Amerman Active-Learning Workbook: Chapter 18 Answers

Key Concept: Why is it important that a vessel be able to stretch? Which structures allow a vessel to stretch? What prevents it from overstretching?
The extra blood and increased pressure brought to vessels during systole is handled without damaging them by the ability to stretch. Elastic fibers in the tunica intima (internal elastic lamina) and the tunica media (external elastic lamina) allow a vessel to stretch. The collagenous connective tissue of the tunica externa prevents it from overstretching.

Key Concept: Why is a greater percentage of blood found in veins? Why is this important?
There are typically more veins than arteries, and their lumens have a larger average diameter. This allows veins to function as blood reservoirs, which allows blood to be diverted from the veins to other parts of the body when necessary.

Key Concept: How does the heart drive blood through the blood vessels?
The heart produces a pressure gradient that drives blood from the area of higher pressure near the heart to the area of lower pressure in the peripheral vasculature.

Complete It: Blood Flow

Fill in the blanks to complete the following paragraphs that describe properties of blood flow.
Blood pressure is the outward force the blood exerts on the wall of the blood vessels. The magnitude of this gradient is one factor that determines blood flow, which is the volume of blood that flows per minute. In general, this value matches the cardiac output of about 5–6 liters/min. The second factor that determines blood flow is resistance, which is any impedance to blood flow. Generally, as resistance increases, blood flow decreases.
The velocity with which blood flows is largely determined by the cross-sectional area of the blood vessel. As this area increases, the velocity of blood flow decreases.

Key Concept: What the three factors that determine blood pressure? How does each factor influence blood pressure?
The three factors that determine blood pressure are resistance, cardiac output, and blood volume. Each factor is directly proportional to blood pressure. When each factor (resistance, blood volume, and cardiac output) increases, blood pressure increases.

Key Concept: Why does venous blood need assistance in returning to the heart? What mechanisms are in place to assist in venous return?
Pressure drops to very low levels in venules and veins, making it difficult for blood to flow continuously back to the heart (especially in vessels that flow against gravity). Venous valves prevent backflow, smooth muscle constriction increases pressure, and the skeletal muscle pump and respiratory pump squeeze the blood in the veins and propel it toward the heart.

Key Concept: Which body systems are responsible for short-term maintenance of blood pressure? Which factors do these systems regulate?
Short-term control of blood pressure is accomplished by the autonomic nervous system and certain hormones of the endocrine system. Sympathetic neurons increase BP by increasing heart rate and cardiac output, and triggering vasoconstriction of arterioles. Parasympathetic neurons do the opposite. The hormones epinephrine, norepinephrine, and thyroid hormone increase cardiac output.

Key Concept: Why may someone temporarily lose consciousness when held in a choke hold?
Although there are several arteries that supply blood to the head region, reduction of blood flow through the common carotid arteries could cause a drop in blood pressure to the brain that could cause a sudden decrease in tissue perfusion leading to temporary loss of consciousness.

Key Concept: What is hypertension, and why is it dangerous? Why is hypotension also dangerous?
Hypertension or high blood pressure is a risk factor associated with coronary artery disease, stroke, heart failure, dementia, kidney disease, and vascular disease. *Severe* hypotension can lead to circulatory shock, in which there is insufficient blood pressure to deliver oxygen and nutrients to cells, which can result in loss of consciousness and organ failure.

Key Concept: Why is tissue perfusion tightly regulated?
Tissue perfusion is tightly regulated to ensure that the metabolic needs of all tissues are met at all times. Although this is particularly important for organs such as the brain and heart, all tissues would suffer death of cells without tight regulation.

Key Concept: How does the myogenic mechanism regulate local tissue perfusion?
The myogenic mechanism relies on properties of vascular smooth muscle cells in the arterioles supplying capillary beds such that their smooth muscle cells can contract without nervous system

stimulation. It slows blood flow by increasing resistance when arteriolar pressure rises, and speeds up blood flow by decreasing resistance when arteriolar pressure lowers.

Key Concept: A cell is actively metabolizing glucose and producing carbon dioxide and consuming oxygen at a high rate. What effect will this have on local arterioles?
An increase in carbon dioxide (which results in increased carbonic acid and hydrogen ions) and a low concentration of oxygen cause the smooth muscle cells of local arterioles to relax, dilating the arterioles ("metabolic controls"). This increases perfusion and brings extra oxygen and nutrients to the actively metabolizing cells.

Complete It: Tissue Perfusion in Special Circuits

Fill in the blanks to complete the following paragraphs that describe tissue perfusion in different circuits.

Perfusion to the tissues of the heart decreases during systole and increases during diastole. Perfusion to the heart increases dramatically during strenuous activity due to a low level of oxygen in the interstitial fluid, which triggers vasodilation.

Blood flow to the brain is maintained nearly constantly at 750 ml/min; however, perfusion to areas of the brain varies with activity.

The increase in blood flow to skeletal muscle during exercise is called hyperemia. When exercise begins, the terminal arterioles dilate, which triggers the arterioles to dilate, which finally triggers the feed arteries to dilate.

Perfusion to the skin is regulated by the sympathetic nervous system as part of the body's temperature regulation physiology.

Key Concept: What is hydrostatic pressure? In which direction does hydrostatic pressure push fluid in a capillary bed?
Hydrostatic pressure is the force that a fluid exerts on the wall of its container, or in this case, blood pressure pushing on the capillaries. This pressure on the capillary walls drives water out of the capillary and into the interstitial fluid.

Key Concept: What is osmotic pressure? In which direction does osmotic pressure push or pull fluid in a capillary bed?
Osmotic pressure is the pressure that causes movement of water from a solution with a lower solute concentration to one with a higher solute concentration. In part because of its higher protein and solute concentration, osmotic pressure of the blood pulls water into the capillary.

Key Concept: What are the four divisions of the aorta? How does the last division of the aorta end, and what structures do these vessels supply?

The four divisions of the aorta are the ascending aorta, aortic arch, descending thoracic aorta, and descending abdominal aorta. The descending abdominal aorta branches at its end to produce the right and left common iliac arteries.

Key Concept: What is the importance of the cerebral arterial circle?

The arteries of the cerebral arterial circle are an anastomosis of vessels that stabilize systemic arterial pressure and provide collateral circulation that allows blood to continue flowing to the brain even if blood flow through one of the brain's major arteries is disrupted.

Key Concept: Why do arteries pulsate?

The pressure gradient generated by the heart rises during ventricular systole and declines during ventricular diastole, producing two separate pressures in the arteries (systolic pressure and diastolic pressure).

Key Concept: How is the venous drainage of the brain different from other structures in the body?

Rather than draining into larger and larger veins as occurs in most structures in the body, the veins of the brain drain into large venous channels in the meninges called the dural sinuses. In addition to blood, these dural sinuses receive cerebrospinal fluid from the meninges.

Key Concept: Where does the blood from most of the abdominal organs go before it enters the inferior vena cava? Why?

Most of the veins from the abdominal organs drain into a large vein that enters the liver, called the hepatic portal vein. This hepatic portal vein branches in the liver to form another set of capillary beds which allow liver cells to perform metabolic and detoxification functions on the blood from the digestive system (which typically contains nutrients and toxins).