CHAPTER 15 READING QUESTIONS

These reading questions are designed to help you focus your reading on the most important points in the chapter. They are arranged using chapter section headers so that the file can be easily edited to reflect the material covered in class.

1. If blood flow through the systemic circulation is 5 L/min, what is blood flow through the pulmonary circulation?

15.1 THE BLOOD VESSELS

2. Diagram the layered composition of blood vessel walls. (Fig. 15.2)

Blood Vessels Contain Vascular Smooth Muscle

3. Contraction of vascular smooth muscle causes _____, or a narrowing of vessel diameter. Relaxation of vascular smooth muscle causes an increase in vessel diameter, or _____.

4. What is muscle tone? What factors can influence it?

Arteries and Arterioles Carry Blood Away from the Heart

5. Describe the physical characteristics of the aorta and major arteries. (Fig. 15.2)

6. Blood flow from arteries to arterioles is best described as _____ (divergent or convergent?).

7. Describe the key characteristic of arterioles.

8. How do metarterioles differ from arterioles? What is the function of metarterioles? (Fig. 15.3)

9. What vessels make up the microcirculation?

Exchange Takes Place in the Capillaries

10. Describe the structure of capillary walls. How does capillary wall structure relate to capillary function? What are pericytes?

Blood Flow Converges in the Venules and Veins

11. Compare the walls of veins with those of arteries. (Figs. 15.2, 15.4)

Angiogenesis Creates New Blood Vessels

12. Define angiogenesis. Compare angiogenesis in children and in adults.

13. If we can find a way to stop angiogenesis, why might this become useful in treating cancer?

14. In coronary artery disease, what happens to the arteries? Why would a drug that stimulates angiogenesis be useful for treating this condition?

15.2 Blood Pressure

15. What property of artery walls plays a key role in the ability of arteries to sustain the driving pressure created by the heart? (Fig. 15.5)

Blood Pressure Is Highest in the Arteries and Lowest in the Veins

16. Why does blood pressure decrease as blood flows through the circulatory system? (Fig. 15.5)

17. Define systolic pressure and diastolic pressure. Provide average aortic systolic and diastolic values (with units). (Fig. 15.6)

18. True or false: The pulse is created by a wave of blood flowing through the arteries. Defend your answer.

19. What is pulse pressure and how do you calculate it?

20. How can low-pressure venous blood in the feet flow uphill against gravity to get back to the heart? (Fig. 15.4)

Arterial Blood Pressure Reflects the Driving Pressure for Blood Flow

21. Explain mean arterial pressure (MAP). What formula is used to determine MAP?

22. What kinds of problems might result when blood pressure is too low? Too high?

Blood Pressure Is Estimated by Sphygmomanometry

23. Explain how a sphygmomanometer and Korotkoff sounds can be used to estimate arterial pressure of the radial artery. (Fig. 15.7)

24. Explain a blood pressure of 100/70.

Cardiac Output and Peripheral Resistance Determine Mean Arterial Pressure

25. Write the mathematical expression that relates MAP to cardiac output and resistance.

26. If blood flow into the arteries increases but there is no change in blood flow out of the arteries, MAP will _____ (increase or decrease?).

27. What happens to MAP if peripheral resistance increases?

28. Explain how the relative distribution of blood between the arterial and venous sides of the circulation can be an important factor in maintaining arterial blood pressure.

Changes in Blood Volume Affect Blood Pressure

29. If the volume of blood circulating through the system decreases, blood pressure _____ (increases or decreases?).

30. Which two systems of the body are responsible for homeostatic regulation of blood pressure? (Fig. 15.9)

31. True or false: If blood volume decreases, the kidneys can increase blood volume by reabsorbing water. Defend your answer.

32. Name two ways the cardiovascular system tries to compensate for a decrease in blood volume.

15.3 Resistance in the Arterioles

33. Write the mathematical expression for the relationship between radius (r) and resistance (R).

34. Which vessels are the main site of variable resistance in the systemic circulation? What property of these vessels permits them to change resistance?

35. What are the goals of local control of arteriolar resistance?

36. What are the goals of autonomic reflex control of arteriolar resistance?

37. What are the goals of hormonal control of arteriolar resistance?

Myogenic Autoregulation Adjusts Blood Flow

38. When blood pressure in an arteriole increases, myogenic autoregulation causes the arteriole to _____.

39. Diagram the mechanism of myogenic autoregulation.

Paracrine Signals Influence Vascular Smooth Muscle

40. Precapillary sphincters provide _____ control of blood flow.

41. Diagram the reflex pathway for active hyperemia. (Fig. 15.10a)

42. Diagram the reflex pathway for reactive hyperemia. (Fig. 15.10b)

The Sympathetic Branch Controls Most Vascular Smooth Muscle

43. Tonic norepinephrine release onto _____ receptors creates myogenic tone. Vasodilation is accomplished by _____ (increasing or decreasing?) release of norepinephrine.

