INSTRUCTIONS

This examination is composed of 113 multiple choice questions. Write your name on both the question booklet and the answer sheet. The answers are to be written on the answer sheet preferably in pencil, since it is easier to change your answer. For each multiple choice question there is only one correct response, so write only one letter as an answer. At the end of the test, the answer sheet should be stapled to the question booklet and they both must be handed in.
1. A 34-year-old man comes to see you. You review his blood pressure readings over the last few months, which have been 148/82, 140/78, 146/86, and 150/76. Which of the following statements are true?

A. Because his diastolic blood pressure is normal, there is no necessity to treat him.
B. His mean pulse pressure is about 100 mmHg.
B. It is likely that anxiety and stress are primarily responsible elevation in his systolic blood pressure.
B. He has a statistically higher chance of developing end stage renal disease and a myocardial infarction over his lifetime than someone with an average blood pressure of 120/70.
B. Given his age, it is more likely that he will have secondary rather than essential hypertension.

THE FOLLOWING THREE QUESTIONS REFER TO THE NEXT CASE

A 57-year-old woman with diabetes and diabetic nephropathy has chronic renal failure and is currently treated with hemodialysis, for 4 hours 3 times per week. On examination, you find her blood pressure to be 170/104 mmHg. Her Na+ is 129 mEq/L, K+ is 5.5 mEq/L, Cl- is 91 mEq/L, HCO3- is 19 mEq/L, BUN is 90 mg/dL, and creatinine is 8.6 mg/dL. The pH is 7.33.

2. Which factor is most important in explaining her hypertension?

. decreased glomerular filtration of sodium
. glycosylation of her vascular smooth muscle cells
. increased renin and aldosterone levels
. anxiety related to his chronic illness
. osmotic shifts of fluid due to high BUN levels

3. Which factor is most important in explaining her hyponatremia?

A. increased release of ADH
B. the development of nephrogenic diabetes insipidus
C. increased renal losses of sodium
D. malnutrition induced decreased oral intake of sodium
E. decreased glomerular filtration of water

4. What process will have the greatest effect on lowering the bicarbonate level below 19 mEq/L?

A. if the patient is given a thiazide diuretic
B. if the patient is given a steak sandwich to eat
C. if the patient is given ipecac and she vomits
D. if the patient is given intravenous isotonic sodium chloride
E. if the patient is given a beta blocker for hypertension
5. A 5-year-old boy is brought to the emergency room after collapsing at his day care center. He is too ill to answer questions, his parents do not speak English and for the moment, no further history is available. An arterial blood gas shows a pH of 7.20, a pCO2 of 64, and a HCO3- of 26 mEq/L. Other bloodwork is pending. Of the following, which is the most likely cause of his acid-base disturbance?

- overdose of salicylates ✓
- severe diarrhea ✓
- diabetic ketoacidosis ✓
- pneumonia and respiratory failure
- acute renal failure

6. A 20 year old woman is referred to you by the college health service because of abnormal blood tests, following her complaint of not feeling well. Her medical history is unremarkable, she takes no medications, and her examination is notable for a blood pressure of 135/80, a heart rate of 70/minute, and clear lungs, a normal abdomen, and no edema. Arterial pH is 7.33, Na+ is 135 mEq/L, K+ is 3.5 mEq/L, Cl- is 110 mEq/L, and HCO3- is 16 mEq/L. Of the following, which is the most likely diagnosis?

- distal renal tubular acidosis
- an aldosterone secreting tumor
- early pregnancy
- chronic renal failure
- excess ingestion of salicylates

7. A 51-year-old man has a history of chronic alcoholism and has been vomiting constantly over the past two weeks. You order bloodwork and find that the bicarbonate level is elevated at 45 Mec/L; the arterial pH is 7.62. All of the following are major mechanisms explaining the abnormal bicarbonate level except:

- increased H+ secretion in the cortical collecting duct
- increased HCO3- generation in the descending limb of the loop of Henle ✓
- increased HCO3- reabsorption in the proximal tubule
- increased HCl loss into the upper gastrointestinal tract

8. A 19-year-old man comes to see you because he has been feeling weak and tired. His exam shows normal mucous membranes, clear lungs, a normal heart exam, and no peripheral edema. His labs show an arterial pH of 7.47, a pCO2 of 47 mmHg, and a HCO3- level of 36 mEq/L. His Na+ is 135 mEq/L, K+ is 3.5 mEq/L, Cl- is 90 mEq/L, and glucose is 100 mg/dL. The urine sodium is 12 mEq/L, and the urine chloride is 10 mEq/L. Based upon the bloodwork, which of all of the following possibilities is the most likely explanation for his condition?

- surreptitious use of thiazide diuretics
- an aldosterone secreting tumor
- anxiety with hyperventilation
- renal artery stenosis
- chronic diarrhea
THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING CASE.

A 72-year-old man has end stage congestive heart failure from ischemic heart disease. His exam shows a blood pressure of 130/76, heart rate of 96/minute, jugular venous distension, bilateral rales, an S3 gallop, and ascites and 2+ peripheral edema. A chest x-ray shows pleural effusions and pulmonary vascular congestion. Her serum Na+ is 119 mEq/L. Her serum creatinine level is 1.0 mg/dL.

