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Vascular System: Arteries, Veins, Capillaries & Regulation

Exam — Vascular System

Pre-med/IB-level practice on vessel anatomy (tunics, valves, compliance), artery vs vein function, capillary types and exchange, portal systems (hepatic and pituitary), and regulation of vascular tone (autonomic, endothelial and hormonal control).

60 items — Printable Exam

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1 Which structural feature most directly allows arteries to withstand and maintain higher pressures than veins?

- A** A larger lumen diameter that reduces pressure
- B** A thicker tunica media with more smooth muscle and elastic tissue
- C** A one-cell-thick wall optimized for diffusion
- D** Numerous one-way valves along their length
- E** Fenestrations that allow proteins to pass through the wall



2 Valves that prevent backflow of blood are most characteristic of:

- A** Elastic arteries (e.g., aorta)
- B** Arterioles
- C** Capillaries
- D** Medium and large veins, especially in the limbs
- E** Pulmonary arteries only



3 Which vessels contribute the most to total peripheral resistance (TPR) in the systemic circulation?

- A** Aorta
- B** Large veins
- C** Arterioles
- D** Capillaries
- E** Venules





4 At rest, the greatest fraction of blood volume is found in the:



- A Aorta and elastic arteries
- B Systemic veins and venules
- C Arterioles
- D Capillaries
- E Pulmonary arteries

5 Which statement about oxygen content and vessel type is correct in an adult?



- A All arteries carry oxygenated blood and all veins carry deoxygenated blood
- B Pulmonary arteries carry oxygenated blood from the lungs to the heart
- C Pulmonary veins carry deoxygenated blood from the heart to the lungs
- D Systemic veins always have higher oxygen content than systemic arteries
- E Pulmonary veins generally carry oxygenated blood to the left atrium

6 A vessel that carries blood away from the heart is classified as an artery even if the blood is deoxygenated. Which example best illustrates this rule?



- A Pulmonary artery leaving the right ventricle
- B Pulmonary vein entering the left atrium
- C Superior vena cava entering the right atrium
- D Hepatic vein leaving the liver
- E Coronary vein leaving the myocardium





7 The main functional advantage of elastic arteries (e.g., the aorta) is that they:



- A** Contain valves that prevent backflow during diastole
- B** Are the main site of nutrient and gas exchange
- C** Stretch during systole and recoil during diastole to smooth blood flow and maintain diastolic pressure
- D** Generate action potentials to coordinate heartbeat
- E** Have the highest resistance to slow blood flow

8 In the systemic circulation, blood pressure is highest in the:



- A** Aorta
- B** Large veins
- C** Capillaries
- D** Venules
- E** Vena cava

9 The greatest drop in blood pressure in the systemic circulation occurs across the:



- A** Aorta
- B** Large arteries
- C** Capillaries
- D** Arterioles





E Large veins

10 Blood flow velocity is lowest in the:



- A Aorta
- B Arterioles
- C Capillaries
- D Large veins
- E Pulmonary artery

11 Blood velocity decreases dramatically from arteries to capillaries mainly because:



- A Capillaries have the highest pressure
- B The total cross-sectional area of capillaries is very large
- C Capillaries have valves that slow flow
- D Blood becomes more viscous in capillaries
- E Capillaries actively pump blood forward

12 Compared with arteries, veins generally have a thinner tunica media. In many veins, the most prominent layer is the:



- A Tunica intima only
- B Endothelium + basement membrane only





- C Tunica media only
- D Elastic lamina only
- E Tunica externa (adventitia)

13 Veins are often called 'capacitance' vessels primarily because they:



- A Have the highest resistance in the circulation
- B Always carry oxygenated blood
- C Act as the main exchange surface for gases
- D Can store large volumes of blood with relatively small changes in pressure
- E Contain pacemaker cells that control heart rate

14 Large arteries (e.g., aorta) contain vasa vasorum mainly because:



- A They need valves to prevent backflow
- B Diffusion of oxygen/nutrients from the lumen is insufficient to supply the outer wall layers
- C They must exchange glucose directly with tissues like capillaries
- D They have no endothelium so must be supplied externally
- E They are always surrounded by skeletal muscle that consumes oxygen

15 Which capillary type has large gaps that can allow proteins (and sometimes cells) to pass and is common in liver and bone marrow?





