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Gradients, Osmotic & Oncotic Pressure

Exam — Cell Membrane

Comprehensive Pre-med style questions on gradients, osmotic and oncotic pressure, Starling forces, and physiological examples (edema, capillaries, IV fluids).

28 items — Printable Exam

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1 In physiology, a gradient is best defined as:

A Any difference in size between two cells

B A difference in the value of a variable (such as concentration or pressure) between two points, often across a membrane

C A constant level of a substance throughout a tissue

D The total amount of a substance in the body

E The rate at which a membrane protein works

2 An electrochemical gradient across a cell membrane for an ion consists of:

A Only the concentration difference for that ion

B Only the electrical potential difference across the membrane

C The sum of a chemical (concentration) gradient and an electrical gradient

D The difference in water concentration across the membrane

E The difference in plasma protein concentration between blood and interstitium

3 Osmotic pressure of a solution is best defined as:

A The hydrostatic pressure generated by the heart to drive blood flow

B The pressure that must be applied to a solution to prevent net movement of water across a semipermeable membrane

C The force required to push ions through an open channel

D The pressure inside a cell due to cytoskeletal tension

E The total pressure exerted by blood in arteries

4 **Which property of a solute most strongly determines its contribution to osmotic pressure of a solution?**

- A Its molecular weight
- B Its chemical nature (for example, glucose versus NaCl)
- C The number of dissolved particles it produces per unit volume
- D Its ability to cross the plasma membrane rapidly
- E Its colour and taste

5 **Which statement best distinguishes osmolarity from tonicity of a solution?**

- A Osmolarity describes only impermeant solutes; tonicity describes all solutes
- B Osmolarity describes the total number of solute particles; tonicity describes the effect of a solution on cell volume
- C Osmolarity is measured only inside cells; tonicity only outside cells
- D They are identical terms and interchangeable
- E Osmolarity is expressed as a percentage, whereas tonicity is not

6 **A red blood cell is placed in a solution containing 300 mOsm of urea. Urea is freely permeable across the RBC membrane. Which outcome is most likely after equilibrium is reached?**

- A The solution is isotonic; the cell retains its normal volume
- B The solution is hypertonic; the cell shrinks and crenates
- C The solution is initially iso-osmotic but effectively hypotonic; the cell swells and may lyse
- D The solution is hypotonic; the cell immediately shrinks

E No water movement occurs because only urea moves

7 A red blood cell is placed in 0.9 percent NaCl solution (about 300 mOsm). What happens to the cell?

A It swells and bursts

B It shrinks and crenates

C It maintains its normal volume and shape

D It loses only Na^+ but not water

E It gains K^+ and loses Na^+

8 A patient receives a large intravenous infusion of isotonic saline (0.9 percent NaCl). Which statement best describes the immediate effect on body fluid compartments?

A Both extracellular and intracellular volumes increase equally

B Extracellular volume increases; intracellular volume is largely unchanged

C Intracellular volume increases; extracellular volume decreases

D Total body osmolarity decreases, causing cells to swell

E Total body osmolarity increases, causing cells to shrink

9 A patient receives an intravenous infusion of a hypertonic saline solution. What is the immediate effect on cell volume and plasma osmolarity?

A Cell volume increases; plasma osmolarity decreases

B Cell volume decreases; plasma osmolarity increases

C Both cell volume and plasma osmolarity decrease

D Cell volume and plasma osmolarity are unchanged

E Cell volume increases; plasma osmolarity remains constant

10 Oncotic (colloid osmotic) pressure of plasma is mainly generated by:

A Glucose

B Na^+ and Cl— ions

C Plasma proteins, especially albumin

D Dissolved oxygen and carbon dioxide

E Cholesterol in cell membranes

11 Which statement best distinguishes total osmotic pressure from oncotic pressure in capillaries?

A Osmotic pressure is due only to proteins; oncotic pressure is due only to ions

B Osmotic pressure includes all solute particles; oncotic pressure refers specifically to the contribution of plasma proteins

