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RAAS & ADH: Blood Pressure and Osmoregulation

Exam — Renal Physiology

Conceptual Pre-med/IB-style questions on the renin–angiotensin–aldosterone system (RAAS) and antidiuretic hormone (ADH): why these systems exist, what triggers them, how they amplify signals, how they change urine composition, and how they interact during dehydration, hemorrhage, salt/water loads, and common physiology-style scenarios.

50 items — Printable Exam

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1 Which change most directly stimulates renin release from juxtaglomerular (JG) cells?

- A** Increased stretch/pressure in the afferent arteriole wall
- B** Decreased stretch/pressure in the afferent arteriole wall
- C** Increased NaCl delivery to the macula densa
- D** Increased angiotensin II levels
- E** Increased atrial stretch (high venous return)



2 Renin is best described as:

- A** A steroid hormone that enters nuclei to change transcription
- B** An enzyme that converts angiotensinogen into angiotensin I
- C** An enzyme that converts angiotensin I into angiotensin II
- D** A channel that inserts aquaporins into membranes
- E** A hormone secreted by the posterior pituitary



3 Angiotensin-converting enzyme (ACE) most directly catalyzes:

- A** Angiotensin II → aldosterone
- B** Angiotensinogen → angiotensin I
- C** Angiotensin I → angiotensin II
- D** Renin → angiotensin I
- E** ADH → aldosterone





4 Severe liver failure would most directly reduce which RAAS component, lowering the body's ability to generate angiotensin II?



- A Renin production
- B Angiotensinogen production
- C ACE production
- D Aldosterone receptor production
- E ADH synthesis

5 Which is NOT a typical effect of angiotensin II?



- A Vasoconstriction that increases blood pressure
- B Stimulation of aldosterone secretion
- C Stimulation of thirst and ADH release
- D Decreased Na^+ reabsorption in the proximal tubule
- E Constriction of the efferent arteriole in the kidney

6 During low renal perfusion, angiotensin II helps maintain GFR primarily by causing:



- A Dilation of the efferent arteriole
- B Constriction of the efferent arteriole
- C Constriction of the afferent arteriole
- D Closure of Bowman's capsule
- E Immediate destruction of the filtration barrier





7 Aldosterone is secreted primarily by the:



- A Posterior pituitary
- B Zona glomerulosa of the adrenal cortex
- C Adrenal medulla
- D Pancreatic alpha cells
- E Kidney collecting duct cells

8 In principal cells of the late distal tubule/collecting duct, aldosterone most directly increases:



- A Water permeability by inserting aquaporin-2 channels
- B Na^+ reabsorption and K^+ secretion
- C Glucose reabsorption via SGLT transporters
- D Urea secretion into the tubule lumen
- E Ca^{2+} reabsorption as the primary effect

9 Which stimulus can increase aldosterone secretion even if renin is low?



- A Low plasma K^+
- B High plasma K^+
- C Low plasma osmolality
- D High atrial stretch (high blood volume)
- E Low blood glucose





10 ADH is synthesized in the _____ and released from the _____.



- A Posterior pituitary; anterior pituitary
- B Hypothalamus; posterior pituitary
- C Kidney cortex; adrenal medulla
- D Liver; pancreas
- E Thyroid; parathyroid

11 ADH increases water reabsorption most directly by acting on the _____ to insert _____ into the membrane.



- A Proximal tubule; SGLT2
- B Collecting duct principal cells; aquaporin-2
- C Thick ascending limb; $\text{Na}^+/\text{K}^+ / 2\text{Cl}^-$ cotransporter
- D Glomerulus; collagen pores
- E Macula densa; chloride channels

12 If ADH levels rise (and the kidney responds normally), what happens to urine volume and urine osmolality?



- A Urine volume increases; urine osmolality decreases
- B Urine volume decreases; urine osmolality increases
- C Both urine volume and urine osmolality increase
- D Both urine volume and urine osmolality decrease





