بسم الله الرحمن الرحيم

Test Bank - Source

'MID FINAL'

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4. A patient with cirrhosis experiences a doubling of his serum

creatinine over a 6-month period after sustained heavy ingestion of a nonsteroidal antiinflammatory drug (NSAID) for his arthritis. Which of the following is the best explanation for his increased serum creatinine?

A) Increased efferent arteriolar resistance which reduced glomerular filtration rate (GFR)

B) Decreased Bowman's capsule pressure which reduced GFR

C) Increased afferent arteriolar resistance which reduced GFR

D) Increased glomerular capillary filtration coefficient which reduced GFR

E) Increased renal prostaglandins due to the NSAID

F) Increased nitric oxide formation due to the NSAID

Ans: 4. C) A doubling of serum creatinine implies a reduction in glomerular filtration rate (GFR). Non-steroidal anti-inflammatory drugs (NSAIDS) inhibit prostaglandin synthesis, which would tend increase afferent arteriolar and reduce GFR.

5. Administration of empagliflozin, an inhibitor of sodium-glucose co-transporter 2 (SGLT2), would be expected to cause which of the following sets of changes compared with normal?

	GFR	Resistance Afferent Arteriole	Renal Blood Flow
A)	↔	↔	↔
B)	↔	↔	↓
C)	↓	↑	↓
D)	↓	↑	↔
E)	↓	↓	↓
F)	↑	↓	↑

ANS : 5. C) Inhibition of

sodium-glucose co-transporter 2 (SGLT2) would reduce glucose and sodium chloride reabsorption in the proximal tubules, causing increased sodium chloride delivery to the macula densa, which would, in turn, cause a feedback-mediated vasoconstriction of afferent arterioles and reductions in glomerular filtration rate and renal blood flow.

6. Given the following measurements, calculate the approximate

filtration fraction:

Glomerular capillary hydrostatic pressure = 60 mm Hg

Colloid osmotic pressure in the glomerular capillaries = 30 mm

Hg

Bowman's space hydrostatic pressure = 20 mm Hg

Glomerular capillary filtration coefficient (Kf) = 10 ml/min/mm

Hg

Renal plasma flow = 600 ml/min

Hematocrit = 0.4

A) 10 mm Hg

B) 100 ml/min

C) 0.100

D) 0.167

E) 0.200

F) 0.333

ans: 6. D) Filtration fraction (FF) = glomerular filtration rate (GFR)/renal plasma flow. GFR = Kf x (PG - ПС – PB) where Kf is the glomerular capillary filtration coefficient, PG is glomerular hydrostatic pressure, ПС is glomerular capillary colloid osmotic pressure, and PB is Bowman's space hydrostatic pressure. Therefore, GFR= 10 × (60 − 20 − 10) = 100 ml/min. Since renal plasma flow is 600 ml/min, FF= 100 ml/min/600 ml/min = 0.167.

7. Which of the following statements is incorrect?

A) Creatinine concentration in the urine is normally higher than in

the glomerular filtrate.

B) Urea concentration in the urine is normally higher than in the

glomerular filtrate.

C) The proximal tubules normally reabsorb almost all of the

glucose filtered by the glomerular capillaries.

D) hco3 concentration in the urine is normally higher than in the

glomerular filtrate.

E) Organic acids and bases are secreted mainly by the proximal

tubules.

F) Sodium concentration remains relatively constant as tubular

fluid flows along the proximal tubule.

Ans: 7. D) Bicarbonate is more avidly reabsorbed in the proximal tubules than water, and therefore concentration decreases along the proximal tubules and has a lower concentration in the urine than in the glomerular filtrate. Approximately 85% of the filtered load of is normally reabsorbed in the proximal tubules. All of the other statements are correct

8. A patient with diabetes mellitus has a glomerular filtration rate of 100 ml/min, a urine flow rate of 4.0 ml/min, and a urine glucose concentration of 2 mg/ml. If he has a kidney transport maximum for glucose of 200 mg/min, what would be his approximate rate of glucose excretion?

A) 0 mg/min

B) 8 mg/min

C) 100 mg/min

D) 180 mg/min

E) 300 mg/min

F) Urinary excretion rate of glucose cannot be determined from these data

ans: 8. B) With a glomerular filtration rate of 100 ml/min and a plasma glucose concentration of 4 mg/ml, the filtered load of glucose would be 400 mg/min. Since the transport maximum for glucose in this case is 200 mg/min, the maximum rate of glucose reabsorption is 200 mg/min. Glucose excreted rate is therefore the difference between the filtered load of glucose (400 mg/min) and the glucose reabsorption rate (200 mg/min), or 200 mg/min.

9. As tubular fluid passes along a juxtamedullary nephron of a person with severe central diabetes insipidus and essentially no antidiuretic hormone, where is the osmolarity lowest?

A) Bowman's capsule (glomerular filtrate)

B) Fluid leaving the proximal tubule and entering the loop of Henle

C) Fluid leaving the descending thin limb and entering the

ascending thin limb of the loop of Henle

D) Fluid leaving the thick ascending segment of the loop of Henle

and entering the early distal tubule

E) Fluid in the cortical collecting tubules

F) Fluid leaving the collecting ducts (urine)

Ans: 9. F) Fluid in the ascending loop of Henle becomes dilute as electrolytes are reabsorbed and water remains in the tubule. When antidiuretic hormone (ADH) levels are very low, as occurs in central diabetes insipidus, fluid in the distal and collecting tubules, and the collecting ducts is further diluted by the reabsorption of sodium chloride and the failure to reabsorb water. This lead to a very dilute urine (see figure below).

10. If GFR = 60 ml/min, urine flow rate = 2.0 ml/min, plasma K+

concentration = 4.0 mmol/l, and urine K+

concentration = 80 mmol/l,

what is the approximate rate of K+

excretion?

A) 0.08 mmol/min

B) 0.16 mmol/min

C) 0.32 mmol/min

D) 16 mmol/min

E) 160 mmol/min

F) Excretion rate of K+

cannot be determined from these data

ans: 10. B) Potassium excretion in this case is equal to urine concentration of K+ (80 mmol/l) multiplied by the urine flow rate (2.0 ml/min, or 0.002 l/min) which is 0.16 mmol/min.

11. If the glomerular filtration rate (GFR) of a patient is reduced to 50% of

normal and sustained at that level, you would expect to find

_____ renal creatinine excretion rate, _____ renal

creatinine clearance, and _____ serum creatinine concentration

6 weeks after the decrease in GFR compared with normal. Assume

steady-state conditions and that the patient has maintained the same

diet.