9. The single most important explanation for her hyponatremia is:

A. an increased ADH effect on the collecting duct
B. sodium loss from the use of loop diuretics
C. the fact that she has been taking a low sodium diet
D. decreased renal sodium excretion
E. decreased filtration of sodium and water in the glomerulus

10. What can you conclude about her total body sodium and water stores?

A. total body sodium increased, total body water increased
B. total body sodium decreased, total body water increased
C. total body sodium increased, total body water decreased
D. total body sodium decreased, total body water decreased
E. total body sodium decreased, total body water normal

11. A 91-year-old man with Alzheimer disease is referred to your emergency room from his nursing home with a urinary tract infection. On exam, he has profound dementia, is nonverbal and makes no purposeful movements. He has a temperature of 98 degrees, a blood pressure of 148/90, a respiratory rate of 12/minute, and a heart rate of 88/minute. He is emaciated and cachectic. Cloudy urine, which seems grossly infected, drains from an indwelling urinary catheter. A serum sodium is drawn and is 164 mEq/L. His creatinine is 1.3 mg/dL. The single most important contributor to his high serum sodium level is

A. water loss from insensible losses
B. an inability to excrete sodium from his urine due to urinary obstruction
C. decreased water intake
D. shift of sodium into the extracellular space
E. increased dietary intake of sodium

12. A 62-year-old woman with lung cancer has a diagnosis of the syndrome of inappropriate ADH release. Which of the following laboratory tests would be expected to be present in a patient with this diagnosis?

A. a urine Na+ of 82 mEq/L
B. a urine specific gravity of 1.002
C. a urine osmolality of 65 mOsm/L
D. a creatinine level of 2.2 mg/dL
   a. a serum sodium level of 148 mEq/L
13. A patient has the following blood tests done. The arterial pH is 7.52. The Na+ is 137 mEq/L, the K+ is 3.9 mEq/L, the Cl- is 105 mEq/L, the HCO3- is 22 mEq/L, and the pCO2 is 50 mmHg. What acid-base abnormality is present?

A. respiratory acidosis  
B. respiratory alkalosis  
C. metabolic acidosis  
D. metabolic alkalosis  
E. none of the above; a lab error must be present

14. A 27-year-old graduate student runs a marathon on a hot day. She has some stomach cramps, and at the end of the race has an episode of vomiting. You see her immediately afterwards, where her blood pressure is 86/40, her heart rate is 120/minute, and she has flushed, dry skin, with dry mucous membranes, and a clear chest. Labs show a Na+ of 147 mEq/L, K+ of 3.3 mEq/L. Which of the following is true about her status?

. There is increased water reabsorption in the ascending thick limb of the loop of Henle.  
B. The total body sodium content is increased.  
C. The patient probably has nephrogenic diabetes insipidus  
D. There is increased water filtration across the glomerulus  
E. The urine osmolality is probably very high.

15. A 65-year-old man is admitted with crushing sub-sternal chest pain. He vomited once in the emergency room. He takes hydrochlorothiazide 25-mg each day for hypertension. Serum K+ was 3.9 mEq/L two days prior to admission. The patient is anxious with cool cyanotic extremities. Blood pressure is 88/56 mmHg. Laboratory tests show Na+  140, K+ 2.9, Cl- 104, HCO3- 19 and lactate 5.0 mEq/L. Urine K+ is 15 mEq/L.

The most likely cause of the hypokalemia is:

. vomiting  
. diuretics  
. acidosis  
. catecholamines  
. primary aldosteronism
16. A 24-year-old woman with focal segmental glomerulosclerosis is taking furosemide 40 mg each day for control of edema. Blood pressure is elevated: 145/96 mmHg. Serum K\(^+\) is 3.0 mEq/L.

All of the following might raise serum K\(^+\) concentration EXCEPT:

- spironolactone
- β-blocker
- corticosteroid
- angiotensin receptor blocker
- ACE inhibitor

17. A 19-year-old college wrestler has been taking a laxative and limiting his fluid intake to lose weight. He sees his pediatrician for dizziness on standing, and muscle weakness. Systolic blood pressure is 104 mmHg lying and 63 mmHg standing. Electrolytes are Na\(^+\) 147, K\(^+\) 2.1, Cl\(^-\) 123, and HCO\(_3\)\(^-\) 11 mEq/L. Arterial blood shows pH 7.02, pO\(_2\) 65 mmHg and pCO\(_2\) 44 mmHg.

Initiating treatment of one of these fluid and electrolyte disorders at the outset could cause the patient’s death. Which disorder?

- metabolic acidosis
- respiratory acidosis
- hypovolemia
- hypokalemia
- hyponatremia

18. A 4-year-old girl presents to her pediatrician after awaking with a swollen face. Blood pressure is 83/58 mmHg. There is swelling of the face, abdomen and legs. Serum creatinine is 0.6 mg/dl and albumin is 1.8 g/dl. Urinalysis shows 1000 mg/dl protein and negative sediment.

Possible complications in this patient include all of the following EXCEPT:

- pulmonary edema
- pulmonary embolism
- cellulitis
- arterial thrombosis
- peritonitis
19. An 18-year-old army recruit develops dark urine following strenuous exercise. Blood pressure is 204/112 mmHg. Urine is red brown in color with protein 100 mg/dl. Sediment shows >100 RBC/HPF and red cell casts. 24-hour urine protein is 1.8 g. Serum creatinine is 2.2 mg/dl, albumin 3.9 g/dl, complements normal, ANA negative, ANCA negative and anti-GBM antibody positive (1:128). Chest Xray is normal.