- E Neither changes in any situation

13 Which pairing is most accurate?



- A Aldosterone primarily retains water without solute; ADH primarily retains sodium
- B Aldosterone primarily increases Na^+ reabsorption; ADH primarily increases water reabsorption
- C Both primarily increase K^+ retention
- D Both directly increase glucose reabsorption
- E ADH is a steroid; aldosterone is a peptide hormone

14 Which statement best explains why the body benefits from having both RAAS and ADH systems?



- A RAAS regulates body temperature; ADH regulates red blood cell count
- B RAAS mainly defends extracellular volume/blood pressure via Na^+ retention and vasoconstriction; ADH mainly defends plasma osmolality via water retention
- C They do the exact same job; two systems exist only by accident
- D RAAS works only in embryos; ADH works only in adults
- E ADH is used only for digestion; RAAS only for vision

15 After heavy sweating with no water intake (sweat is hypotonic compared with plasma), which change is most likely?



- A Renin decreases and ADH decreases





- B Renin increases and ADH increases
- C Renin increases and ADH decreases
- D Renin decreases and ADH increases
- E Neither renin nor ADH changes

16 A person loses a large volume of blood quickly. Plasma osmolality initially stays near normal. Which response is most likely in the first minutes?



- A ADH decreases because osmolality is unchanged
- B Both RAAS and ADH increase because low effective circulating volume activates baroreceptor pathways
- C Only aldosterone rises immediately within seconds; renin does not change
- D Renin decreases because blood volume decreased
- E The kidney increases urine output to replace lost blood

17 After rapidly drinking several liters of water, which hormone pattern is most expected?



- A ADH increases; renin increases
- B ADH decreases; renin decreases
- C ADH decreases; renin increases
- D ADH increases; renin decreases
- E Both remain unchanged because kidneys do not respond to water intake





18 A patient receives a hypertonic saline infusion (saltier than plasma). Immediately after, which hormone pattern is most likely?



- A** ADH increases; renin increases
- B** ADH increases; renin decreases
- C** ADH decreases; renin increases
- D** ADH decreases; renin decreases
- E** Neither changes because saline is not a hormone

19 Infusion of isotonic saline (same osmolality as plasma) would most likely cause:



- A** Renin increases; ADH increases
- B** Renin decreases; ADH decreases
- C** Renin increases; ADH decreases
- D** Renin decreases; ADH increases
- E** Renin unchanged; ADH unchanged

20 Renin is released from specialized cells in the wall of the:



- A** Efferent arteriole
- B** Afferent arteriole (juxtaglomerular cells)
- C** Glomerular capillaries
- D** Proximal tubule
- E** Collecting duct





21 The macula densa contributes to RAAS activation primarily by sensing:



- A Blood glucose concentration in the afferent arteriole
- B NaCl concentration in the distal tubule fluid
- C Oxygen concentration in the renal vein
- D ADH concentration in plasma
- E Albumin concentration in urine

22 Which sequence correctly represents the core RAAS pathway?



- A Angiotensin II —renin→ angiotensin I —ACE→ angiotensinogen —→ aldosterone
- B Angiotensinogen —renin→ angiotensin I —ACE→ angiotensin II —stimulates→ aldosterone
- C Aldosterone —ACE→ angiotensin II —renin→ angiotensinogen
- D ADH —renin→ aldosterone —ACE→ angiotensin I
- E Angiotensinogen —ACE→ angiotensin II —renin→ angiotensin I —→ aldosterone

23 Which response occurs fastest after a sudden drop in blood pressure: angiotensin II vasoconstriction or aldosterone-driven Na⁺ retention?