A) Decreased, decreased, increased

B) Decreased, no change, increased

C) No change, increased, increased

D) No change, no change, increased

E) No change, decreased, increased

F) Decreased, no change, decreased

Ans: 11. E) A 50% reduction in glomerular filtration rate (GFR) would initially cause a reduction in creatinine excretion rate. However, within a few days, the filtered load and excretion of creatinine would return to normal as serum creatinine concentration increased to approximately twice the normal level under steady-state conditions. Creatinine clearance is approximately equal to GFR and would also be reduced by approximately 50%

12. If glomerular filtration rate suddenly decreases by 50%, from 80

ml/min to 40 ml/min and tubular fluid reabsorption simultaneously

decreases from 78 ml/min to 40 ml/min, which of the following

changes in urinary excretion rate will occur (assuming that the

changes in GFR and tubular fluid reabsorption are maintained)?

A) Urine flow rate will decrease to zero

B) Urine flow rate will not change

C) Urine flow rate will decrease by 50%

D) Urine flow rate will increase by 50%

Ans: 12. A) Urine excretion rate is equal to glomerular filtration rate (GFR) minus tubular reabsorption rate. In this example, the final is 40 ml/min, and the tubular reabsorption rate is 40 ml/min. Therefore, the urine excretion rate is zero.

13. Calculate the approximate total renal plasma flow given the

following data:

Urine PAH concentration = 200 µg/ml

Urine flow rate = 2 ml/min

Arterial plasma paraaminohippuric acid (PAH) concentration =

1.0 µg/ml

Renal venous PAH concentration = 0.2 µg/ml

Hematocrit = 0.4

A) 120 ml/min

B) 200 ml/min

C) 400 ml/min

D) 500 ml/min

E) 667 ml/min

F) 833 ml/min

Ans: 13. D) Total renal plasma flow (RPF) is equal to the clearance of paraaminohippuric acid (PAH) divided by the renal PAH extraction ratio (EPAH). Clearance of PAH (CPAH) = (UPAH × V) / APAH = (200 µg/ml × 2 ml/min)/1.0 µg/ml = 400 ml/min (EPAH) = (APAH – VPAH)/APAH = (1.0 µg/ml − 0.2 µg/ml)/1.0 µg/ml = 0.8 RPF = 400 ml/min / 0.8 = 500 ml/min Where UPAH is urine PAH concentration, APAH is arterial PAH concentration, VPAH is renal venous PAH concentration, and V is urine flow rate.

14. Which of the following occurs in type A intercalated cells of the

collecting tubules?

A) Secretion of H+

, reabsorption of hco3, and reabsorption of K+

B) Secretion of H+

, reabsorption of hco3, and secretion of K+

C) Secretion of K+

, reabsorption of Na+

, and reabsorption of hco3

D) Reabsorption of H+

, secretion of , and secretion of K+

E) Reabsorption of H+

, secretion of hco3, and reabsorption of K+

Ans: 14. A) Type A intercalated cells of the collecting tubules secrete H+ by a hydrogen-ATPase transporter and by a hydrogen-potassium-ATPase transporter. They also reabsorb and K+ (see figure on next page).

16. Which of the following statements is incorrect?

A) Urea transporters UT-A1 and UTA-3 in the collecting ducts are

activated by antidiuretic hormone (ADH)

B) Urea reabsorption in the inner medullary collecting duct is

greater than in the distal tubule during dehydration

C) Increased ADH markedly increases urea reabsorption by the

cortical collecting tubule

D) The inner medullary collecting tubule reabsorbs more urea

during antidiuresis than the thick ascending limb of Henle's loop

E) The cortical collecting tubule is less permeable to urea than is

the inner medullary collecting duct during antidiuresis

F) Passive diffusion of urea into the thin loops of Henle is

facilitated by the urea transporter UT-A2

ans: 16. C) The cortical collecting tubule is relatively impermeable to urea, and very li

17. In a dehydrated person with normal kidneys and high ADH levels, which part of the nephron normally reabsorbs the smallest amount of water (see figure below of a renal tubule)?

Ans: 17. C) The thick ascending loop of Henle is relatively impermeable to water even in the presence of high levels of ADH. The other tubular segments reabsorb significant amounts of water.

18. Acute metabolic alkalosis tends to _____K+

secretion by the cortical

collecting tubules and _____ plasma K+

concentration.

A) decrease, decrease

B) decrease, increase

C) increase, increase

D) increase, decrease

E) cause no change in, increase

F) cause no change in, cause no change in

Ans: 18. D) Acute metabolic alkalosis tends to shift K+ from the extracellular fluid into the cells, including the renal tubular cells, contributing to increased K+ secretion and decreased plasma K+ concentration (hypokalemia).

19. Which of the following statements is incorrect?

A) Carbonic anhydrase inhibitors tend to cause metabolic acidosis.

B) Thiazide diuretics inhibit the Na-Cl co-transporter in the distal

tubules.

C) Osmotic diuretics tend to increase potassium secretion.

D) Aldosterone antagonists (e.g., spironolactone) tend to cause

hypokalemia.

E) Sodium channel blockers (e.g., amiloride) inhibit sodium

transport across the luminal membrane of the collecting tubules.

F) Loop diuretics (e.g., furosemide) tend to cause hypokalemia.

ans: 19. D) Aldosterone antagonists such as spironolactone tend to cause hyperkalemia rather than hypokalemia by shifting potassium from the intracellular to the extracellular fluid and by inhibiting potassium secretion in the principal cells of collecting tubules. All of the other statements are correct.

22. Atrial natriuretic peptide causes which of the following effects?

A) Reduced renal tubular sodium reabsorption

B) Reduced renin secretion

C) Increased renal sodium excretion

D) Only A and C

E) A, B, and C

Ans:e

23. If creatinine clearance = 100 ml/min, urine flow rate = 1.0 ml/min,

plasma Na+

concentration = 140 mmol/l, and urine Na+

concentration

= 80 mmol/l, what is the approximate rate of Na+

excretion?

A) 0.08 mmol/min

B) 0.16 mmol/min

C) 16 mmol/min

D) 160 mmol/min

E) Excretion rate of Na+

cannot be calculated from these data

ans:a

24. If a person maintains a high (150 mmol/day) potassium diet, which

part of the nephron would be expected to reabsorb the most

potassium? Choose the appropriate nephron site in the figure below.