- A Sinusoidal (discontinuous) capillaries
- B Continuous capillaries
- C Fenestrated capillaries
- D Arterioles
- E Lymphatic capillaries only

16 Fenestrated capillaries are especially common where rapid filtration/absorption occurs, such as in the:



- A Skeletal muscle
- B Brain (blood–brain barrier)
- C Kidney glomeruli
- D Aorta
- E Large veins of the leg

17 Continuous capillaries with tight junctions are most associated with tissues requiring controlled exchange, such as the:



- A Liver
- B Brain (blood–brain barrier)
- C Bone marrow
- D Kidney glomerulus
- E Splenic red pulp





18 A portal system is best defined as:



- A** A single artery that branches into many capillaries and then returns directly to the heart
- B** A direct artery-to-vein connection that bypasses capillaries
- C** Any vein that carries blood back to the heart
- D** Blood flowing from one capillary bed to a second capillary bed before returning to the heart
- E** Any circulation that includes both arteries and veins

19 The hepatic portal system is important because it:



- A** Delivers nutrient-rich blood from the gastrointestinal tract to the liver for processing before it enters systemic circulation
- B** Carries oxygenated blood from the liver to the intestines
- C** Bypasses the liver so nutrients reach the heart faster
- D** Is the only route for blood to reach the kidneys
- E** Carries lymph directly into the portal vein

20 The hypothalamic–hypophyseal (pituitary) portal system is especially useful because it:



- A** Carries oxygenated blood to the brain
- B** Allows the posterior pituitary to release insulin directly into the liver
- C** Delivers hypothalamic releasing hormones to the anterior pituitary at high concentration without systemic dilution
- D** Prevents any hormones from reaching the pituitary
- E** Connects the pituitary directly to the right ventricle





21 Medium-sized muscular arteries are sometimes called 'distributing arteries' because they primarily:



- A Perform gas exchange with tissues
- B Deliver blood to specific organs and can adjust regional flow by changing diameter
- C Store the largest fraction of blood volume
- D Generate the greatest pressure drop in the circulation
- E Contain valves to prevent backflow during standing

22 Which statement correctly compares elastic arteries and muscular arteries?



- A Elastic arteries have more smooth muscle than muscular arteries
- B Muscular arteries are closest to the heart and mainly buffer pulse pressure
- C Elastic arteries are the main site of nutrient exchange
- D Elastic arteries have more elastin and help smooth pulsatile flow; muscular arteries have more smooth muscle and regulate distribution to organs
- E Both types are identical; the names only reflect location

23 Nitric oxide (NO) released by endothelial cells causes vasodilation mainly by:



- A Directly opening voltage-gated Na⁺ channels in smooth muscle
- B Increasing intracellular Ca²⁺ in smooth muscle
- C Activating actin–myosin cross-bridges in smooth muscle
- D Blocking oxygen delivery to tissues
- E Diffusing into smooth muscle and increasing cGMP, which promotes relaxation





24 Endothelin is best described as a molecule that:



- A** Is released by red blood cells to increase oxygen delivery by vasodilation
- B** Is produced by endothelium and is a potent vasoconstrictor
- C** Is a valve-like structure inside veins
- D** Always causes vasodilation in all tissues
- E** Only exists in capillaries and never affects arterioles

25 In most systemic arterioles, sympathetic release of norepinephrine (NE) primarily causes:



- A** Vasoconstriction via α_1 receptors, increasing resistance
- B** Vasodilation via α_2 receptors, decreasing resistance
- C** No change because arterioles lack receptors
- D** Opening of venous valves
- E** Direct increase in blood viscosity

26 During a stress response, epinephrine can increase blood flow to skeletal muscle despite overall sympathetic activation. The best explanation is:



- A** Epinephrine only binds receptors in veins, not arteries
- B** Skeletal muscle arterioles have no smooth muscle so they cannot constrict
- C** β_2 receptors in skeletal muscle arterioles can mediate vasodilation (especially at lower epinephrine levels)
- D** α_1 receptors in skeletal muscle arterioles always cause vasoconstriction





- E Epinephrine decreases cardiac output, lowering resistance everywhere

27 During intense exercise, why is blood flow to active skeletal muscle able to rise even though sympathetic tone is increased?