- A Aldosterone-driven Na⁺ retention is fastest (seconds); angiotensin II is slower (hours)
- B Angiotensin II vasoconstriction is fast (minutes); aldosterone effects are slower (hours to days)
- C Both are equally slow because they require new kidney growth
- D Neither changes because blood pressure is controlled only by the brain
- E Aldosterone is fastest because it is an ion channel





24 ADH increases water permeability in the collecting duct by binding a receptor that activates cAMP. This receptor is best classified as a:



- A** Ligand-gated ion channel
- B** G-protein-coupled receptor (GPCR)
- C** Receptor tyrosine kinase
- D** Intracellular nuclear receptor
- E** Voltage-gated sodium channel

25 Aldosterone mainly acts by binding to an intracellular receptor and changing gene transcription. This receptor is best classified as a:



- A** Ligand-gated ion channel
- B** GPCR
- C** Receptor tyrosine kinase
- D** Intracellular nuclear receptor
- E** Aquaporin channel

26 If ADH remains high for a prolonged period and the person has access to water (can drink normally), the most likely direction of plasma osmolality is:



- A** Increase
- B** Decrease
- C** No change is possible
- D** Become infinite





- E Switch randomly between high and low each minute

27 Which hormone is most likely to increase extracellular fluid volume with minimal direct change in plasma osmolality (by promoting Na^+ retention so water follows)?



- A ADH
- B Aldosterone
- C Glucagon
- D Insulin
- E Thyroxine

28 Constriction of the efferent arteriole by angiotensin II can promote proximal tubular reabsorption partly because it:



- A Decreases peritubular capillary oncotic pressure
- B Increases filtration fraction, raising peritubular capillary oncotic pressure and favoring reabsorption
- C Eliminates the medullary osmotic gradient
- D Directly inserts aquaporin-2 into proximal tubule membranes
- E Stops GFR completely in all cases

29 After RAAS raises blood pressure/volume, renin secretion falls. This is an example of:





- A Positive feedback
- B Negative feedback
- C Independent assortment
- D Transduction
- E Lysogenic conversion

30 Atrial natriuretic peptide (ANP) is released when the atria are stretched by high blood volume. Which effect best opposes RAAS?



- A Increased renin release
- B Increased aldosterone secretion
- C Increased Na^+ excretion (natriuresis) and inhibition of renin/aldosterone
- D Increased thirst and salt appetite
- E Increased angiotensin II production

31 If aldosterone levels are abnormally high, which change is most expected?



- A Decreased Na^+ reabsorption in the collecting duct
- B Decreased K^+ secretion in the collecting duct
- C Increased Na^+ reabsorption and increased K^+ excretion
- D Increased glucose excretion by blocking SGLT
- E Complete prevention of water reabsorption even if ADH is high





32 A tumor secretes aldosterone independently of normal control. Which hormone pattern best fits (before treatment)?



- A** Aldosterone high; renin high
- B** Aldosterone high; renin low
- C** Aldosterone low; renin high
- D** Aldosterone low; renin low
- E** Both always remain normal due to homeostasis

33 If the adrenal cortex cannot produce aldosterone (primary aldosterone deficiency), what happens to renin release from the kidney?



- A** Renin decreases because aldosterone is low
- B** Renin increases because volume/pressure tends to fall without aldosterone
- C** Renin becomes permanently zero in all cases
- D** Renin increases only if plasma osmolality is low
- E** Renin has no relationship to aldosterone or volume

34 A person produces very large volumes of dilute urine, and blood tests show high plasma osmolality. Which hormone problem best explains this pattern?



- A** Excess aldosterone
- B** Low ADH (central diabetes insipidus pattern)
- C** Excess ANP
- D** Low insulin
- E** Excess glucagon





35 Two patients have polyuria and dilute urine. Patient 1 has very low ADH; patient 2 has high ADH. Which interpretation is most consistent?