The most likely diagnosis is:

- post-streptococcal glomerulonephritis
- lupus nephritis
- IgA nephropathy
- microscopic polyarteritis
- crescentic glomerulonephritis

20. All of the following describe the natural history of chronic kidney disease except:

A. hyperfiltration of non-injured nephrons cause eventual sclerosis
B. hypertension develops as a consequence of chronic kidney disease
C. onset of proteinuria is reflective of worsening of kidney disease
D. proteinuria itself contributes to glomerular damage and progression of kidney disease
E. progression of chronic kidney disease is reversible depending on the underlying cause

21. Which of the following are important for the autoregulation of glomerular pressure?

A. Erythropoeitin
B. Macula densa
C. ADH
D. Renal artery diameter
E. None of the above

22. Which of the following patients is most likely to have complete recovery of kidney function?

- 70 yo male with benign prostatic hypertrophy causing bladder outlet obstruction for 3 months
- 24 yo female with crescentic glomerulonephritis and a creatinine of 8 mg/dl
- 54 yo male with diabetic nephropathy and a creatinine of 1.6 mg/dl
- 83 yo female with sepsis develops hypotension and becomes anuric
E. All will have progression of renal disease
23. Acute renal failure in cirrhosis can occur due to which of the following:

A. Splanchnic vasoconstriction  
B. Ischemia to the tubules resulting in necrosis  
C. Intravascular volume overload  
D. Vasodilation of the efferent arteriole due to circulating vasoactive peptides  
E. None of the above

A 33 yo female presents with fever, chills, sweats, headache and rash. She becomes confused, then hypotensive with systolic blood pressure of 80, requiring immediate hospitalization and is transferred to the ICU. She is intubated and requires blood pressure support with vasopressors. Lumbar puncture is performed revealing acute meningitis. Ceftriaxone (IV cephalosporin antibiotic) is initiated. On exam, T 102, BP 90/45, HR 110, RR 16. Unresponsive, Heart: tachycardia, Lung: clear, 2+ peripheral edema, petechial rash.

Laboratory data: BUN 40, creatinine 1.9, Na 136, K 5.3, Cl 110, HCO3 16  
Urinalysis: Specific gravity 1.020, trace protein, 5-10 RBCs, 10-20 WBCs, no WBCs, RBC or granular casts, Urine Na 15 mEq/L

24. The most appropriate next step would be:

A. Diuretics to reduce the peripheral edema  
B. Intravenous isotonic normal saline administration  
C. Hypotonic half normal saline administration  
D. 5% Dextrose (D5W) solution to replace insensible losses due to fever and mechanical ventilation  
E. None of the above

THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING CASE

68 yo woman with no medical history complains of chronic joint aches and pains with gardening. She is prescribed ibuprofen 800 mg po tid which adequately controls her symptoms. One month later, she presents with multiple episodes of hematemesis. The patient is thirsty and dizzy. She was able to keep water and ginger ale down without vomiting. On exam she is alert and awake, HR 115, BP 120/80 sitting, 96/64 standing. Exam is otherwise unremarkable. Laboratory data reveals: Na 132 mEq/L, BUN 98 mg/dL, creatinine 1.3 mg/dL, HCT 27%. Urine Na 10 mEq/L, urine chloride 10 mEq/L, urine specific gravity 1.020, pH 5, no cells or casts

25. The hyponatremia can be explained by:

A. Inappropriate stimulation of ADH hormone  
B. Excess sodium loss with vomiting of blood  
C. Hypovolemia due to blood loss with excessive water intake  
D. NSAID induced inhibition of prostaglandin causing afferent arteriolar vasoconstriction  
E. All of the above
26. The appropriate next step would be:

A. Free water restrict 1 L per day  
B. Transfuse with 2 units of packed red blood cells  
C. Administer half normal saline (77 mEq/L, Na⁺) given the low urine Na concentration  
   which suggests ongoing renal water losses  
D. Continue with oral hydration  
E. Treat with erythropoietin

27. A 24 yo medical student is studying for the boards. She buys a bag of pretzels and  
finishes the entire bag by the end of the night. Assuming she takes in approximately  
180 mEq of Na⁺ over a 24 hour period, which of the following would you expect?

A. Urine osmolality will fall  
B. Serum Na will increase due to increase total body Na content  
C. ADH is turned off due to adequate volume  
D. She will develop hypertension due to the increased Na intake  
E. Urine Na will be 100 mEq/L if the urine volume is 1800 ml/24 hours

A 40 yo woman with normal kidney function weighs 60 kg and has a serum Na of 140  
mEq/L.

28. Calculate the total body water:

A. 24 L  
B. 5 L  
C. 12 L  
D. 36 L  
E. More information is needed for this calculation

29. Approximately how much sodium is filtered through the glomerulus per day  
assuming normal GFR of 100 ml/min?

A. 20,000 mEq  
B. 5000 mEq  
C. 1700 mEq  
D. 140 mEq  
E. None of the above

30. A 72 yo male with a history of hypertension presents to the emergency room with  
lower abdominal pain and nausea. He reports a history of urinary hesitancy and  
octoria for many months, but did not notice any change in his urine output.

On exam, he has a pulse of 85/min, BP 138/80 mmHg. He appears reasonably  
comfortable. Mucous membranes are moist. He has some abdominal discomfort.  
There is mild pedal edema.
Laboratory data shows the following:
BUN 85 mg/dL
Creatinine 2.5 mg/dL
K: 5.3 meq/L

Urine Na: 7 meq/L
Uosm: 535 mosm/kg

The most appropriate next step would be:

A. Administration of isotonic intravenous fluids
B. Obtain a CT scan of pelvis to look for obstructing stones
C. Placement of urinary catheter after patient has voided
D. Administration of intravenous D5W (5% dextrose in water) to replace excess free water losses
E. Give intravenous furosemide (loop diuretic) to increase urine output

31. All of the following dietary interventions are appropriate to manage a patient with recurrent calcium oxalate stones EXCEPT:

A. Increase fluid intake to achieve urine output >2L/day
B. Reduce amount of salt in the diet
C. Reduce the amount of animal protein in the diet
D. Avoidance of high oxalate foods (rhubarb, kale, tea)
E. Place on a low calcium diet

32. The presence of complete unilateral ureteral obstruction usually presents with which of the following laboratory abnormalities?