Ans: 24. A) Approximately 65% of the filtered load of potassium is reabsorbed in the proximal tubule. Variations in renal excretion of potassium during change in potassium intake are achieved mainly by changes in potassium secretion in collecting tubules. With high potassium intake, the proximal tubule still reabsorbs a high fraction of the filtered load of potassium.

26. What is the theoretical maximum clearance rate possible for a

substance X that is freely filtered, actively secreted by the renal

tubules, and completely cleared from the plasma given the following

data?

Glomerular filtration rate = 100 ml/min

Plasma concentration of a substance X = 2 mg/ml

Urine flow= 5 ml/min

Renal plasma flow = 800 ml/min

A) 5 ml/min

B) 100 ml/min

C) 200 ml/min

D) 500 ml/min

E) 800 ml/min

F) 1000 ml/min

Ans: 26. E) Theoretically, if all of the plasma flowing through the kidneys was cleared of a substance, the clearance rate would be equal to the total renal plasma flow. In this example, renal plasma flow is equal to 800 ml/min.

29. A 36-year-old woman reports headaches and frequent urination.

Laboratory values reveal the following information.

Urine specific gravity = 1.003

Urine protein = negative

Plasma sodium (Na+) = 165 mmol/l

Plasma potassium (K+) = 4.4 mmol/l

Plasma creatinine = 1.4 mg/dl

Blood pressure = 88/40 mm Hg

Heart rate = 115 beats/min

What is the most likely cause of her elevated plasma Na+

concentration?

A) Primary aldosteronism

B) Diabetes mellitus

C) Diabetes insipidus

D) Simple dehydration caused by insufficient water intake and heavy

exercise

ans: 29. C) The hypernatremia (plasma Na+ = 165 mmol/l) associated with a low blood pressure (88/44 mm Hg) suggests dehydration. The frequent urination and low urine specific gravity (1.003, which implies a urine osmolarity of about 100-120 mOsm/l)

despite hypernatremia and dehydration suggests diabetes insipidus due to either insufficient secretion of ADH (central diabetes insipidus) or failure of the kidneys to respond to ADH (nephrogenic diabetes insipidus).

34. Which of the following tends to decrease potassium secretion by the

cortical collecting tubule?

A) Increased plasma potassium concentration

B) A diuretic that decreases proximal tubule sodium reabsorption

C) A diuretic that inhibits the action of aldosterone (e.g.,

spironolactone)

D) Acute alkalosis

E) High sodium intake

Ans:c

Use the following clinical laboratory test results to answer Questions 36

and 37.

Urine flow rate = 1 ml/min

Urine inulin concentration = 100 mg/ml

Plasma inulin concentration = 2 mg/ml

Urine urea concentration = 50 mg/ml

Plasma urea concentration = 2.5 mg/ml

36. What is the GFR?

A) 25 ml/min

B) 50 ml/min

C) 100 ml/min

D) 125 ml/min

E) None of the above

Ans: 36. B) GFR is equal to inulin clearance, which is calculated as the urine inulin concentration (100 mg/ml) × urine flow rate (1 ml/min)/plasma inulin concentration (2 mg/ml), which is equal to 50 ml/min.

37. What is the net urea reabsorption rate?

A) 0 mg/min

B) 25 mg/min

C) 50 mg/min

D) 75 mg/min

E) 100 mg/min

Ans: 37. D) The net urea reabsorption rate is equal to the filtered load of urea (GFR [50 ml/min] × plasma urea concentration [2.5 mg/ml]) − urinary excretion rate of urea (urine urea concentration [50 mg/ml] × urine flow rate [1 ml/min]). Therefore, net urea reabsorption = (50 ml/min × 2.5 mg/ml) − (50 mg/ml × 1 ml/min) = 75 mg/min.

38. In normal kidneys, which of the following is true of the osmolarity of

renal tubular fluid that flows through the early distal tubule in the

region of the macula densa?

A) Usually isotonic compared with plasma

B) Usually hypotonic compared with plasma

C) Usually hypertonic compared with plasma

D) Hypertonic, compared with plasma, in antidiuresis

Ans:b

39. Which of the following changes would be expected in a patient with diabetes insipidus due to a lack of ADH secretion, assuming free access to water and normal thirst mechanisms for controlling water intake?

Ans:c

	Plasma Osmolarity Concentration	Plasma Sodium Concentration	Plasma Renin Concentration	Urine Volume
A)	↔	↔	↓	↑
B)	↔	↔	↑	↑
C)	↑	↑	↑	↑
D)	↑	↑	↔	↔
E)	↓	↓	↓	↔

40. A 26-year-old woman recently decided to adopt a healthier diet and eat more fruits and vegetables. As a result, her potassium intake increased from 80 to 160 mmol/day. Which of the following conditions would you expect to find 2 weeks after she increased her potassium intake, compared with before the increase?

	Potassium Excretion Rate	Sodium Excretion Rate	Plasma Aldosterone Concentration	Plasma Potassium Concentration
A)	↔	↔	↑	Large increase (>1 mmol/l)
B)	↔	↓	↑	Small increase (<1 mmol/l)
C)	↑ 2×	↔	↑	Small increase (<1 mmol/l)
D)	↑ 2×	↑	↓	Large increase (>1 mmol/l)
E)	↑ 2×	↑	↔	Large increase (>1 mmol/l)

Ans:c

41. When the dietary intake of K+
increases, body K+
balance is
maintained by an increase in K+
excretion primarily by which of the
following?
A) Decreased glomerular filtration of K+
B) Decreased reabsorption of K+
by the proximal tubule
C) Decreased reabsorption of K+
by the thick ascending limb of the
loop of Henle
D) Increased K+

secretion by the late distal and collecting tubules

E) Shift of K+

into the intracellular compartment

ans:d

42. Which of the following would cause the greatest decrease in GFR in

a person with otherwise normal kidneys?

A) Decrease in renal arterial pressure from 100 to 80 mm Hg in a

normal kidney

B) 50% increase in glomerular capillary filtration coefficient

C) 50% increase in proximal tubular sodium reabsorption

D) 50% decrease in afferent arteriolar resistance

E) 50% decrease in efferent arteriolar resistance

F) 5 mm Hg decrease in Bowman's capsule pressure

Ans:e

ans: 44. C) In a patient with a very high rate of renin secretion, there would also be increased formation of angiotensin II, which in turn would stimulate aldosterone secretion.

