

Pharma Renal

1. A 75-year-old man (height 73 inches, weight 92.5 kg; baseline serum creatinine [SCr] 0.9 mg/dL) presents to your institution with abdominal pain and dizziness. He has a brief history of gastroenteritis and has had nothing to eat or drink for 24 hours. His blood pressure reading while sitting is 120/80 mm Hg, which decreases to 90/60 mm Hg when standing. His heart rate is 90 beats/minute. His basic metabolic panel shows sodium (Na) 135 mEq/L, chloride (Cl) 108 mEq/L, potassium (K) 4.7 mEq/L, carbon dioxide (CO₂) 26 mEq/L, blood urea nitrogen (BUN) 40 mg/dL, SCr 1.5 mg/dL, and glucose 188 mg/dL. He has no known drug allergies. Which initial treatment of this patient's acute kidney injury (AKI) is best?

- a) Administer furosemide 40 mg intravenously × 1 dose.
- b) Insert Foley catheter to check for residual urine.
- c) Administer fluid bolus (500 mL of normal saline solution).
- d) Administer insulin lispro 3 units subcutaneously.

2. A 44-year-old man is admitted with gram-negative bacteremia. He receives 4 days of parenteral aminoglycoside therapy and develops acute tubular necrosis (ATN). Antibiotic therapy is adjusted on the basis of culture and sensitivity results. Which laboratory value is most consistent with this presentation?

- a) BUN/SCr ratio greater than 20:1.
- b) Urinalysis with no casts visible.
- c) Fractional excretion of sodium (FENa) more than 2%.
- d) Urinary sodium less than 20 mEq/L.

3. Which of the following pharmacokinetic parameters describes a drug that will be most effectively removed by hemodialysis?

- a) Serum protein binding 90% and volume of distribution of 2.5 L/kg
- b) Serum protein binding 30% and volume of distribution of 2.5 L/kg
- c) Serum protein binding 90% and volume of distribution of 0.3 L/kg
- d) Serum protein binding 30% and volume of distribution of 0.3 L/kg

4. A 45-year-old man (weight 59 kg, height 70 inches) has a long history of cancer and malnutrition. His SCr is 0.5 mg/dL. Carboplatin will be initiated, for which an accurate estimate of kidney function is critical. Which group of parameters is best to use when estimating kidney function using the Cockcroft-Gault equation?

- a) Actual body weight and measured SCr.
- b) Actual body weight and SCr rounded to 1 mg/dL.
- c) Ideal body weight and measured SCr.
- d) Ideal body weight and SCr rounded to 1 mg/dL.

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5. A 59-year-old patient who has had CKD category G5D for 10 years has hypertension, coronary artery disease, mild heart failure with reduced ejection fraction (HFrEF), and type 2 diabetes. Medications are as follows: epoetin 10,000 units intravenously three times/week at dialysis, renal multivitamin once daily, atorvastatin 20 mg/day, insulin, and calcium acetate 1334 mg three times daily with meals. Laboratory values are as follows: hemoglobin (Hgb) 9.2 g/dL, parathyroid hormone (PTH) 300 pg/mL, Na 140 mEq/L, K 4.9 mEq/L, SCr 7.0 mg/dL, calcium 9 mg/dL, albumin 3.5 g/dL, and phosphorus 4.8 mg/dL. His serum ferritin concentration is 80 ng/mL and transferrin saturation (TSAT) is 14%. Mean corpuscular volume, mean corpuscular hemoglobin concentration, and white blood cell count (WBC) are all normal. He is afebrile. Which is best for managing this patient's anemia?

- a) Increase epoetin.
- b) Add oral iron.
- c) Add intravenous iron.
- d) Maintain current regimen; patient is at goal.

6. A 60-year-old patient (weight 72 kg) with a history of diabetes and hypertension is in the intensive care unit after having a myocardial infarction about 1 week ago with secondary heart failure. He now has pneumonia. He has been hypotensive for the past 5 days. Before his admission 1 week ago, his SCr was 1.0 mg/dL. His urinary output has steadily been declining for the past 3 days, despite adequate hydration, with 700 mL of urinary output in the past 24 hours. His medications include intravenous dobutamine, nitroglycerin, and cefazolin. Yesterday, his BUN and SCr were 32 and 3.1 mg/dL, respectively; today, they are 41 and 3.9 mg/dL. His urinary osmolality is 290 mOsm/kg. His urinary sodium is 45 mEq/L, and there are tubular cellular casts in his urine. Which type of AKI is this patient most likely experiencing?