A. Increased BUN/Creatinine ratio
B. Low urinary sodium concentration
C. Hyperkalemia out of proportion to the creatinine elevation
D. Increased urinary osmolality
E. None of the above

33. Which of the following casts found upon urine microscopy are suggestive of glomerulonephritis?

A. Red blood cell casts
B. White blood cell casts
C. Granular brown casts
D. Hyaline casts
E. Waxy casts
34. A 69-year-old African-American retired construction worker sees his primary care physician for lower back pain and poor appetite. His past medical history is remarkable for hypertension and enlarged prostate. The physical examination is remarkable for a blood pressure of 100/60, a pulse of 90, and tenderness over his mid-lumbar spine and pitting edema over his shins. Blood work shows an elevated serum creatinine of 3.2 mg \text{d/L}. The hemoglobin is 9.2 gm/dL, Urinalysis reveals: specific gravity 1.015, pH 5.0, protein trace, blood trace. Urine microscopy reveals occasional red blood cells, rare white blood cells, and occasional oval fat bodies. The protein content of a 24-hour urine collection is 6 grams.

What is the most likely cause of this patient’s renal disease?

A. Obstruction of urinary flow due to an enlarged prostate
B. Acute tubular necrosis due to hypotension
C. Acute interstitial nephritis
D. Myeloma
E. Glomerulonephritis

35. The following are true regarding tubuloglomerular feedback (TGF) except:

A. High tubular flow rates are associated with a decreased renin release and TGF mediated afferent arteriolar constriction
B. Angiotensin II plays an important role in modulating TGF activity during changes in sodium intake, extracellular fluid volume, and renal perfusion
C. Vasconstrictor prostaglandins serve an important protective function and homeostatically balance the hemodynamic effects of angiotensin II
D. Predominant products of arachidonic acid metabolism in the normal kidney are prostaglandin E2 and prostaglandin I2
E. The juxtaglomerular apparatus is composed of the macula densa, the afferent arteriole, the efferent arteriole and the extraglomerular mesangium

36. The following are true of prerenal azotemia except

A. Prerenal azotemia may occur in the setting of decreased effective arterial filling
B. Prerenal azotemia may occur in the setting of impaired renal autoregulation
C. Administration of nonsteroidal anti-inflammatory drugs in patients with cirrhosis and sodium depletion will produce a decline in the GFR and an increase in the renal blood flow
D. Prerenal azotemia is associated with a high urine specific gravity and a high urine osmolarity due to increased ADH mediated reabsorption of water
E. The elevated BUN/creatinine ratio seen in prerenal azotemia reflects enhanced proximal tubular reabsorption of urea
37. The following are true of renal perfusion except

A. Blood flow to the kidney is determined by renal perfusion pressure and vascular resistances offered by the afferent and efferent arteriole
B. Mesangial cells play a role in regulation of GFR by way of their effects on the colloid oncotic pressure within the glomerular capillary
C. Elevations in afferent arteriolar resistance results in reduction of renal blood flow, which in turn decreases the hydrostatic pressure within the glomerulus and consequently reduces the GFR
D. The colloid oncotic pressure within the glomerulus increases as plasma flows from the afferent to the efferent arteriole

THE NEXT THREE QUESTIONS REFER TO THE FOLLOWING CASE

38. A 36 year old African American man with a ten year history of hypertension comes to the hospital with a headache. His blood pressure is 280/140 mm Hg. His urine analysis shows 2+ proteinuria and 2+ hematuria. His SCr is 2.7 mg/dL and the BUN is 34 mg/dL. What other abnormality would be expected to be present?

A. high glucose level
B. abnormal liver function tests
C. high level of ADH
D. chest x ray findings consistent with pulmonary vascular congestion
E. high serum calcium level

39. The basic anatomic unit of the kidney most responsible for this patient’s renal-related disease is:

A. the blood vessel
B. the glomerulus
C. the tubule
D. interstitium
E. the collecting system

40. In Figure 1, a characteristic lesion in this disease is illustrated. This lesion is best described as:

A. fibrinoid necrosis
B. hyaline arteriolosclerosis
C. inflammatory arteriolitis
D. glomerulosclerosis
E. hyperplastic arteriolitis
THE NEXT FIVE QUESTIONS REFER TO THE FOLLOWING CASE

A 56 year old female has hypertension for two years and type II diabetes mellitus for seven years. She has diabetic nephropathy and peripheral neuropathy. She is on oral glyburide for diabetes and hydrochlothiazide for hypertension. Two years ago, bloodwork showed: glucose 170 mg/dL, Na+ 140 mEq/L, K+ 5.3 mEq/L, HCO3- 16 mEq/L, BUN 18 mg/dL, creatinine 1.2 mg/dL. Urine analysis showed specific gravity of 1.015, pH 5, no proteinuria, and 2+ glucosuria.

She returns to see you today, two years later. Physical exam shows BP 148/88 lying and standing, HR 75/minute, clear lungs, and 1+ lower extremity edema.