44. A patient with severe hypertension (blood pressure 185/110 mm Hg) is referred to you. A renal magnetic resonance imaging scan shows a tumor in the kidney, and laboratory findings include a very high plasma renin activity of 12 ng angiotensin I/ml/h (normal = 1). The diagnosis is a renin-secreting tumor. Which of the following changes would you expect to find in this patient, under steady-state conditions, compared with normal?

	Plasma Aldosterone Concentration	Sodium Excretion Rate	Plasma Potassium Concentration	Renal Blood Flow
A)	↔	↓	↓	↑
B)	↔	↔	↓	↑
C)	↑	↔	↓	↓
D)	↑	↓	↔	↓
E)	↑	↓	↓	↔

The increased levels of angiotensin II and aldosterone would cause a transient decrease in sodium excretion, which would cause expansion of the extracellular fluid volume and increased arterial pressure. The increased arterial pressure, as well as other compensations, would return sodium excretion to normal so that intake and output are balanced. Therefore, under steady-state conditions, sodium excretion would be normal and equal to sodium intake. The increased aldosterone concentration would cause hypokalemia (decreased plasma potassium concentration), whereas the high level of angiotensin II would cause renal vasoconstriction and decreased renal blood flow.

45. The clinical laboratory returned the following values for arterial

blood taken from a patient: plasma pH = 7.28, plasma ,hco3=32

and plasma partial pressure of carbon dioxide (pco2) = 70 mm Hg.

What is this patient's acid-base disorder?

A) Acute respiratory acidosis without renal compensation

B) Respiratory acidosis with partial renal compensation

C) Acute metabolic acidosis without respiratory compensation

D) Metabolic acidosis with partial respiratory compensation

Ans:b

46. The following laboratory values were obtained in a 58-year-old man:

Urine volume = 4320 ml of urine collected during the preceding

24 hours

Plasma creatinine = 3 mg/100 ml

Urine creatinine = 50 mg/100 ml

Plasma potassium = 4.0 mmol/l

Urine potassium = 30 mmol/l

What is his approximate GFR, assuming that he collected all of his urine in the 24-hour period?

A) 20 ml/min

B) 30 ml/min

C) 40 ml/min

D) 50 ml/min

E) 60 ml/min

F) 80 ml/min

G) 100 ml/min

Ans:d

49. What would cause the greatest degree of hyperkalemia?

A) Increase in potassium intake from 60 to 180 mmol/day in a person with normal kidneys and a normal aldosterone system

B) Chronic treatment with a diuretic that inhibits the action of aldosterone

C) Decrease in sodium intake from 200 to 100 mmol/day

D) Chronic treatment with a diuretic that inhibits loop of Henle

Na+-2Cl – -K+

co-transport

E) Chronic treatment with a diuretic that inhibits sodium

reabsorption in the collecting ducts

ans:b

52. Which change tends to increase GFR?

A) Increased afferent arteriolar resistance

B) Decreased efferent arteriolar resistance

C) Increased glomerular capillary filtration coefficient

D) Increased Bowman's capsule hydrostatic pressure

E) Decreased glomerular capillary hydrostatic pressure

Ans:c

ans: 53. D) Impairment of proximal tubular NaCl reabsorption would increase NaCl delivery to the macula densa, which in turn would cause a tubuloglomerular feedback–mediated increase in afferent arteriolar resistance.

53. Which of the following changes, compared with normal, would you expect to find 3 weeks after a patient ingested a toxin that caused sustained impairment of proximal tubular NaCl reabsorption? Assume that there has been no change in diet or ingestion of electrolytes.

	Glomerular Filtration Rate	Afferent Arteriolar Resistance	Sodium Excretion
A)	↔	↔	↑
B)	↔	↔	↑
C)	↓	↑	↑
D)	↓	↑	↔
E)	↑	↓	↔

The increased afferent arteriolar resistance would decrease the GFR. Initially there would be a transient increase in sodium excretion, but after 3 weeks, steady-state conditions would be achieved. Sodium excretion would equal sodium intake, and no significant change would occur in urinary sodium excretion.

54. A patient has the following laboratory values: arterial pH = 7.13,

plasma , plasma chloride concentration = 118 mEq/l,

arterial = 28 mm Hg, and plasma Na+

concentration = 141 mEq/l.

What is the most likely cause of his acidosis?

A) Salicylic acid poisoning

B) Diabetes mellitus

C) Diarrhea

D) Emphysema

Ans:c

55. The GFR of a 26-year-old man with glomerulonephritis decreases by

50% and remains at that level for one month. For which substance

would you expect to find the greatest increase in plasma

concentration?

A) Creatinine

B) K+

C) Glucose

D) Na+

E) Phosphate

F) H+

Ans:a

56. Which changes would you expect to find after administering a vasodilator drug that caused a 50% decrease in afferent arteriolar resistance and no change in arterial pressure?

A) Decreased renal blood flow, decreased GFR, and decreased peritubular capillary hydrostatic pressure

B) Decreased renal blood flow, decreased GFR, and increased peritubular capillary hydrostatic pressure

C) Increased renal blood flow, increased GFR, and increased peritubular capillary hydrostatic pressure

D) Increased renal blood flow, increased GFR, and no change in peritubular capillary hydrostatic pressure

E) Increased renal blood flow, increased GFR, and decreased peritubular capillary hydrostatic pressure

ans:c

57. If the average hydrostatic pressure in the glomerular capillaries is 50 mm Hg, the hydrostatic pressure in the Bowman's space is 12 mm Hg, the average colloid osmotic pressure in the glomerular capillaries is 30 mm Hg, and there is no protein in the glomerular ultrafiltrate, what is the net pressure driving glomerular filtration?