- A** Patient 1 has nephrogenic DI; patient 2 has central DI
- B** Patient 1 has central DI; patient 2 has nephrogenic DI
- C** Both must have SIADH
- D** Both must have excess aldosterone
- E** ADH levels cannot be used to interpret urine dilution

36 Excess ADH (SIADH-like physiology) is most likely to cause which combination?



- A** High plasma osmolality + very dilute urine + high urine volume
- B** Low plasma osmolality + concentrated urine + low urine volume
- C** Low plasma osmolality + dilute urine + high urine volume
- D** High plasma osmolality + concentrated urine + high urine volume
- E** No change in either plasma osmolality or urine concentration

37 After drinking alcohol, a person urinates frequently and becomes thirsty. The most direct hormonal explanation is that alcohol typically:



- A** Increases ADH release, concentrating urine
- B** Decreases ADH release, reducing collecting duct water permeability
- C** Increases aldosterone release, causing immediate diuresis
- D** Blocks renin release, causing concentrated urine





- E Turns aquaporins into sodium channels

38 Which brain region contains key osmoreceptors that help regulate ADH release in response to plasma osmolality?



- A Cerebellum
- B Hypothalamus
- C Occipital lobe
- D Spinal cord
- E Medulla oblongata (as the primary osmolality sensor)

39 Which situation is most likely to cause high ADH even if plasma osmolality is low (dilute)?



- A Drinking a large amount of water rapidly
- B Receiving an isotonic saline infusion
- C Severe hemorrhage (major drop in blood volume/pressure)
- D Eating a low-salt meal
- E Spending time at room temperature in a resting state

40 During sympathetic activation (stress, low blood pressure), renin release is increased mainly via which receptor on JG cells?



- A 1-adrenergic receptor





- B 1-adrenergic receptor
- C 2-adrenergic receptor
- D Muscarinic receptor
- E Nicotinic receptor

41 A person eats a very salty meal but drinks little water. Plasma osmolality rises before any major volume expansion. Which hormonal response is most immediate?



- A Renin increases strongly because salt intake triggers RAAS
- B ADH increases because higher osmolality stimulates osmoreceptors
- C Aldosterone increases because salt directly stimulates the adrenal cortex
- D ANP increases immediately because atria are stretched by salt
- E Both ADH and renin decrease immediately in all cases

42 Activation of RAAS generally leads to which urinary change (assuming kidneys function normally)?



- A Increased urinary sodium excretion (natriuresis)
- B Decreased urinary sodium excretion (sodium retention)
- C No change in sodium handling because RAAS affects only water
- D Increased glucose excretion as the main effect
- E Complete shutdown of filtration (GFR becomes zero)





43 ADH can concentrate urine only because the kidney already has a hyperosmotic medulla. Which nephron segment most directly creates this gradient by actively reabsorbing NaCl while being relatively impermeable to water?

- A** Descending limb of the loop of Henle
- B** Thick ascending limb of the loop of Henle
- C** Bowman's capsule
- D** Proximal tubule
- E** Glomerular capillary endothelium



44 Angiotensin II causes vasoconstriction by binding receptors on vascular smooth muscle. This receptor is most likely a:

- A** Nuclear receptor that binds DNA directly
- B** G-protein-coupled receptor (GPCR)
- C** Ligand-gated ion channel
- D** Receptor tyrosine kinase
- E** Voltage-gated calcium channel (as the receptor itself)



45 A drug blocks ACE, lowering angiotensin II. In a person whose kidney filtration pressure depends on angiotensin II, what effect may occur on glomerular pressure and GFR?

- A** Efferent arteriole constricts more, increasing glomerular pressure and GFR
- B** Efferent arteriole dilates, lowering glomerular pressure and potentially lowering GFR
- C** Afferent arteriole constricts, increasing GFR
- D** GFR always increases because ACE inhibitors increase renin





- E** There is no possible effect of angiotensin II on GFR

46 Which component provides an early amplification step in the RAAS cascade?



- A** One renin enzyme molecule can catalyze cleavage of many angiotensinogen molecules over time
- B** Aldosterone inserts aquaporin-2 channels directly
- C** Angiotensin II is stored in the kidney and released without enzymes
- D** Renin binds DNA to turn on aldosterone genes
- E** ADH is produced by the adrenal cortex as a steroid