41. Which of the following statements is correct regarding the serum creatinine?

- She has an increased serum creatinine level due to longstanding diabetes mellitus, with progression of her kidney disease over the past two years.
- It is unlikely that her serum creatinine is from diabetic nephropathy, as she had no proteinuria two years ago.
- The hypertension is not contributing to the progression of her kidney disease.
- She has developed acute renal failure due to volume depletion in the setting of diuretic use.
- There is no evidence of kidney disease and the increased creatinine level is due to a decrease in total body water.

One year later, her creatinine is increased to 1.7 mg/dL. Urine analysis shows a specific gravity of 1.005, pH of 5, 1+ proteinuria, and trace glucosuria. 24 hour urine shows 1.2 grams of protein.

42. What recommendations would you make?

- stop the thiazide diuretic
- avoid angiotensin converting enzyme inhibitors given the acute renal failure
- optimize the blood pressure to less than 130/80
- Place on a high protein diet
- Continue current management. Stricter control of her diabetes mellitus will not help delay progression of her kidney disease.

43. The basic anatomic unit of the kidney most responsible for this patient's proteinuria is:

A. the blood vessel
B. the glomerulus
C. the tubule
D. interstitium
E. the collecting system
44. A renal biopsy removed from this patient 5 years ago is shown in Figure 2. The asterisks identify lesions that are characteristic of this disease process. These lesions (*) are primarily located:

A. within mesangial cells
B. within the basement membrane of glomerular capillary loops
C. within the mesangial extracellular matrix
D. within the vasculature
E. within podocytes

45. The biopsy image shown in Figure 2 was prepared using the following technique:

A. periodic acid Schiff’s reagent (PAS) staining
B. immunofluorescence staining
C. silver staining
D. ultrastructural examination
E. RT-PCR

THE NEXT FOUR QUESTIONS REFER TO THE FOLLOWING CASE
A 42 year old man with hypertension and asthma presents with fever and cough. He is given oral cefuroxime, a cephalosporin antibiotic, with initial improvement. Two weeks later, he notes general malaise, poor appetite, and dyspnea, with peripheral edema. On exam, his temperature is 100 degrees F, blood pressure is 170/90, HR is 88, and he has crackles on pulmonary exam, no murmurs, and 1+ peripheral edema. Labs show: Na+ 140 mEq/L, K+ 4.0 mEq/L, Cl- 100 mEq/L, HCO3- 22 mEq/L, BUN 32 mg/dL, creatinine 2.0 mg/dL, urine Na+ 40 mEq/L. Urine analysis shows: specific gravity 1.010, trace proteinuria, 100 WBC/hpf, no red cells, no granular casts. Chest x ray shows pulmonary edema.

46. The patient’s pulmonary edema is likely due to:

- congestive heart failure with elevated venous pressures
- decreased oncotic pressure from the nephrotic syndrome
- sodium retention in response to renal hypoperfusion
- volume overload with acute renal failure due to acute interstitial nephritis
- acute tubular necrosis due to sepsis
47. A renal biopsy is obtained from this patient and is made into slides stained with hematoxylin and eosin (Figure 3a and 3b). Given your knowledge of this case, the arrows in Figure 3b most likely point to which of the following cell types:

A. mast cells
B. plasma cells
C. lymphocytes
D. eosinophils
E. polymorphonuclear leukocytes

48. Based on the case description and the images shown in Figure 3a and 3b, the disease process is best described as:

A. acute post-streptococcal glomerulonephritis
B. acute tubular necrosis
C. acute drug-induced interstitial nephritis
D. an autoimmune disorder
E. a paraneoplastic syndrome

49. In Figure 3a, the asterisk (*) identifies a structure (delimited by arrows) of the following type:

A. a normal glomerulus
B. a glomerulus with nodular glomerulosclerosis
C. a glomerulus affected by rapidly progressive glomerulonephritis
D. a glomerulus with segmental glomerulosclerosis
E. a glomerulus with acute proliferative glomerulonephritis

THE NEXT FIVE QUESTIONS REFER TO THE FOLLOWING CASE
A 58 year old woman with coronary artery disease and chronic congestive heart failure is treated with the angiotensin converting enzyme inhibitor lisinopril, the diuretic furosemide, and the beta blocker metoprolol, as well as aspirin. She has been taking an increased amount of ibuprofen for chronic back pain, and she comes to the emergency room with increasing angina and dyspnea. She has a blood pressure of 130/80, bilateral rales, and trace peripheral edema. Her Na+ is 136 mEq/L, BUN is 60 mg/dL, creatinine is 2.4 mg/dL, and urine sediment shows no cells or casts.
50. What urine findings would you expect to find? (Urine Na+ expressed as mEq/L, FeNa (fractional excretion of Na) expressed as %, urine osmolality expressed as mOsm/L)

A. urine Na+ 40, FeNa 3, urine osmolality 100
B. urine Na+ < 10, FeNa 0.6, urine osmolality 800
C. urine Na+ 10, FeNa 0.9, urine osmolality 60
D. urine Na+ 80, FeNa 5, urine osmolality 800
E. urine Na+ 40, FeNa 3, urine osmolality 300

The patient's chest xray shows congestive heart failure, for which the patient is given intravenous furosemide; she is also put on intravenous nitroglycerin. Blood pressure falls to 80/50, and she is now oligoanuric, with 100 cc urine output over 24 hours. The urine dipstick is negative and the urine sediment shows muddy brown casts and renal tubular epithelial cells.