A) 8 mm Hg

B) 32 mm Hg

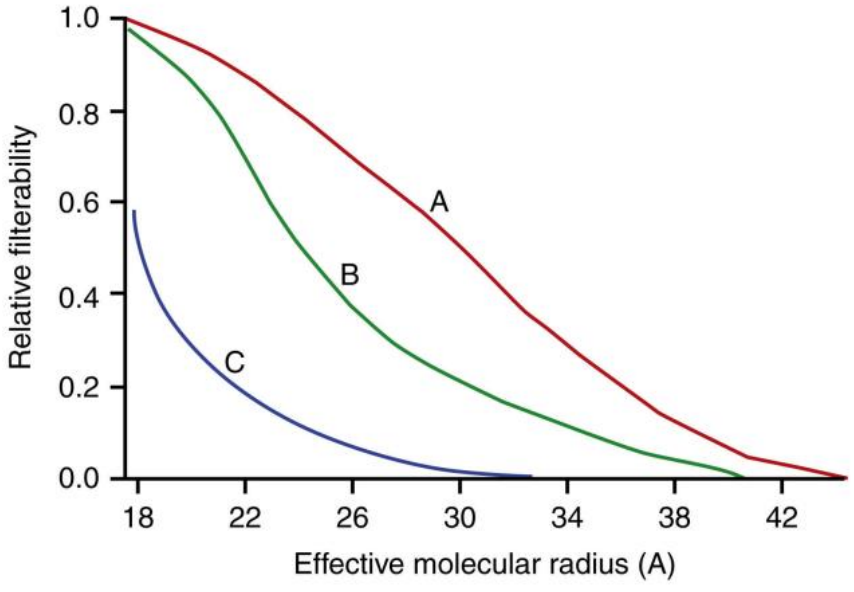
C) 48 mm Hg

D) 60 mm Hg

E) 92 mm Hg

Ans:a

ans:a



60. Lines A, B, and C on the figure above show the relative filterability by the glomerular capillaries of dextran molecules as a function of their molecular radius and electrical charges. Which lines on the graph best describe the electrical charges of the dextrans?

A) A = polycationic; B = neutral; C= polyanionic
B) A = polycationic; B = polyanionic; C = neutral
C) A = polyanionic; B = neutral; C = polycationic
D) A = polyanionic; B = polycationic; C = polycationic
E) A = neutral; B = polycationic; C = polyanionic
F) A = neutral; B = polyanionic; C = polycationic

61. If distal tubule fluid creatinine concentration is 5 mg/100 ml and plasma creatinine concentration is 1.0 mg/100 ml, what is the approximate percentage of the water filtered by the glomerular capillaries that remains in the distal tubule?

A) 5%

B) 10%

C) 20%

D) 50%

E) 80%

F) 95%

Ans:c

62. Which change tends to increase peritubular capillary fluid reabsorption?

A) Increased blood pressure

B) Decreased filtration fraction

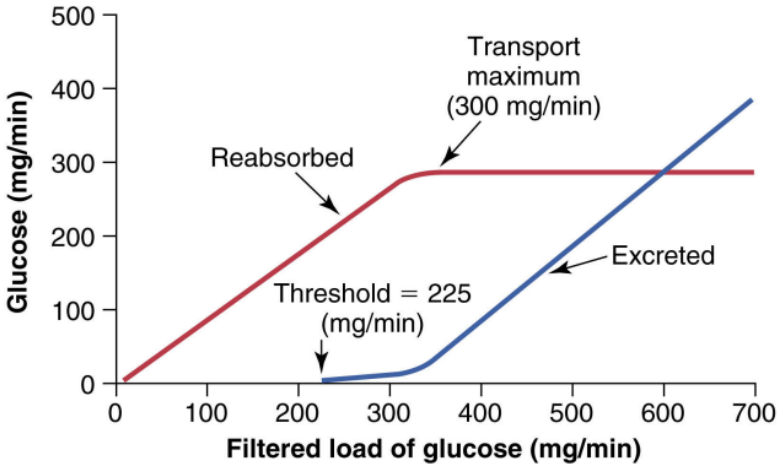
C) Increased efferent arteriolar resistance

D) Decreased angiotensin II

E) Increased renal blood flow

Ans:c

Ans: 63. C) The filtered load of glucose in this example is determined as follows: GFR (150 ml/min) × plasma glucose (300 mg/dl) = 450 mg/min. The transport maximum for glucose in this example is



63. A 32-year-old man reports frequent urination. He is overweight (280 lb [127 kg], 5 feet 10 inches [178 cm] tall). After measuring the 24-hour creatinine clearance, you estimate his GFR to be 150 ml/min. His plasma glucose level is 300 mg/dl. Assuming that his renal transport maximum for glucose is normal, as shown in the figure above, what would be this patient's approximate rate of urinary glucose excretion?

A) 0 mg/min
B) 100 mg/min
C) 150 mg/min
D) 225 mg/min
E) 300 mg/min

300 mg/min. Therefore, the maximum rate of glucose reabsorption is 300 mg/min. The urinary glucose excretion is equal to the filtered load (450 mg/min) minus the tubular reabsorption of glucose (300 mg/min), or 150 mg/min.

64. An adrenal tumor that causes excess aldosterone secretion would

tend to _____ plasma K+

concentration, _____ plasma pH,

_____ renin secretion, and _____ blood pressure.

A) decrease, decrease, decrease, decrease

B) decrease, increase, decrease, increase

C) decrease, decrease, decrease, increase

D) decrease, increase, increase, increase

E) increase, increase, decrease, increase

F) increase, decrease, decrease, increase

Ans:b

65. Which of the following tends to increase potassium secretion by the

cortical collecting tubule?

A) A diuretic that inhibits the action of aldosterone (e.g.,

spironolactone)

B) A diuretic that decreases loop of Henle sodium reabsorption

(e.g., furosemide)

C) Decreased plasma potassium concentration

D) Acute metabolic acidosis

E) Low sodium intake

Ans: 65. B) Potassium secretion by the cortical collecting ducts is stimulated by (1) aldosterone, (2) increased plasma potassium concentration, (3) increased flow rate in the cortical collecting tubules, and (4) alkalosis. Therefore, a diuretic that inhibits aldosterone, decreased plasma potassium concentration, acute acidosis, and low sodium intake would all tend to decrease potassium secretion by the cortical collecting tubules. A diuretic that decreases loop of Henle sodium reabsorption, however, would tend to increase the flow rate in the cortical collecting tubule and therefore stimulate potassium secretion.

68. A 48-year-old woman reports severe polyuria (producing about 0.5 l

of urine each hour) and polydipsia (drinking two to three glasses of

water every hour). Her urine contains no glucose, and she is placed

on overnight water restriction for further evaluation. The next

morning, she is weak and confused, her sodium concentration is 160

mEq/l, and her urine osmolarity is 80 mOsm/l. Which of the

following is the most likely diagnosis?

A) Diabetes mellitus

B) Diabetes insipidus

C) Primary aldosteronism

D) Renin-secreting tumor

E) Syndrome of inappropriate ADH

Ans: 68. B) The most likely diagnosis for this patient is diabetes insipidus, which can account for the polyuria and the fact that her urine osmolarity is very low (80 mOsm/l) despite overnight water restriction. In many patients with diabetes insipidus, the plasma sodium concentration can be maintained relatively close to normal by increasing fluid intake (polydipsia). When water intake is restricted, however, the high urine flow rate leads to rapid depletion of extracellular fluid volume and severe hypernatremia, as occurred in this patient. The fact that she has no glucose in her urine rules out diabetes mellitus. Neither primary aldosteronism nor a renin-secreting tumor would lead to an inability to concentrate the urine after overnight water restriction. Syndrome of inappropriate ADH would cause excessive fluid retention and increased urine osmolarity.