- a) Prerenal azotemia.
- b) ATN.
- c) Acute interstitial nephritis (AIN).
- d) Hemodynamic/functional-mediated AKI.

7. You are evaluating a study comparing epoetin and darbepoetin with respect to their efficacy on mean Hgb concentrations. Both drugs are initiated at the recommended dose, and the Hgb concentration is checked at 4 weeks. Fifty patients are in each group. The mean Hgb in the epoetin group is 12.1 g/dL and is 12.2 g/dL in the darbepoetin group. Which statistical test is best for this comparison?

- a) Paired t-test.
- b) Independent (unpaired) t-test.
- c) Analysis of variance.
- d) Chi-square test.

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8. A pharmacoeconomic study compared the use of erythropoiesis-stimulating agents with various Hgb concentrations. The primary outcome of this study was cost per quality-adjusted life-year gained. Which best describes this economic evaluation?

- a) Cost-minimization.
- b) Cost-effectiveness.
- c) Cost-benefit.
- d) Cost-utility.

9. A 58-year-old woman is being evaluated for AKI. Laboratory test results include serum sodium 134 mEq/L, BUN 35 mg/dL, SCr 1.8 mg/dL, urinary sodium 24 mEq/L, and urinary creatinine 14.3 mg/dL. Which is the best estimate of this patient's FENa?

- a) 0.8%.
- b) 1.25%.
- c) 2.3%.
- d) 4.4%.

10. A 55-year-old man has a history of hypertension. His eGFR is 48 mL/minute/1.73 m² and urinary albumin/creatinine ratio (ACR) is 28 mg/g. Which best depicts what this patient's goal blood pressure should be less than, according to the kidney disease: Improving Global Outcomes (KDIGO) guidelines?

- a) 130/80 mm Hg.
- b) 140/90 mm Hg.
- c) 140/80 mm Hg.
- d) 130/90 mm Hg.

11. A 66-year-old man has an eGFR of 55 mL/minute/1.73 m². His ACR is 100 mg/g. His Hgb is currently 13.2 g/dL, with normal red blood cell indices without treatment. Which best reflects the recommended minimum frequency of Hgb monitoring in this patient?

- a) Monthly.
- b) Every 3 months.
- c) Every 6 months.
- d) Every 12 months.

12. A 68-year-old patient has diabetes, hypertension, and an eGFR of 40 mL/minute/1.73 m². Medications include a renal multivitamin once daily, simvastatin, lisinopril, and hydrochlorothiazide. Laboratory values are as follows: Hgb 11.2 g/dL, immunoassay for PTH 200 pg/mL, Na 138 mEq/L, K 4.9 mEq/L, calcium 8.6 mg/dL, albumin 3.5 g/dL, phosphorus 5.8 mg/dL, and 25-hydroxyvitamin D 45 ng/mL. Which is best to prevent CKD-mineral and bone disorder (MBD) in this patient?

- a) Ergocalciferol.
- b) Calcium acetate.
- c) Calcitriol.
- d) Cinacalcet.

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1-5. A 48-year-old African American man (weight 70 kg) with a history of type 2 diabetes, hypertension, and osteoarthritis is admitted to the intensive care unit after an acute myocardial infarction. He was initially hypotensive, requiring 3 L of intravenous fluid. His blood pressure is now 100/65 mm Hg. Medications before admission include nicotine patch, metformin 500 mg orally twice daily, lisinopril 20 mg/day, acetaminophen 650 mg every 6 hours for joint pain, and aspirin 81 mg/daily. Before admission, his kidney function was normal (SCr 1.0 mg/dL); however, during the past 24 hours, his kidney function has declined (BUN 20 mg/dL, SCr 2.1 mg/dL). Serum sodium is 140 mEq/L and serum potassium is 4.4 mEq/L. Urinary volume has been 300 mL over the past 12 hours through urinary catheter. His urine shows muddy casts. His urinary sodium is 45 mEq/L and urinary creatinine is 20 mg/dL. He has edema and pulmonary congestion.

