ESV, and what would this do to cardiac output?

A high ESV signifies a low stroke volume, as less blood was ejected, and more remains in the ventricles at the end of systole. High blood pressure is one factor that could causes this, and it would reduce cardiac output.

Key Concept: Why does left ventricular failure cause pulmonary congestion and edema? Why do both right and left ventricular failure cause peripheral edema?

In left ventricular failure, pulmonary edema may follow as blood backs up in the pulmonary circuit, increasing pulmonary vessel pressure, and driving fluid out of the pulmonary capillaries and into the lungs. Similarly right and left ventricular failure may cause peripheral edema, in which blood backs up in the systemic capillaries, forcing fluid out of the capillaries and into the tissues.