69. Which substance is filtered most readily by the glomerular

capillaries?

A) Albumin in plasma

B) Neutral dextran with a molecular weight of 25,000

C) Polycationic dextran with a molecular weight of 25,000

D) Polyanionic dextran with a molecular weight of 25,000

E) Red blood cells
ans:c

70. A 22-year-old woman runs a 10-km race on a hot day and becomes

dehydrated. Assuming that her ADH levels are very high and that her kidneys are functioning normally, in which part of the renal tubule is the most water reabsorbed?

A) Proximal tubule

B) Loop of Henle

C) Distal tubule

D) Cortical collecting tubule

E) Medullary collecting duct

Ans:a

71. Furosemide (Lasix) is a diuretic that also produces natriuresis. Which of the following is an undesirable side effect of furosemide due to its site of action on the renal tubule?

A) Edema

B) Hyperkalemia

C) Hypercalcemia

D) Decreased ability to concentrate the urine

E) Heart failure

Ans:d

72. A female patient has unexplained hypernatremia (plasma Na+

= 167

mmol/l) and reports frequent urination and large urine volumes. A urine specimen reveals that the Na+ concentration is 15 mmol/l (very low) and the osmolarity is 155 mOsm/l (very low). Laboratory tests reveal the following data: plasma renin activity = 3 ng angiotensin I/ml/h (normal = 1.0), plasma ADH = 30 pg/ml (normal = 3 pg/ml), and plasma aldosterone = 20 ng/dl (normal = 6 ng/dl). Which of the following is the most likely reason for her hypernatremia?

A) Simple dehydration caused by decreased water intake

B) Nephrogenic diabetes insipidus

C) Central diabetes insipidus

D) Syndrome of inappropriate ADH

E) Primary aldosteronism

F) Renin-secreting tumor

Ans:b

73. Which change would you expect to find in a dehydrated person deprived of water for 24 hours?

A) Decreased plasma renin activity

B) Decreased plasma antidiuretic hormone concentration

C) Increased plasma atrial natriuretic peptide concentration

D) Increased water permeability of the collecting duct

Ans:d

74. Juvenile (type 1) diabetes mellitus is often diagnosed because of polyuria (high urine flow) and polydipsia (frequent drinking) that occur because of which of the following?

A) Increased delivery of glucose to the collecting duct interferes with the action of antidiuretic hormone

B) Increased glomerular filtration of glucose increases Na+ reabsorption via the sodium-glucose co-transporter

C) When the filtered load of glucose exceeds the renal threshold, a rising glucose concentration in the proximal tubule decreases the osmotic driving force for water reabsorption

D) High plasma glucose concentration decreases thirst

E) High plasma glucose concentration stimulates ADH release from the posterior pituitary

ans:c

75. Which of the following would cause the most serious hypokalemia?

A) A decrease in potassium intake from 150 mEq/day to 60

mEq/day

D) An increase in sodium intake from 100 to 200 mEq/day

C) Excessive aldosterone secretion plus high sodium intake

D) Excessive aldosterone secretion plus low sodium intake

E) A patient with Addison's disease

F) Treatment with a beta-adrenergic blocker

G) Treatment with spironolactone

Ans:c

77. Under conditions of normal renal function, which of the following statements is true of the concentration of urea in tubular fluid at the end of the proximal tubule?

A) It is higher than the concentration of urea in tubular fluid at the tip of the loop of Henle

B) It is higher than the concentration of urea in the plasma

C) It is higher than the concentration of urea in the final urine in antidiuresis

D) It is lower than plasma urea concentration because of active urea reabsorption along the proximal tubule

ans: 77. B) Approximately 30% to 40% of the filtered urea is reabsorbed in the proximal tubule. However, the tubular fluid urea concentration increases because urea is not

nearly as permeant as water in this nephron segment. Urea concentration increases further in the tip of the loop of Henle because water is reabsorbed in the descending limb of the loop of Henle. Under conditions of antidiuresis, urea is further concentrated as water is reabsorbed and as fluid flows along the collecting ducts. Therefore, the final urine concentration of urea is substantially greater than the concentration in the proximal tubule or in the plasma.

79. Which change, compared with normal, would be expected to occur,

under steady-state conditions, in a patient whose severe renal disease

has reduced the number of functional nephrons to 25% of normal?

A) Increased GFR of the surviving nephrons

B) Decreased urinary creatinine excretion rate

C) Decreased urine flow rate in the surviving nephrons

D) Decreased urinary excretion of sodium

E) Increased urine-concentrating ability

Ans:a

80. Which statement is correct?

A) Urea reabsorption in the medullary collecting tubule is less than

in the distal convoluted tubule during antidiuresis

B) Urea concentration in the interstitial fluid of the renal cortex is

greater than in the interstitial fluid of the renal medulla during antidiuresis

C) The thick ascending limb of the loop of Henle reabsorbs more urea than the inner medullary collecting tubule during antidiuresis

D) Urea reabsorption in the proximal tubule is greater than in the cortical collecting tubule

ans:d

81. A patient's urine is collected for 2 hours, and the total volume is 600 ml during this time. Her urine osmolarity is 150 mOsm/l, and her plasma osmolarity is 300 mOsm/l. What is her "free water clearance"?