1. Which is the best assessment of this patient's AKI?

- a) KDIGO stage 1 AKI.
- b) KDIGO stage 2 AKI.
- c) KDIGO stage 3 AKI.
- d) Too early to assess for AKI.

2. Which best depicts this patient's FENa?

- a) 0.32%.
- b) 0.67%
- c) 1.5%.
- d) 3.4%.

3. Which is the best classification of this patient's AKI?

- a) Prerenal azotemia.
- b) Intrinsic renal disease.
- c) Postrenal obstruction.
- d) Functional AKI.

4. Which medication should be discontinued because of its risk for worsening kidney function in this patient?

- a) Lisinopril.
- b) Nicotine patch.
- c) Acetaminophen.
- d) Aspirin.

5. Which is most appropriate to add at this time?

- a) Intravenous 0.9% sodium chloride.
- b) Hydrochlorothiazide.
- c) Furosemide.
- d) Fluid restriction.

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6. A 67-year-old man is referred for intermittent chest pain. His medical history is significant for CKD KDIGO category G3a, type 2 diabetes, and hypertension. Medications include enalapril, hydrochlorothiazide, and pioglitazone. Laboratory values include SCr 1.8 mg/dL, glucose 189 mg/dL, Hgb 12 g/dL, and hematocrit (Hct) 36%. His physical examination is normal. The treatment plan is elective cardiac catheterization. Which is best for hydration?

- a) 0.9% sodium chloride.
- b) 0.45% sodium chloride.
- c) 5% dextrose/0.45% sodium chloride.
- d) Oral hydration with water.

7. After the administration of radiocontrast, which best represents the optimal time to reevaluate renal function to assess for the development of contrast-associated nephropathy?

- a) 6 hours.
- b) 24 hours.
- c) 4 days.
- d) 7 days

8-11. A 55-year-old man has a history of hypertension and newly diagnosed type 2 diabetes. He denies alcohol use but does smoke cigarettes (1 pack/day). His medications include atenolol 50 mg/day and a multivitamin. At your pharmacy, his blood pressure is 149/92 mm Hg. His ACR is 400 mg/g. A recent SCr is 1.9 mg/dL, which is consistent with a value measured 3 months earlier. His eGFR is 50 mL/minute/1.73 m².

8. Which category best reflects his kidney disease, according to the KDIGO criteria?

- a) G2.
- b) G3a.
- c) G3b.
- d) G4.

9. Using the KDIGO categorization, which best assesses this patient's albuminuria?

- a) Category A1.
- b) Category A2.
- c) Category A3.
- d) Nephrotic-range proteinuria.

10. Assuming that nonpharmacologic approaches have been optimized, which is best to limit the progression of his kidney disease?

- a) Add nifedipine.
- b) Add diltiazem.
- c) Add enalapril.
- d) Increase atenolol.

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11. Enalapril is added to this patient's regimen. Two weeks later, he returns for a follow-up. His blood pressure is 139/89 mm Hg. A repeat SCr is 2.3 mg/dL, and serum potassium is 5.2 mEq/L. Which is the best recommendation for this patient?

- a) Add chlorthalidone 50 mg/day. Monitor blood pressure, SCr, and K in 2 weeks.
- b) Change enalapril to diltiazem extended release. Monitor blood pressure, SCr, and K in 2 weeks.
- c) Change enalapril to valsartan.
- d) Increase atenolol.

12. A study compared use of an ARB alone and in combination with an ACEI in patients with CKD. Acute kidney injury occurred in 80 of 724 patients (11%) receiving monotherapy and 130 of 724 patients (18%) receiving combination therapy. Given this information, which most accurately depicts the number of patients needed to harm?

- a) 7.
- b) 14.
- c) 50.
- d) 105

13. A 70-year-old man is being assessed for HD access. He has a history of diabetes mellitus and hypertension but is otherwise healthy. Which HD access modality is best to use in this patient?

- a) Subclavian catheter.
- b) Tenckhoff catheter.
- c) Arteriovenous graft.
- d) Arteriovenous fistula.

14. A patient undergoing long-term HD has intradialytic hypotension. After nonpharmacologic approaches have been optimized, which medication is best to manage his low blood pressure?