47 Which hormone is most likely to raise blood pressure quickly with minimal immediate change in blood volume?



- A** Angiotensin II
- B** Aldosterone
- C** Erythropoietin
- D** Growth hormone
- E** Melatonin

48 Which statement best explains why aldosterone alone cannot create highly concentrated urine?



- A** Aldosterone acts only on the glomerulus and never on tubules





- B** Without ADH, collecting duct water permeability stays low, so water cannot be reabsorbed efficiently at the final step
- C** Aldosterone destroys the medullary gradient
- D** Aldosterone blocks Na^+ reabsorption, preventing any concentration
- E** Aldosterone is secreted by the posterior pituitary, so it cannot affect kidneys

49 A patient has polyuria with very dilute urine. After an injection of synthetic ADH, urine becomes much more concentrated. Which diagnosis is most consistent?



- A** Nephrogenic diabetes insipidus (kidney unresponsive to ADH)
- B** Central diabetes insipidus (not enough ADH produced/released)
- C** Excess aldosterone
- D** High ANP state
- E** Normal physiology; this is the expected response to any injection

50 A patient has ankle swelling (total body fluid increased) but low blood pressure and poor cardiac output. The kidney activates RAAS. What is the best explanation?



- A** RAAS responds directly to total body water volume, regardless of blood pressure
- B** RAAS responds to decreased effective arterial blood volume/renal perfusion, even if total body fluid is high
- C** RAAS is activated mainly by high plasma glucose
- D** RAAS activates only when plasma osmolality is high
- E** RAAS is activated by atrial stretch as its main trigger







#	Ans	Answer Text
1	B	Decreased stretch/pressure in the afferent arteriole wall
2	B	An enzyme that converts angiotensinogen into angiotensin I
3	C	Angiotensin I → angiotensin II
4	B	Angiotensinogen production
5	D	Decreased Na ⁺ reabsorption in the proximal tubule
6	B	Constriction of the efferent arteriole
7	B	Zona glomerulosa of the adrenal cortex
8	B	Na ⁺ reabsorption and K ⁺ secretion
9	B	High plasma K ⁺
10	B	Hypothalamus; posterior pituitary
11	B	Collecting duct principal cells; aquaporin-2
12	B	Urine volume decreases; urine osmolality increases
13	B	Aldosterone primarily increases Na ⁺ reabsorption; ADH primarily increase...
14	B	RAAS mainly defends extracellular volume/blood pressure via Na ⁺ retentio...
15	B	Renin increases and ADH increases
16	B	Both RAAS and ADH increase because low effective circulating volume acti...
17	B	ADH decreases; renin decreases
18	B	ADH increases; renin decreases
19	B	Renin decreases; ADH decreases
20	B	Afferent arteriole (juxtaglomerular cells)
21	B	NaCl concentration in the distal tubule fluid
22	B	Angiotensinogen —renin→ angiotensin I —ACE→ angiotensin II —stimulates→ ...
23	B	Angiotensin II vasoconstriction is fast (minutes); aldosterone effects a...
24	B	G-protein-coupled receptor (GPCR)
25	D	Intracellular nuclear receptor
26	B	Decrease
27	B	Aldosterone
28	B	Increases filtration fraction, raising peritubular capillary oncotic pre...
29	B	Negative feedback
30	C	Increased Na ⁺ excretion (natriuresis) and inhibition of renin/aldosteron...
31	C	Increased Na ⁺ reabsorption and increased K ⁺ excretion
32	B	Aldosterone high; renin low
33	B	Renin increases because volume/pressure tends to fall without aldosteron...
34	B	Low ADH (central diabetes insipidus pattern)
35	B	Patient 1 has central DI; patient 2 has nephrogenic DI
36	B	Low plasma osmolality + concentrated urine + low urine volume
37	B	Decreases ADH release, reducing collecting duct water permeability
38	B	Hypothalamus