51. All of the following contribute to the development of acute renal failure except:

A. underlying chronic kidney disease
B. ACE (angiotensin converting enzyme inhibitor) therapy
C. Diabetes mellitus
D. Nonsteroidal anti-inflammatory drug use
E. myoglobinuria

52. The basic anatomic unit of the kidney most responsible for this patient's renal-related disease is:

A. the blood vessel
B. the glomerulus
C. the tubule
D. interstitium
E. the collecting system

53. Figure 4 illustrates a biopsy taken from this patient at the time that she becomes anuric. The structures identified with asterisks (*) are best described as:

A. tubule lumens lined by regenerating tubular cells
B. veins
C. abscesses containing many gram negative bacteria
D. tubule lumens lined by necrotic tubular cells
E. dilated lymphatic channels
54. In this patient, the pathogenesis of her acute renal dysfunction is most likely:

A. ischemia
B. direct toxic injury
C. hypersensitivity
D. disseminated intravascular coagulation
E. urinary obstruction

THE NEXT FIVE QUESTIONS REFER TO THE FOLLOWING CASE

A 25 year old man comes to see you with a 2 month history of leg swelling. His blood pressure is 138/84. There is 2+ ankle edema. The serum creatinine is 1.3 mg/dL and the serum albumin level is 2.1 gm/dL. Urine analysis shows 4+ proteinuria and there is no hematuria. The 24 hour protein excretion is 8.4 gms.

55. What else would be expected to be present in this patient?

A. positive HIV serology
B. high level of antibodies against the streptococcal antigen
C. red blood cell casts on the urine sediment
D. positive anti-neutrophil cytoplasmic antibody titer
E. elevated total cholesterol level

56. A renal biopsy is performed and is illustrated in Figure 5a, 5b, and 5c. In Figure 5a, microscopic components of the kidney are illustrated with the numbers “1” through “4.” Which number is used to identify capillary lumens?

A. Number 1
B. Number 2
C. Number 3
D. Number 4

57. The biopsy image shown in Figure 5b was prepared using the following technique:

A. periodic acid Schiff’s reagent (PAS) staining
B. immunofluorescence staining
C. silver staining
D. ultrastructural examination
E. RT-PCR
58. In Figure 5b, the small boxes are used to identify changes that are further illustrated in Figure 5c. The numbers used to identify microscopic structures in Figure 5a are used to illustrate the same structures in Figure 5c. The lesions identified with arrows in Figure 5c are best described as:

A. fused foot processes
B. subendothelial electron dense deposits
C. subepithelial electron dense deposits
D. thickened slit diaphragms
E. infiltrating inflammatory cells

59. Based on the history and the morphological findings illustrated in Figure 5a, 5b, and 5c, this patient’s diagnosis is:

A. membranoproliferative glomerulonephritis
B. IgA nephropathy
C. rapidly progressive plomerulonephritis
D. membranous glomerulopathy
E. minimal change disease

QUESTIONS 60-63. For each of the characteristics listed below, choose which type of polycystic kidney disease it best describes: autosomal recessive polycystic kidney disease (ARPKD), autosomal dominant polycystic kidney disease (ADPKD), both of these, or neither of these.

A. autosomal recessive polycystic kidney disease (ARPKD)
B. autosomal dominant polycystic kidney disease (ADPKD)
C. both of these
D. neither of these

60. May be accompanied by liver cysts and/or fibrosis

61. Usually presents in childhood

62. On gross examination of the kidneys, you often see dilated channels at right angles to the cortical surface involving the cortex and medulla

63. Subarachnoid hemorrhages may occur in 4-10% of these patients
QUESTIONS 64-68 For each of the characteristics listed below, choose which type of glomerulonephritis it best describes: minimal change disease, IgA nephropathy, both of these, or neither of these.

A. minimal change disease
B. IgA nephropathy
C. both of these
D. neither of these

64. Frequently associated with hematuria

65. Can be definitively diagnosed by light microscopy

66. Most commonly presents in the elderly

67. Most often responds to steroid therapy and has an excellent overall prognosis

68. May be etiologically related to a respiratory tract infection

QUESTIONS 69-71. For each of the characteristics listed below, choose the best associated disease from the following list:

A. malignant hypertension
B. hemolytic uremic syndrome
C. fibromuscular dysplasia
D. benign hypertension
E. thrombotic thrombocytopenic purpura

69. Typically occurs in children after a gastrointestinal illness

70. Fibrinoid necrosis of arterioles

71. Involves the main renal artery

QUESTIONS 72-74. For each of the characteristics listed below, choose which type of pyelonephritis it best describes: acute pyelonephritis, chronic pyelonephritis, both of these, or neither of these.

A. acute pyelonephritis
B. chronic pyelonephritis
C. both of these
D. neither of these

72. Most often due to vesicoureteral reflux

73. Associated with polymorphonuclear leukocytes in the tubules and interstitium

74. Associated with cortical scarring and slowly evolving renal failure
QUESTIONS 75-79. For each of the characteristics listed below, choose which type of urinary tract tumor it best describes: renal cell carcinoma, transitional cell carcinoma of the urinary bladder, both of these, or neither of these.