- a) Levocarnitine.
- b) Sodium chloride tablets.
- c) Fludrocortisone.
- d) Midodrine.

15. A patient with CKD on peritoneal dialysis presents with fever and abdominal pain. She also notes that her peritoneal dialysate has become cloudy. Laboratory evaluation of dialysate reveals many white blood cells, primarily neutrophils. Gram stain and culture of the fluid are ordered. According to the 2016 International Society for Peritoneal Dialysis Peritonitis Recommendations, which is the best empiric therapy for this patient?

- a) Intravenous metronidazole plus gentamicin.
- b) Intravenous clindamycin plus vancomycin.
- c) Cefazolin plus ceftazidime instilled intraperitoneally.
- d) Vancomycin instilled intraperitoneally.

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16-17. A 60-year-old patient on HD has had ESRD for 10 years. His HD access is a left arteriovenous fistula. He has a history of hypertension, coronary artery disease, mild HFrEF, type 2 diabetes, and a seizure disorder. Medications are as follows: epoetin alfa 14,000 units intravenously three times/week at dialysis, a renal multivitamin once daily, atorvastatin 20 mg/day, insulin, calcium acetate 2 tablets three times daily with meals, phenytoin 300 mg/day, and intravenous iron 100 mg/month. Laboratory values are as follows: Hgb 10.2 g/dL, PTH 800 pg/mL, Na 140 mEq/L, K 4.9 mEq/L, SCr 7.0 mg/dL, calcium 9.5 mg/dL, albumin 2.5 g/dL, and phosphorus 7.8 mg/dL. Serum ferritin is 550 ng/mL, and TSAT is 32%. The red blood cell count indices are normal. His WBC is normal, and he is afebrile.

16. Which is most likely contributing to this patient's relative epoetin resistance?

- a) Hyperparathyroidism.
- b) Iron deficiency.
- c) Phenytoin therapy.
- d) Infection.

17. In addition to diet modification and emphasizing adherence, which is best for managing this patient's hyperparathyroidism?

- a) Increase calcium acetate.
- b) Change calcium acetate to sevelamer and add cinacalcet.
- c) Hold calcium acetate and add intravenous vitamin D analog.
- d) Add intravenous vitamin D analog

18. A 40-year-old patient on dialysis with a history of grand mal seizures takes phenytoin 300 mg/day. His albumin concentration is 3.0 g/dL. His total phenytoin concentration is 5.0 mcg/mL. Which best interprets the phenytoin concentrations?

- a) Subtherapeutic; a dose increase is needed.
- b) Therapeutic; no dosage adjustment is needed.
- c) Toxic; a dose reduction is needed.
- d) Not interpretable.

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1. Which of the following is not part of the definition of Acute Kidney Injury (AKI)? (

- a) Increase in serum creatinine by ≥ 0.3 mg/dL within 72 hours
- b) Urine output of less than 0.5 mL/kg/hour for 6 hours
- c) Increase in serum creatinine to ≥ 1.5 times baseline, which is known or presumed to have occurred within the prior 7 days
- d) An increase in serum creatinine from 0.8 mg/dL to 1.3 mg/dL within 48 hours
- e) Anuria for 12 hours

2. Which of the following patients meet the criteria for stage 3 AKI according to the KDIGO Clinical Practice Guidelines?

- a) 6-year-old girl with an estimated GFR to 50 mL/min/1.73 m²
- b) 88-year-old man with an increase in serum creatinine to two times over baseline the past 48 hours
- c) 45-year-old woman with an increase in baseline serum creatinine from 0.9 to 2.2 mg/dL in 48 hours
- d) 77-year-old man who started renal replacement therapy 3 hours ago
- e) 24-year-old man that has a urine output of 0.4 mL/kg/hour for the past 12 hours

3. Which of the following is not consistent with acute tubular necrosis in a patient with oliguria?

- a) Urine osmolality of 280 mOsm/L
- b) Fractional excretion of sodium (FENa) of 3%
- c) Urine/plasma creatinine ratio of 18
- d) The presence of granular casts on urine microscopy
- e) Urinary sodium of 12 mEq/L

4. Which of the following would not be part of an appropriate initial workup for a postoperative surgical patient with oliguria, a BUN of 45 mg/dL and a creatinine of 2.2 mg/dL?