- A Sympathetic nerves stop firing during exercise
- B Arterioles in active muscle have valves that open wider
- C Oxygenated blood becomes less viscous, reducing resistance everywhere
- D Local metabolic factors (e.g., CO₂, H⁺, adenosine, K⁺) cause strong vasodilation that can override sympathetic vasoconstriction in active regions
- E Active muscle switches from arteries to veins for oxygen delivery

28 The myogenic response of arterioles refers to the tendency of vascular smooth muscle to:



- A Dilate whenever oxygen levels fall, regardless of pressure
- B Constrict in response to increased stretch (pressure), helping stabilize blood flow
- C Stop contracting when sympathetic nerves fire
- D Only respond to hormones, not physical forces
- E Contract only in veins, not arteries

29 Flow-mediated dilation (FMD) is most directly triggered by:



- A Increased shear stress on endothelial cells leading to NO release





- B Decreased blood viscosity causing smooth muscle to contract
- C Valve closure in veins
- D A sudden fall in hematocrit
- E Increased oxygen binding to hemoglobin

30 According to Poiseuille's relationship (all else equal), if an arteriole's radius is reduced to half its original value, its resistance will:



- A Decrease by a factor of 2
- B Decrease by a factor of 4
- C Increase by a factor of 4
- D Increase by a factor of 8
- E Increase by a factor of 16

31 Constriction of arterioles feeding a capillary bed would most directly tend to:



- A Increase capillary hydrostatic pressure and increase filtration
- B Decrease capillary hydrostatic pressure and reduce filtration
- C Increase venous oxygen content immediately
- D Increase the number of venous valves
- E Convert continuous capillaries into fenestrated capillaries





32 Sympathetic venoconstriction (constriction of veins) would most directly:



- A** Decrease venous return by trapping blood in capillaries
- B** Decrease cardiac preload by increasing venous compliance
- C** Increase venous return by reducing venous capacitance (compliance) and pushing blood toward the heart
- D** Lower total peripheral resistance dramatically
- E** Stop blood flow in arteries

33 How do venous valves and skeletal muscle contractions work together to improve venous return from the legs?



- A** Valves open only during expiration to pull blood upward
- B** Muscles squeeze arteries only; veins are unaffected
- C** Valves force blood to move away from the heart
- D** Muscle contraction compresses veins; valves prevent backflow so blood is pushed toward the heart
- E** Valves increase capillary exchange by creating turbulence

34 The respiratory pump increases venous return during inspiration mainly because:



- A** Thoracic pressure falls while abdominal pressure rises, promoting flow of venous blood toward the thorax
- B** Thoracic pressure rises and pushes blood back into the abdomen
- C** Veins actively contract in response to lung expansion
- D** Arteries collapse during inspiration, forcing blood into veins
- E** Capillaries double in number during inspiration





35 Varicose veins in the legs are most directly related to:



- A Excessive thickness of the tunica media in veins
- B An abnormally high pressure in the aorta only
- C Overproduction of red blood cells
- D Complete closure of venous valves preventing any flow
- E Failure of venous valves leading to pooling and vein dilation

36 Compared with the systemic circulation, the pulmonary circulation normally has:



- A Higher arterial pressure and higher resistance
- B Lower arterial pressure and lower resistance
- C Higher arterial pressure but lower resistance
- D Lower arterial pressure but higher resistance
- E The same pressure and resistance

37 Which statement correctly compares the effect of hypoxia on systemic versus pulmonary arterioles?



- A Hypoxia causes vasoconstriction in both systemic and pulmonary arterioles
- B Hypoxia causes vasodilation in both systemic and pulmonary arterioles
- C Hypoxia generally causes systemic vasodilation but pulmonary vasoconstriction
- D Hypoxia has no effect on vascular tone





E Hypoxia causes systemic vasoconstriction but pulmonary vasodilation

38 Angiotensin II tends to increase arterial blood pressure primarily by:



- A Causing vasodilation and decreasing blood volume
- B Blocking sympathetic activity at the heart
- C Directly increasing red blood cell production within minutes
- D Causing vasoconstriction and stimulating aldosterone release (which increases Na^+ and water retention)
- E Opening venous valves to prevent pooling

39 Aldosterone increases blood pressure mainly by:



- A Direct vasodilation of arterioles
- B Increasing Na^+ reabsorption (and therefore water retention), raising blood volume
- C Destroying red blood cells to reduce viscosity
- D Closing the hepatic portal vein
- E Inhibiting the release of ADH

40 ADH (vasopressin) can contribute to an increase in blood pressure by:



- A Increasing glucose uptake into skeletal muscle
- B Breaking down hemoglobin in red blood cells