A) +5.0 ml/min

B) +2.5 ml/min

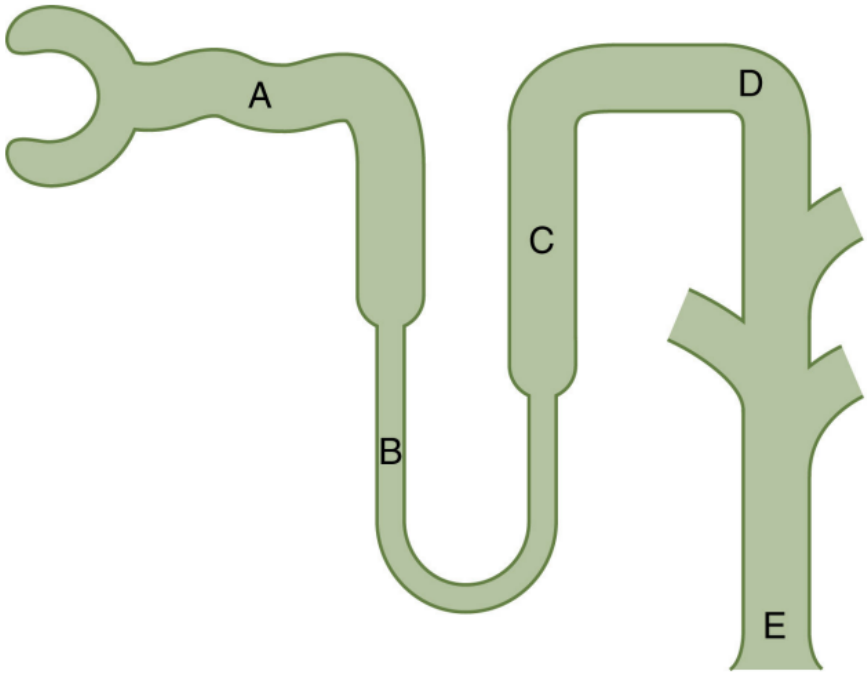
C) 0.0 ml/min

D) −2.5 ml/min

E) −5.0 ml/min

Ans:b

For Questions 82–85, choose the appropriate nephron site in the above figure.



82. In a patient with severe central diabetes insipidus caused by a lack of ADH secretion, which part of the tubule would have the lowest

tubular fluid osmolarity?

A) A

B) B

C) C

D) D

E) E

Ans:e

83. In a person on a very low potassium diet, which part of the nephron would be expected to reabsorb the most potassium?

A) A

B) B

C) C

D) D

E) E

Ans:a

84. Which part of the nephron normally reabsorbs the most water?

A) A

B) B

C) C

D) D

E) E

Ans:a

85. In a normally functioning kidney, which part of the tubule has the lowest permeability to water during antidiuresis?

A) A

B) B

C) C

D) D

E) E

Ans:c

90. If a person has a kidney transport maximum for glucose of 350 mg/min, a GFR of 100 ml/min, a plasma glucose level of 150 mg/dl, a urine flow rate of 2 ml/min, and no detectable glucose in the urine, what would be the approximate rate of glucose reabsorption, assuming normal kidneys?

A) Glucose reabsorption cannot be estimated from these data

B) 0 mg/min

C) 50 mg/min

D) 150 mg/min

E) 350 mg/min

Ans:d

92. A selective decrease in efferent arteriolar resistance would _____

glomerular hydrostatic pressure, _____ GFR, and _____

renal blood flow.

A) increase, increase, increase

B) increase, decrease, increase

C) increase, decrease, decrease

D) decrease, increase, decrease

E) decrease, decrease, increase

F) decrease, increase, increase

Ans:e

ans:d

94. A patient reports that he is always thirsty, and his breath has an acetone smell. You suspect that he has diabetes mellitus, and the diagnosis is confirmed by a urine sample that tests positive for glucose and a blood sample that shows a fasting blood glucose concentration of 400 mg/dl. Compared with normal, you would expect to find which changes in his urine?

	Urine pH	NH_4^+ Excretion	Urine volume (ml/24 h)	Renal HCO_3^- Production
A)	↓	↓	↓	↓
B)	↓	↑	↓	↓
C)	↑	↓	↓	↓
D)	↓	↑	↑	↑
E)	↑	↑	↑	↑

98. Which nephron segment is the primary site of magnesium reabsorption under normal conditions?

A) Proximal tubule

B) Descending limb of the loop of Henle

C) Ascending limb of the loop of Henle

D) Distal convoluted tubule

E) Collecting ducts

Ans:c

Ans:c

99. Which changes would you expect to find in a newly diagnosed 10-year-old patient with type 1 diabetes and uncontrolled hyperglycemia (plasma glucose = 300 mg/dl)?

	Thirst (Water Intake)	Urine Volume	Glomerular Filtration Rate	Afferent Arteriolar Resistance
A)	↑	↓	↑	↓
B)	↑	↑	↓	↑
C)	↑	↑	↑	↓
D)	↓	↑	↑	↑
E)	↓	↓	↓	↓

100. What is this patient's approximate GFR, assuming that she collected all her urine in the 24-hour period?

A) 10 ml/min

B) 20 ml/min

C) 30 ml/min

D) 40 ml/min

E) 80 ml/min

Ans:b

101. What is the net renal tubular reabsorption rate of potassium in this patient?

A) 1.050 mmol/min

B) 0.100 mmol/min

C) 0.037 mmol/min

D) 0.075 mmol/min

E) Potassium is not reabsorbed in this example

Ans:d

107. Which change would you expect to find in a patient who developed acute renal failure after ingesting poisonous mushrooms that caused renal tubular necrosis?

A) Increased plasma bicarbonate concentration

B) Metabolic acidosis

C) Decreased plasma potassium concentration

D) Decreased blood urea nitrogen concentration

E) Decreased hydrostatic pressure in Bowman's capsule
ans:b

109. Which of the following is true of the tubular fluid that passes through the lumen of the early distal tubule in the region of the macula densa?

A) It is usually isotonic

B) It is usually hypotonic

C) It is usually hypertonic

D) It is hypertonic in antidiuresis

E) It is hypertonic when the filtration rate of its own nephron decreases to 50% below normal

ans:b

110. In a person with normal kidneys and normal lungs who has chronic metabolic acidosis, you would expect to find all of the following, compared with normal, EXCEPT:

A) Increased renal excretion of NH4Cl

B) Decreased urine pH

B) Decreased urine hco3 excretion

D) Increased plasma hco3 concentration

E) Decreased plasma pco2

Ans:d

112. If the renal clearance of substance X is 300 ml/min and the glomerular filtration rate is 100 ml/min, it is most likely that substance X is

A) Filtered freely but not secreted or reabsorbed

B) Bound to plasma proteins

C) Secreted

D) Reabsorbed

E) Bound to tubular proteins

F) Clearance of a substance cannot be greater than the GFR

Ans:c

113. Which change tends to increase urinary calcium (Ca^{2+}) excretion?

A) Extracellular fluid volume expansion

B) Increased plasma parathyroid hormone concentration

C) Decreased blood pressure

D) Increased plasma phosphate concentration

E) Metabolic alkalosis

Ans: 113. A) In the proximal tubule, calcium reabsorption usually parallels sodium and water reabsorption. With extracellular volume expansion or increased blood pressure, proximal sodium and water reabsorption are reduced, and a reduction in calcium reabsorption also occurs, causing increased urinary excretion of calcium. Increased parathyroid hormone, increased plasma phosphate concentration, and metabolic alkalosis all tend to decrease the renal excretion of calcium.