- a) Sending urinary electrolytes and creatinine to calculate a fractional excretion of sodium (FENa)
- b) Assessment of intravascular volume by invasive monitoring
- c) Renal arteriography to assess for renal artery stenosis
- d) Calculation of the BUN/Cr ratio
- e) Placement of a Foley catheter to assess hourly urine volume

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5. A 49-year-old woman is admitted to the ICU after undergoing an abdominal peritoneal resection for rectal cancer. Immediately postoperatively, the patient was noted to have decreased urine output. She responds well to a fluid bolus. She was restarted on her home medications, which included atorvastatin, aspirin 325mg, lisinopril, and metoprolol. On postoperative day 4, she is noted to have purulent drainage from her perineal wound. Her abdomen has increased distention. Her WBC is 17 000/mm³, and she is febrile to 38.9°C. Her creatinine was 0.8mg/dL preoperatively and is now 2.7mg/dL. Her urine output was 10ml in the last hour. A bladder pressure is measured and is noted to be 10mm Hg. Which of the following is least likely to have contributed to the AKI in this patient?

- a) Hypovolemia
- b) Nephrotoxic agent
- c) Sepsis
- d) Increased abdominal pressure
- e) Ischemia

6. Which of the following patients with hyperkalemia would most benefit from dialysis?

- a) 58-year-old man with a potassium level of 5.2mEq/L and a urine output of 0.4mL/kg/hour over a 48 hour period
- b) 72-year-old man taking lisinopril 20mg daily with a potassium level of 5.5mEq/L
- c) 49-year-old woman with a potassium level of 5.7mEq/L with a recent diagnosis of stage 1 AKI but decreasing levels of serum creatinine over the past 24 hours
- d) 56-year-old woman with a potassium level of 5.8mEq/L which has been refractory to conservative therapy and a recent diagnosis of stage 2 AKI
- e) 94-year-old woman with a recent diagnosis of stage 3 AKI and a potassium level of 5.5mEq/L, but with a good prognosis

7. In patients with acute kidney injury from traumatic rhabdomyolysis, which of the following is true?

- a) Serum myoglobin levels remain elevated longer than serum CK levels
- b) Early aggressive fluid replacement with saline is the mainstay of treatment
- c) Mannitol is strongly recommended as first line therapy in the treatment of this condition
- d) Alkalinization of the urine using intravenous sodium bicarbonate, targeting a pH of greater than 6.0, can prevent renal failure in patients with rhabdomyolysis
- e) Treatment should be instituted when the creatine kinase (CK) levels rise to above 3000 U/L

8. Which of the following would not be considered an indication for acute dialysis?

- a) A patient with primary hyperparathyroidism, with a serum calcium of 12mg/dL, unresponsive to hydration and calcitonin
- b) A pericardial friction rub in a patient with a BUN of 100mg/dL
- c) A patient with a prolonged international normalized ratio due to warfarin overdose
- d) A central venous pressure of 20cmH₂O in a patient with AKI and acute pulmonary edema
- e) A pH of 7.15, unresponsive to bicarbonate fluid therapy

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9. Which of the following prevention strategies has the highest level of evidence for reducing the risk of contrast-induced nephropathy (CIN) using intravenous low-osmolar contrast media (LOCM)?

- a) Ascorbic Acid plus IV saline
- b) IV sodium bicarbonate alone
- c) N-acetylcysteine plus IV saline
- d) Intravenous saline alone
- e) N-acetylcysteine plus IV sodium bicarbonate

10. Which of the following signs and/or symptoms is unlikely to be observed in a patient with hyperkalemia due to stage 3 AKI?

- a) Widened QRS complex in a patient with a potassium level of 5.5mEq/L
- b) Peaked T waves on the EKG
- c) Left bundle branch block with a potassium level of 7.2mEq/L.
- d) Ventricular fibrillation if untreated
- e) Generalized fatigue

11. Which of the following laboratory findings is consistent with an intrinsic cause of acute kidney injury?

- a) Urine osmolality of 380mOsm/L
- b) BUN/Cr ratio of 18
- c) Urine Na of 15mEq/L
- d) Fractional excretion of sodium (FENa) of 1%
- e) Urine pH of 4.5

12. Which of the following tests is the single most discriminatory test in distinguishing the difference between a prerenal and intrinsic cause of AKI?