- C Blocking all sympathetic nerve activity
- D Causing vasodilation in all arterioles
- E Promoting water reabsorption in the kidneys and (at higher levels) vasoconstriction

41 Atrial natriuretic peptide (ANP) tends to:



- A Lower blood pressure by promoting Na^+ excretion (natriuresis) and reducing blood volume; it also opposes the RAAS
- B Raise blood pressure by increasing angiotensin II levels
- C Cause strong vasoconstriction of arterioles
- D Increase red blood cell count to improve oxygen delivery
- E Stop filtration in capillaries

42 Histamine released during an allergic response most directly causes which vascular effects in the affected area?



- A Vasoconstriction and decreased capillary permeability
- B No vascular changes; only nerves are affected
- C Decreased blood flow due to arteriolar spasm and no swelling
- D Vasodilation and increased capillary permeability, contributing to redness and swelling
- E Permanent closure of venous valves

43 Bradykinin is best associated with which effect in many tissues?





- A Potent vasoconstriction to increase blood pressure instantly
- B Vasodilation and increased vascular permeability during inflammation
- C Direct stimulation of oxygen binding to hemoglobin
- D Closure of arteriovenous shunts in skin to conserve heat
- E Conversion of veins into arteries by thickening the tunica media

44 A sudden drop in arterial blood pressure activates the baroreceptor reflex. Which vascular change is most expected?



- A Decreased sympathetic tone causing widespread vasodilation
- B Increased parasympathetic tone causing arteriolar dilation throughout the body
- C Increased sympathetic tone causing arteriolar vasoconstriction to raise total peripheral resistance
- D Immediate increase in capillary fenestrations to raise blood volume
- E Permanent closure of the hepatic portal system

45 Pulse pressure is most directly determined by the combination of:



- A Stroke volume and arterial compliance
- B Blood glucose and insulin levels
- C Capillary permeability and lymph flow
- D Venous valve number and venous oxygen content
- E Hemoglobin saturation and RBC count





46 If large arteries become less compliant (stiffer) with age, which change is most likely?



- A** Lower systolic pressure and narrower pulse pressure
- B** Lower diastolic pressure and narrower pulse pressure
- C** Higher diastolic pressure only, with unchanged systolic pressure
- D** Higher systolic pressure and wider pulse pressure
- E** Complete disappearance of pulse waves in arteries

47 Mean arterial pressure (MAP) is best approximated by which relationship?



- A** $\text{MAP} = \text{Heart rate} \times \text{Blood viscosity}$
- B** $\text{MAP} = \text{Cardiac output} \times \text{Total peripheral resistance}$
- C** $\text{MAP} = \text{Venous return} \times \text{Capillary permeability}$
- D** $\text{MAP} = \text{Stroke volume} \div \text{Arterial radius}$
- E** $\text{MAP} = \text{Oxygen saturation} \times \text{Hemoglobin concentration}$

48 If cardiac output stays constant, which change would most directly increase mean arterial pressure (MAP)?



- A** Decreased arteriolar radius (vasodilation)
- B** Increased venous compliance
- C** Decreased blood viscosity to zero
- D** Opening more capillary beds to increase total cross-sectional area
- E** Increased arteriolar vasoconstriction (higher TPR)





49 Capillaries are especially suited for exchange mainly because they:



- A** Have thick smooth muscle layers to pump blood
- B** Contain valves that slow blood for diffusion
- C** Have very thin walls (a single endothelial layer) minimizing diffusion distance
- D** Have the highest blood pressure to force substances across
- E** Have the greatest amount of elastin to store energy

50 Most white blood cells (leukocytes) leave the bloodstream to enter tissues primarily through:



- A** Elastic arteries
- B** Postcapillary venules
- C** Capillaries of the aorta
- D** Large veins near the heart
- E** Arterioles only

51 At the arterial end of a typical systemic capillary, net fluid movement is most likely to be:



- A** Out of the capillary into the interstitial space (filtration)
- B** Into the capillary from the interstitial space (reabsorption)
- C** Zero because no forces exist in capillaries
- D** From venules into arterioles directly
- E** From lymph into capillaries only





52 The lymphatic system is essential in microcirculation mainly because it:



- A** Pumps blood from veins into arteries
- B** Directly oxygenates deoxygenated blood
- C** Prevents any filtration from capillaries
- D** Returns excess interstitial fluid and proteins to the bloodstream
- E** Creates the pressure drop across arterioles