C Osmotic pressure is irrelevant for water movement; only oncotic pressure matters

D Oncotic pressure is always larger than osmotic pressure

E They are identical terms in physiology

12 **At the arterial end of a typical systemic capillary, which Starling forces usually cause NET filtration of fluid OUT of the capillary?**

- A Capillary hydrostatic pressure is low; plasma oncotic pressure is high
- B Capillary hydrostatic pressure exceeds plasma oncotic pressure
- C Plasma oncotic pressure exceeds capillary hydrostatic pressure
- D Interstitial hydrostatic pressure is always greater than capillary hydrostatic pressure
- E Interstitial oncotic pressure dominates and pulls fluid into capillaries

13 **At the venous end of a typical systemic capillary, which statement is generally TRUE in classic Starling physiology?**

- A Capillary hydrostatic pressure is still much higher than oncotic pressure, so filtration is maximal
- B Capillary hydrostatic pressure falls below plasma oncotic pressure, favouring reabsorption of fluid
- C Both hydrostatic and oncotic pressures fall to zero
- D Plasma oncotic pressure becomes negligible
- E Interstitial oncotic pressure becomes higher than plasma oncotic pressure

14 **Which change would most clearly INCREASE net filtration of fluid out of systemic capillaries into the interstitial space?**

- A Decreased capillary hydrostatic pressure
- B Increased plasma oncotic (colloid osmotic) pressure
- C Increased capillary hydrostatic pressure, for example due to venous congestion
- D Decreased capillary permeability to water
- E Increased lymphatic drainage

15 **Peripheral edema in a patient with severe liver cirrhosis is largely due to:**

- A Increased plasma albumin concentration
- B Reduced plasma albumin leading to decreased plasma oncotic pressure
- C Reduced capillary permeability to water
- D Marked decrease in capillary hydrostatic pressure
- E Excessive lymphatic drainage

16 **A patient with right-sided heart failure develops ankle edema. Which mechanism best explains this finding in terms of Starling forces?**

- A Decreased capillary hydrostatic pressure in the legs
- B Increased venous and capillary hydrostatic pressure in the lower limbs
- C Increased plasma oncotic pressure due to hemoconcentration
- D Reduced lymphatic capillary permeability
- E Primary increase in interstitial oncotic pressure due to more plasma proteins

17 **Lymphatic vessels help prevent edema primarily by:**

- A Increasing capillary hydrostatic pressure
- B Returning excess filtered interstitial fluid and proteins back to the circulation
- C Producing plasma proteins such as albumin
- D Blocking plasma filtration at the arterial end of capillaries
- E Reducing intracellular fluid volume

18 **A patient with nephrotic syndrome loses large amounts of albumin in the urine. Which combination of changes would you most expect in the capillary–interstitial fluid exchange?**

- A Increased plasma oncotic pressure and reduced filtration
- B Decreased plasma oncotic pressure and increased net filtration into tissues
- C Increased capillary hydrostatic pressure and decreased filtration
- D No change in Starling forces
- E Increased interstitial hydrostatic pressure and reduced edema

19 **Intravenous infusion of concentrated albumin solution in a patient with hypoalbuminaemic edema is expected to:**

- A Decrease plasma oncotic pressure and worsen edema
- B Increase plasma oncotic pressure and draw water from the interstitial space into the vascular compartment
- C Directly lower capillary hydrostatic pressure
- D Prevent further lymph drainage
- E Only expand intracellular volume

20 **Mannitol, an osmotic diuretic, is sometimes given intravenously to reduce cerebral edema. Its main mechanism is to:**

- A Lower plasma osmolarity so water leaves blood and enters brain tissue
- B Increase plasma osmolarity, drawing water from brain interstitial and intracellular spaces into the blood

C Increase plasma oncotic pressure by acting like a plasma protein

D Decrease capillary hydrostatic pressure in the brain

E Act as a primary active transporter of Na^+ out of neurons

21 A patient with severe hyperglycaemia (very high blood glucose) is most likely to have which immediate effect on body water distribution?