- a) Urine Na
- b) Urine osmolality
- c) FENa
- d) Urine specific gravity
- e) BUN/Cr ratio

13. In a patient with severe hyperkalemia (potassium >6.5mEq/dL) and widened QRS complexes, which of the following treatments should be administered first to prevent malignant ventricular arrhythmias?

- a) Albuterol
- b) Intravenous calcium gluconate
- c) Intravenous sodium bicarbonate
- d) Intravenous furosemide
- e) Intravenous insulin and glucose

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14. Which of the following statements is correct regarding the use of furosemide in acute kidney injury (AKI)?

- a) Furosemide will decrease the percentage of patients with AKI who will require renal replacement therapy
- b) The use of high-dose furosemide for AKI is not associated with significant side effects
- c) Furosemide can convert patients from an oliguric to non-oliguric state, which is associated with a decreased hospital length of stay
- d) Administration of furosemide for AKI is associated with increased mortality
- e) Furosemide will induce a diuresis in some patients with acute kidney injury

15. When used in the treatment of acute kidney injury, dopamine has all of the following effects except?

- a) Tachycardia and other arrhythmias
- b) An increase in the glomerular filtration rate
- c) A significant rise in the urine output in the majority of patients
- d) Administration of low-dose dopamine at $5\mu\text{g/kg/min}$ is more effective than $3\mu\text{g/kg/min}$ in preventing the need for renal replacement therapy
- e) Has been shown to effectively reduce the need for renal replacement therapy

16. Which of the following medications would be the least likely cause of acute kidney injury in a female patient with a new rash, white blood cells in the urine, a normal white blood cell count and eosinophilia on urine microscopy?

- a) Phenytoin
- b) Ketorolac
- c) Heparin
- d) Pantoprazole
- e) Amoxicillin

17. Which of the following is not an advantage of continuous renal replacement therapy over intermittent dialysis?

- a) It can be used in hemodynamically abnormal patients
- b) Less expensive
- c) Useful to remove fluid in smaller volumes
- d) More effective in lowering intracranial pressure
- e) Better removal of pro-inflammatory mediators

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18. A 55-year-old man sustained multiple injuries in a motorcycle collision. Imaging revealed a grade 3 liver laceration with a blush. He undergoes embolization and is admitted to the ICU. On hospital day 3, the patient is noted to have decreased urinary output. His creatinine of 2.0mg/dL, sodium is 133mEq/L, urine creatinine 90mg/dL, urine sodium is 10mEq/L. What is the calculated FENa?

- a) 5.0
- b) 2.0
- c) Cannot be calculated with the information given
- d) 0.2
- e) 1

19. All of the following are true except:

- a) A FENa of 0.7 is consistent with a prerenal process
- b) A urine sodium concentration of 12mEq/L is consistent with a prerenal process
- c) Fractional excretion of urea (FEUrea) can be used in place of FENa in patients that have received diuretics
- d) Fractional excretion of urea (FEUrea) is <35% in ATN
- e) A urine sodium concentration greater than 40mEq/L occurs in ATN

20. The workup for obstructive uropathy might include all of the following except?

- a) Rectal exam
- b) Ultrasonography of the urinary tract
- c) Placement of a Foley catheter
- d) Abdominal CT scan
- e) Renal arteriography

21. Regarding nutrition for a patient with acute kidney injury requiring dialysis, which of the considerations listed below is correct?

- a) Fat-soluble vitamin supplementation is important
- b) Total caloric intake should be in the order of 35–40kcal/kg/day
- c) Enteral formulas do not need to be low in nitrogen
- d) Caloric needs are not increased due to acute kidney injury.
- e) Parenteral nutrition is the preferred route while the patient is on continuous renal replacement therapy

22. Which of the following is an appropriate indication for the use of sodium bicarbonate?

- a) A patient with gram-negative sepsis undergoing CRRT, with a pH of 7.3
- b) Post-cardiac arrest in a hospitalized patient who was cardioverted for ventricular fibrillation
- c) A trauma patient post-splenectomy with a pH of 7.15 and a hemoglobin of 7.0mg/dL
- d) Severe non-gap metabolic acidosis (pH<7.0)
- e) Torsades de pointes