53 A major reason low plasma albumin can cause edema is that it:



- A** Increases arterial compliance, raising systolic pressure
- B** Increases blood viscosity, slowing venous return
- C** Raises capillary hydrostatic pressure in arterioles
- D** Directly opens fenestrations in all capillaries
- E** Decreases plasma oncotic pressure, reducing reabsorption of fluid into capillaries

54 Standing still for a long time can cause ankle swelling mainly because gravity increases:



- A** Arterial oxygen content in the feet
- B** Venous pressure in the legs, raising capillary hydrostatic pressure and filtration
- C** Plasma protein concentration in the legs, raising oncotic pressure
- D** Valve number in leg veins
- E** Heart rate variability





55 Compared with arteries, veins are more likely to collapse when external pressure is applied because veins generally have:



- A** Lower internal pressure and thinner walls
- B** Higher internal pressure and thicker walls
- C** More elastin and higher recoil force
- D** More smooth muscle and stronger contraction
- E** A complete absence of endothelium

56 Which change would most directly increase capillary hydrostatic pressure in a tissue (promoting filtration), all else equal?



- A** Constriction of the upstream arteriole
- B** Increased plasma albumin concentration
- C** Increased lymphatic drainage
- D** Dilation of the upstream arteriole
- E** Decreased venous pressure

57 Precapillary sphincters and local arterioles tend to dilate most directly in response to:



- A** High local oxygen and low CO₂
- B** High local blood pressure only
- C** Low local oxygen and/or high local CO₂/H⁺ (metabolic demand signals)
- D** Closure of venous valves





- E High plasma albumin

58 Arteriovenous anastomoses (AV shunts) in the skin are particularly important for:



- A Increasing filtration in kidney glomeruli
- B Producing red blood cells
- C Converting venous blood into arterial blood
- D Maintaining the hepatic portal system
- E Thermoregulation by diverting blood away from or toward surface capillaries

59 Blood in the hepatic portal vein is typically best described as:



- A Oxygen-rich and nutrient-poor
- B Nutrient-rich and relatively oxygen-poor compared with systemic arterial blood
- C Identical in composition to blood in the aorta
- D Free of any absorbed drugs or toxins
- E Purely lymph with no red blood cells

60 Which sequence correctly describes blood flow through the hepatic portal system (starting from nutrient absorption in the gut)?



- A Gut capillaries → hepatic veins → liver sinusoids → hepatic portal vein → inferior vena cava
- B Gut capillaries → inferior vena cava → hepatic portal vein → liver sinusoids → hepatic veins





- C** Gut capillaries → hepatic portal vein → liver sinusoids → hepatic veins → inferior vena cava
- D** Gut capillaries → aorta → hepatic portal vein → liver sinusoids → pulmonary veins
- E** Gut capillaries → lymphatic vessels → hepatic portal vein → liver sinusoids → aorta







#	Ans	Answer Text
	B	
2	D	Medium and large veins, especially in the limbs
	C	
4	B	Systemic veins and venules
	E	
6	A	Pulmonary artery leaving the right ventricle
	C	
8	A	Aorta
	D	
10	C	Capillaries
	B	
12	E	Tunica externa (adventitia)
	D	
14	B	Diffusion of oxygen/nutrients from the lumen is insufficient to supply t...
	A	
16	C	Kidney glomeruli
	B	
18	D	Blood flowing from one capillary bed to a second capillary bed before re...
	A	
20	C	Delivers hypothalamic releasing hormones to the anterior pituitary at hi...
	B	
22	D	Elastic arteries have more elastin and help smooth pulsatile flow; muscu...
	E	
24	B	Is produced by endothelium and is a potent vasoconstrictor
	A	
26	C	2 receptors in skeletal muscle arterioles can mediate vasodilation (esp...
	D	
28	B	Constrict in response to increased stretch (pressure), helping stabilize...
	A	
30	E	Increase by a factor of 16
	B	
32	C	Increase venous return by reducing venous capacitance (compliance) and p...
	D	
34	A	Thoracic pressure falls while abdominal pressure rises, promoting flow o...
	E	
36	B	Lower arterial pressure and lower resistance
	C	
38	D	Causing vasoconstriction and stimulating aldosterone release (which incr...