A Decreased extracellular osmolarity, causing cells to swell

B Increased extracellular osmolarity, causing water to leave cells and making them shrink

C Decreased intracellular osmolarity, causing water to enter cells

D No osmotic effect because glucose is osmotically inactive

E Immediate equilibration of glucose across cell membranes with no water shift

22 In the pulmonary circulation, left-sided heart failure commonly leads to pulmonary edema because:

A Pulmonary capillary hydrostatic pressure falls below oncotic pressure

B Pulmonary capillary hydrostatic pressure increases, favouring filtration into lung interstitium and alveoli

C Plasma oncotic pressure increases markedly

D Lymphatic drainage from lungs becomes excessive

E Alveolar epithelium becomes completely impermeable to water

23 **Which statement best describes the main driving force for O2 diffusion from alveolar air into pulmonary capillary blood?**

- A A gradient in total gas pressure between alveoli and blood
- B A gradient in oxygen partial pressure between alveoli and blood
- C A gradient in nitrogen partial pressure
- D A gradient in blood hydrostatic pressure
- E A gradient in plasma oncotic pressure

24 **In a typical neuron at rest, the K^+ concentration is higher inside than outside, and the inside of the cell is negatively charged relative to the outside. How do these gradients influence K^+ movement if K^+ channels open?**

- A Both the chemical and electrical gradients drive K^+ inward
- B The chemical gradient drives K^+ outward, while the electrical gradient tends to pull K^+ inward
- C Both gradients drive K^+ outward
- D Neither gradient acts on K^+ because it is uncharged
- E The gradients cancel completely, so K^+ never moves

25 **Which situation is most likely to cause cellular swelling due to osmotic water movement?**

- A Infusion of large volumes of isotonic saline
- B Acute ingestion of large volumes of pure water without solutes
- C Infusion of hypertonic saline
- D Loss of water without solute (for example, sweating without replacement)
- E Increase in plasma oncotic pressure due to albumin infusion

26 **Which statement best describes Gibbs–Donnan equilibrium across a semipermeable membrane separating two compartments when one side contains impermeant negatively charged proteins?**

- A All permeant ions distribute equally on both sides, regardless of charge
- B Permeant ions distribute unequally so that electroneutrality is maintained in each compartment, creating both electrical and osmotic gradients
- C Water cannot move across the membrane, so no osmotic gradient develops
- D Impermeant proteins cross the membrane to equalise charge
- E It has no relevance to real biological systems

27 **Which of the following changes would tend to REDUCE the tendency for edema formation in peripheral tissues?**

- A Marked increase in capillary hydrostatic pressure
- B Decrease in plasma oncotic pressure due to low albumin
- C Obstruction of lymphatic drainage
- D Decrease in capillary permeability to proteins and water
- E Increase in interstitial oncotic pressure due to protein leakage

28 **Which statement correctly links oncotic pressure and hydrostatic pressure in the context of capillary fluid exchange?**

- A Oncotic pressure pushes fluid out of capillaries; hydrostatic pressure pulls fluid in
- B Both oncotic and hydrostatic pressures always push fluid out of capillaries
- C Capillary hydrostatic pressure tends to push fluid out, whereas plasma oncotic pressure tends

to pull fluid into capillaries

- D Neither oncotic nor hydrostatic pressures affect fluid exchange
- E Hydrostatic pressure is constant along the capillary, while oncotic pressure changes rapidly

#	Ans	Answer Text
	B	
2	C	The sum of a chemical (concentration) gradient and an electrical gradien...
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4	C	The number of dissolved particles it produces per unit volume
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8	B	Extracellular volume increases; intracellular volume is largely unchange...
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