114. Which change would you expect to find in a patient consuming a

high-sodium diet (200 mEq/day) compared with the same patient on

a normal-sodium diet (100 mEq/day), assuming steady-state

conditions?

A) Increased plasma aldosterone concentration

B) Increased urinary potassium excretion

C) Decreased plasma renin activity

D) Decreased plasma atrial natriuretic peptide

E) An increase in plasma sodium concentration of at least 5 mmol/l

Ans:c

115. What would tend to decrease GFR by more than 20% in a normal kidney?

A) Decrease in renal arterial pressure from 100 to 85 mm Hg

B) 50% decrease in afferent arteriolar resistance

C) 50% decrease in efferent arteriolar resistance

D) 50% increase in the glomerular capillary filtration coefficient

E) Decrease in plasma colloid osmotic pressure from 28 to 20 mm Hg

Ans:c

116. Acute metabolic acidosis tends to _____ intracellular K+ concentration and _____ K+ secretion by the cortical collecting tubules.

A) Increase, increase

B) Increase, decrease

C) Decrease, increase

D) Decrease, decrease

E) Cause no change in, increase

F) Cause no change in, cause no change in

Ans:d

117. Which statement is true?

A) ADH increases water reabsorption from the ascending loop of Henle

B) Water reabsorption from the descending loop of Henle is normally less than that from the ascending loop of Henle

C) Sodium reabsorption from the ascending loop of Henle is normally less than that from the descending loop of Henle

D) Osmolarity of fluid in the early distal tubule would be less than 300 mOsm/l in a dehydrated person with normal kidneys and increased ADH levels

E) ADH decreases the urea permeability in the medullary collecting tubules

ans:d

118. In a person on a high-potassium (200 mmol/day) diet, which part of the nephron would be expected to secrete the most potassium?

A) Proximal tubule

B) Descending loop of Henle

C) Ascending loop of Henle

D) Early distal tubule

E) Collecting tubules

Ans:e

122. A 26-year-old construction worker is brought to the emergency department with a change in mental status after working a 10-hour shift on a hot summer day (average outside temperature was 97°F [36°C]). The man had been sweating profusely during the day but did not drink fluids. He has a fever of 102°F [39°C], a heart rate of 140 beats/min, and a blood pressure of 100/55 mm Hg in the supine position. Upon examination, he has no perspiration, appears to have dry mucous membranes, and is poorly oriented to person, place, and time. Assuming that his kidneys were normal yesterday, which set of hormone levels describes his condition, compared with normal?

A) High ADH, high renin, low angiotensin II, low aldosterone

B) Low ADH, low renin, low angiotensin II, low aldosterone

C) High ADH, low renin, high angiotensin II, low aldosterone

D) High ADH, high renin, high angiotensin II, high aldosterone

E) Low ADH, high renin, low angiotensin II, high aldosterone

Ans:d

124. Which change would tend to increase Ca2+

reabsorption in the renal

tubule?

A) Extracellular fluid volume expansion

B) Increased plasma parathyroid hormone concentration

C) Increased blood pressure

D) Decreased plasma phosphate concentration

E) Metabolic acidosis

Ans:b

126. In a person with chronic respiratory acidosis who has partial renal

compensation, you would expect to find which changes, compared

with normal? _____ urinary excretion of NH4+

; _____ plasma

concentration; and _____ urine pH.

A) Increased, increased, decreased

B) Increased, decreased, decreased

C) No change in, increased, decreased

D) No change in, no change in, decreased

E) Increased, no change in, increased

Ans:a

127. Increases in both renal blood flow and GFR are caused by which mechanism?

A) Dilation of the afferent arterioles

B) Increased glomerular capillary filtration coefficient

C) Increased plasma colloid osmotic pressure

D) Dilation of the efferent arterioles

Ans:a

128. A 55-year-old male patient with hypertension has had his blood pressure reasonably well controlled by administration of a thiazide diuretic. At his last visit (6 months ago), his blood pressure was 130/75 mm Hg, and his serum creatinine was 1 mg/100 ml. He has been exercising regularly for the past 2 years but recently has reported knee pain and began taking large amounts of a nonsteroidal antiinflammatory drug. When he arrives at your office, his blood pressure is 155/85 mm Hg, and his serum creatinine is 2.5 mg/100 ml. What best explains his increased serum creatinine level?

A) Increased efferent arteriolar resistance that reduced GFR

B) Increased afferent arteriolar resistance that reduced GFR

C) Increased glomerular capillary filtration coefficient that reduced GFR

D) Increased angiotensin II formation that decreased GFR

E) Increased muscle mass due to the exercise

Ans:b

129. An older adult patient reports muscle weakness and lethargy. A urine specimen reveals a Na+ concentration of 600 mmol/l and an osmolarity of 1200 mOsm/l. Additional laboratory tests provide the following information: plasma Na+ concentration = 167 mmol/l, plasma renin activity = 4 ng angiotensin I/ml/h (normal = 1 ml/h), plasma ADH = 60 pg/ml (normal = 3 pg/ml), and plasma aldosterone = 15 ng/dl (normal = 6 ng/dl). What is the most likely reason for this patient's hypernatremia?

A) Dehydration caused by decreased fluid intake

B) Syndrome of inappropriate ADH

C) Nephrogenic diabetes insipidus

D) Primary aldosteronism

E) Renin-secreting tumor

Ans: 129. A) In this example, the plasma sodium concentration is markedly increased but the urine sodium concentration is relatively normal, and

urine osmolarity is almost maximally increased to 1200 mOsm/l. In addition, there are increases in plasma renin, ADH, and aldosterone, which is consistent with dehydration caused by decreased fluid intake. The syndrome of inappropriate ADH would result in a decrease in plasma sodium concentration, as well as suppression of renin and aldosterone secretion. Nephrogenic diabetes insipidus, caused by the kidneys' failure to respond to ADH, would also be associated with dehydration, but urine osmolarity would be reduced rather than increased. Primary aldosteronism would tend to cause sodium and water retention with only a modest change in plasma sodium concentration and a marked reduction in the secretion of renin. Likewise, a renin-secreting tumor would be associated with increases in plasma aldosterone concentration and plasma renin activity but only a modest change in plasma sodium concentration.