A. renal cell carcinoma
B. transitional cell carcinoma of the urinary bladder
C. both of these
D. neither of these

75. May present with hematuria

76. Most often presents as a papillary tumor

77. Most often is composed of clear cells rich in glycogen and lipid

78. Cigarette smoking is an important risk factor

79. May occur in a familial syndrome in association with hemangioblastomas

80. During normal development, an orderly sequence of events occurs. Choose the answer below that orders (from 1st to last) the following developmental events correctly:

1) formation of the last nephron in the definitive kidney
2) appearance of somites
3) appearance of the ureteric bud (metanephric diverticulum)
4) appearance of the uterine tube

A. 2-4-1-3
B. 2-3-4-1
C. 2-4-3-1
D. 3-4-1-2
E. 3-1-2-4

81. Which of the following diuretics is not correctly paired with an associated side effect?

A. Furosemide: ototoxicity
B. Hydrochlorothiazide: hypoglycemia
C. Triamterene: hyperkalemia
D. Bumetanide: hypokalemia
E. Spironolactone: gynecomastia
82. All of the following pairs below represent rational combinations of diuretics, **except:**

A. Furosemide + metolazone  
B. Hydrochlorothiazide + amiloride  
C. Spironolactone + triamterene  
D. Hydrochlorothiazide + spironolactone  
E. Bumetanide + triamterene

83. All of the following statements regarding diuretics are true **except:**

A. Carbonic anhydrase inhibition leads to increased reabsorption of NaHCO3.  
B. Loop diuretics decrease Na+ reabsorption at the loop of Henle by competing for the  
   Cl- site on the Na+/K+/2Cl- cotransporter.  
C. In general, the effectiveness of a diuretic is determined by where it acts in the renal  
   tubule.  
D. Hydrochlorothiazide decreases uric acid excretion  
E. Spironolactone is generally only effective when aldosterone levels are elevated

84. All of the following diuretics may be useful in patients with diminished renal  
function (ie., GFR < 30 ml/min) **except:**

A. Furosemide  
B. Hydrochlorothiazide (HCTZ)  
C. Metolazone  
D. Torsemide  
E. Bumetanide

85. Which of the following statements about diuretics is **not** correct.

A. Thiazides are as likely to produce hypokalemia as loop diuretics  
B. Acetazolamide is more commonly used for glaucoma and altitude sickness than  
   diuresis  
C. Mannitol can lead to volume overload in patients with poor renal function  
D. Bumetanide is both more potent and longer acting than furosemide  
E. Metolazone may be useful in patients that are refractory to HCTZ
86. All of the following diuretics may cause hypersensitivity reactions in patients who are hypersensitive to sulfonamides, except:

A. Furosemide
B. Acetazolamide
C. Spironolactone
D. Triamterene
E. Hydrochlorothiazide (HCTZ)

87. Indicate which of the following is the best way to assess a patient's pain:

- Using patient verbal pain descriptors.
- From EEG monitoring.
- Asking the nurse caring for the patient.
D. By watching the patient at rest.
E. By checking the patient's pulse.

88. The preferred routes of opioid delivery for the treatment of acute postoperative pain in an opioid naïve patient include:

- Oral.
- Intravenous and epidural.
- Transdermal and intramuscular.
- All of the above.
- A and B only.

89. Local anesthetics are useful adjuncts for pain relief because they:

- Are capable of blocking all sensory input.
- Reduce opioid requirements and side effects.
- Are capable of improving ventilation via the epidural route.
- May augment diaphragmatic function following upper abdominal surgery.
- All of the above.

90. The therapeutic uses for morphine include all of the following except:

A. Analgesia
B. Suppression of the cough reflex
C. Suppression of the emetic response
D. Relief of diarrhea
91. Patients treated with methadone maintenance therapy for a history of opioid addiction should be managed postoperatively by:

- Continuing the methadone at the same dose.
- Avoiding opioids for postoperative pain control to prevent opioid craving.
- Providing a morphine dose at least 2-3 times higher than the patient's preoperative opioid dose per 24-hour period.
- Relying only on pain scores for determining the appropriate analgesic dose.
- A and C.

92. When used for postoperative pain control, local anesthetics may:

- Produce seizures if inadvertently injected into the vascular system.
- Produce a cardiac arrest if a high potency agent, such as bupivacaine, is injected for a nerve block and inadvertently enters the systemic circulation.
- Increase the risk of pressure sores and nerve compression injuries because the patient cannot feel discomfort.
- Dramatically reduce opioid requirements and side effects.
- All of the above.

93-97. Match up the numbered antihypertensive drug with the most appropriate lettered description. Each lettered description may be used once, more than once, or not at all.

93. Labetalol
94. Clonidine
95. Minoxidil
96. Prazosin
97. Atenolol

A. A relatively selective \( \alpha_1 \) receptor antagonist
B. A relatively selective \( \beta_1 \) receptor antagonist
C. An antagonist at \( \alpha \) and \( \beta \) adrenergic receptors
D. Produces vascular smooth muscle hyperpolarization via activation of potassium channels
E. Lowers blood pressure via \( \alpha_2 \) receptor stimulation in the central nervous system
98. Indicate which of the following pairings is correct:

A. Hydrochlorothiazide: A loop diuretic used only in the most severe cases of hypertension
B. Nitroprusside: A nitric oxide generator used in hypertensive emergencies
C. Lisinopril: An angiotensin receptor antagonist
D. A and B
E. B and C

99. In normal 70-kg subjects drug A has a half-life of 4 hours and a recommended infusion rate of 10 μg/min. In a 70-kg patient with renal failure, the volume of distribution of drug A is like that found in normal subjects, but its total clearance is only half as large. An appropriate infusion rate of drug A for this patient would be:

A. 2.5 μg/ml
B. 5 μg/ml
C. 10 μg/ml
D. 20 μg/ml
E. 40 μg/ml

100-102. A male adult patient (48 yr, 60 kg) whose serum creatinine is 3.0 mg/dL requires tobramycin. A normal dose is 150 mg twice a day by IV injection. Tobramycin is 90% excreted unchanged in the urine. Assume normal creatinine clearance is 100 ml/min.

\[ \text{Cl}_{dr} = \frac{(140 - \text{age yr}) \times \text{body weight (kg)}}{72 \times C_{cr} (\text{mg/dL})} \]

\[ k^u = 1 - fe \left( \frac{1 - Cl^u \text{Cr}}{Cl^u \text{cr}} \right) = G \]

\[ k^n = \frac{k^n}{Cl^n \text{cr}} \]

\[ D_u = \frac{k^n \times D_n}{k^u} \]

\[ \tau_u = \tau_n \times \frac{k^n}{k^u} \]

100. What is the creatinine clearance of this patient?

A. 10 - 20 ml/min
B. 21-30 ml/min
C. 31- 40 ml/min
D. 41- 50 ml/min
101. What dose of tobramycin should be given twice a day?

A. 10 mg  
B. 25 mg  
C. 50 mg  
D. 100 mg

102. What dosing interval should be used for a dose of 150 mg?

A. 12 hr  
B. 24 hr  
C. 36 hr  
D. 48 hr

103. Indicate which of the following immunosuppressants is a pro-drug:

A. Azathioprine  
B. Mycophenolic acid  
C. OKT3  
D. A and B  
E. A, B and C

104. All of the following immunosuppressants are correctly paired with an associated side effect except:

A. Cyclosporine: Hyperuricemia (gout)  
B. Prednisone: Delayed growth  
C. Tacrolimus: Hirsutism  
D. Sirolimus: Exacerbation of cyclosporine nephrotoxicity  
E. Azathioprine: Leukopenia

105-108. Match up the numbered immunosuppressant with the most appropriate lettered description of its immunosuppressant mechanism of action. Each lettered description may be used once, more than once, or not at all.

105. Cyclosporine  
106. Azathioprine  
107. Mycophenolic acid  
108. Basilixumab

A. Interference with nucleic acid production  
B. Inhibition of function of the IL-2 receptor  
C. Inhibition of microtubule dissociation  
D. Interference with the production of IL-2
109. All of the following statements concerning treatment for chronic renal failure are correct except:

- Less than 1 patient in 10 desiring a kidney transplant will be able to obtain a transplant
- About 85% of patients in the United States choose peritoneal dialysis over hemodialysis
- Most dialysis in the United States is performed in free standing dialysis units run by "for profit" companies
- Dialysis costs more than $10,000 per patient per year
E. The cost of dialysis in the United States is covered by the Federal government

THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING CASE

A 35 year old woman with type I diabetes mellitus for 25 years developed proteinuria about 15 years ago; this reached the nephrotic range about 10 years ago, and despite treatment with angiotensin converting enzyme inhibitors, she has continued to excrete > 5 grams of protein per day. Her renal function was normal 15 years ago, but 10 years ago her creatinine level rose to 1.5 mg/dl, 7 years ago it was 2.1 mg/dL, 5 years ago it was 2.7 mg/dl, 3 years ago it was 4.1 mg/dl, and one year ago it was 5.9 mg/dL. She presents now with weight loss, nausea and vomiting, itching and severe fatigue. Her blood pressure is 170/100, she has neck vein distention, rales, an S3 gallop, and peripheral edema. Her skin is excoriated and she is pale. Her BUN is 110 mg/dl and her creatinine level is 8.8 mg/dl.

110. The patient is offered the choice between hemodialysis (urea clearance of 250 ml/min; 4 hours, three times per week) and CAPD (four 2.5 liters per 24 hours). After the patient is stable and blood BUN has reached steady state, which therapy would remove more urea?

A. Both therapies would remove the same amount of urea
B. Hemodialysis would remove more urea
C. CAPD (Continuous Ambulatory Peritoneal Dialysis) would remove more urea
D. The answer depends upon the patient’s weight which is not provided

111. What is the best chronic therapy for this patient, if available?

A. Transplantation
B. CAPD
C. Hemodialysis
D. Continuous hemofiltration
THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING CASE

A 62 year old woman with mild obesity and is admitted to the hospital with abdominal pain and fever; work up reveals cholelithiasis (gall stones) with a dilated common bile duct. Her temperature rises to 104 degrees and her blood pressure drops to 60/30; blood cultures are positive for the gram negative rod E.coli and she is started on broad spectrum antibiotics. Over the next 24 hours, she is intubated for airway protection and transferred to the intensive care unit. Despite antibiotics, massive doses of intravenous antibiotics, and vasopressors to support her blood pressure, she remains critically ill and with a systolic blood pressure of less than 80 mmHg. She becomes oligoanuric, then anuric, and her BUN rises to 100 mg/dl, with a creatinine of 6.6 mg/dl, and a potassium level of 6.4 mg/dl.

112. This patient is treated with continuous hemofiltration (no dialysate) with an ultrafiltration rate of 20 ml/min. The patient’s hematocrit is 30% What is the urea clearance (closest answer)?

A. 12 ml/min
B. 14 ml/min
C. 20 ml/min
D. 30 ml/min

113. The patient’s weight is 60 Kilograms and the treatment described in question 5 is initiated when the BUN is 100 mg/dl. What is the BUN after 8 hours? (ignore catabolism + intradialytic urea generation; closest answer)

A. 100 mg/dl
B. 80 mg/dl
C. 40 mg/dl
D. 30 mg/dl
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