44. List the types of catecholamine receptors and indicate their affinities for norepinephrine and epinephrine.

45. Fight-or-flight:
    a. vasodilation = epinephrine on _____ receptors (smooth muscle of heart, liver, skeletal muscle arterioles)
    b. vasoconstriction = epinephrine on _____ receptors (other arterioles)

15.4 Distribution of Blood to the Tissues

46. Why don't all tissues get equal blood flow at all times? At rest, which parts of the body receive most of the cardiac output? (Fig. 15.12)

47. At any given moment, the total blood flow through all arterioles of the body = _____.

48. Blood flow through individual arterioles depends on _____. (Fig. 15.13)

49. When blood flow decreases through one set of arterioles, where does that blood go?

15.5 Regulation of Cardiovascular Function

50. Where in the brain is the main integrating center for the regulation of cardiovascular function?

The Baroreceptor Reflex Controls Blood Pressure

51. Where are the two main receptors for blood pressure located? What is significant about these locations?

52. If you are monitoring the electrical activity of the sensory neurons linking these baroreceptors to the cardiovascular control center, would you observe any electrical activity when a person's blood pressure is in the normal range? Are these receptors tonic or phasic?

53. Create a map showing how the baroreceptor reflex would return homeostasis after a stimulus of increased blood pressure.

54. A decrease in blood pressure results in _____ (increased or decreased?) sympathetic activity and _____ (increased or decreased?) parasympathetic activity.

55. What effect will an increase in sympathetic activity have on heart rate, force of contraction, and arteriolar diameter?

56. What effect will an increase in parasympathetic activity have on heart rate, force of contraction, and arteriolar diameter?

Orthostatic Hypotension Triggers the Baroreceptor Reflex

57. What is orthostatic hypotension? Why does blood pressure initially fall when a person stands up after lying flat? (Fig. 15.14)

Other Systems Influence Cardiovascular Function

58. Give three examples of how other systems can influence cardiovascular function.

15.6 Exchange at the Capillaries

59. What determines capillary density in a tissue? Which tissues have the highest capillary density?

60. Compare the structure and function of continuous and fenestrated capillaries. (Fig. 15.16)

61. Which three tissues don't have traditional capillaries? What do they have? Why are these modified vessels necessary?

Velocity of Blood Flow Is Lowest in the Capillaries

62. Explain the relationship between total cross-sectional area and velocity of flow in the circulatory system. Specifically, how does the total cross-sectional area of capillaries compare to that of larger-diameter blood vessels, and what effect does this have on velocity in the different vessels? (Fig. 15.17)

Most Capillary Exchange Takes Place by Diffusion and Transcytosis

63. What types of exchange between the plasma and the interstitial fluid can take place at the capillary?

64. For substances that diffuse freely across capillary walls, what factor is most important for determining the rate of diffusion?

65. How do protein hormones and other essential proteins move out of the blood and into the interstitial fluid? (Fig. 15.16)

Capillary Filtration and Reabsorption Take Place by Bulk Flow

66. Define bulk flow.

67. Distinguish between filtration and absorption in capillaries.

68. What forces regulate capillary bulk flow?

69. What creates the osmotic pressure gradient between the plasma and the interstitial fluid? What is colloid osmotic pressure (π)?

70. Hydrostatic pressure pushes water _____ (into or out of?) capillaries. This pressure decreases along the length of the capillary as energy is lost to _____. (Fig. 15.18)

71. How is net fluid flow determined? Compare net fluid flow at the arterial end of a capillary with net fluid flow at the venous end. (Fig. 15.18)

72. Is filtration in capillaries exactly equal to absorption? Explain. (Fig. 15.18)

15.7 The Lymphatic System

73. Name the three systems with which the lymphatics interact, and briefly summarize the role of the lymphatics in each.

74. Compare the anatomy of the lymphatic system to that of the circulatory system. (Figs. 15.18a, 15.19)

75. Bulk flow moves fluid, proteins, and bacteria _____ (into or out of?) lymph capillaries.

76. What is lymph? What are lymph nodes? (Fig. 15.19)

77. Where does lymph rejoin the blood?

78. Name the factors that influence fluid flow through the lymphatics. (Does the lymph system have a pump like the heart?)

Edema Results from Alterations in Capillary Exchange

79. Outline the mechanisms underlying the two typical causes of edema.

15.8 Cardiovascular Disease

Risk Factors Include Smoking and Obesity

80. List uncontrollable risk factors for cardiovascular disease.

81. List controllable risk factors for cardiovascular disease.

82. Explain how blood elevated lipids and diabetes mellitus have both an uncontrollable genetic component and a modifiable lifestyle component.

Atherosclerosis Is an Inflammatory Process

83. What is atherosclerosis? Why is it considered an inflammatory process?

84. Define and contrast LDL-C with HDL-C. At normal levels, what is the function of LDL-C?

85. Outline the process of atherosclerotic plaque development. (Fig. 15.21)

86. Compare stable plaques and vulnerable plaques, and describe their role in cardiovascular disease.

87. Briefly describe how a blood clot can lead to myocardial infarction, arrhythmia, and potentially cardiac arrest or death.

Hypertension Represents a Failure of Homeostasis

88. Hypertension means chronically elevated blood pressure, with systolic pressures greater than _____ mm Hg or diastolic pressures greater than _____ mm Hg.

For every 20/10 mm Hg increase in blood pressure over a baseline of 115/75, the risk for CVD _____. (Fig. 15.22)

89. Differentiate between essential (primary) hypertension and secondary hypertension.

90. Explain why we say that hypertension represents failure of homeostasis.

91. How does hypertension contribute to atherosclerosis?

92. Why does high arterial blood pressure put additional strain on the heart?

93. How do you explain the fact that stroke volume remains constant in hypertensive patients?

94. What is congestive heart failure? How does it arise, and what are its effects on the body?

95. List some of the common treatments for hypertension.