

## Acute Renal Failure: Review Questions

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### QUESTIONS

Choose the single best answer for each question.

- 1. A 61-year-old woman with hypertension, type 2 diabetes mellitus, ischemic cardiomyopathy, and chronic renal insufficiency reports pain in her right knee. Her blood pressure is 140/84 mm Hg, and her pulse is 70 bpm. Because of tenderness and effusion in the knee joint, the patient is prescribed celecoxib 200 mg once daily. After 14 days of therapy, she reports dyspnea, increased swelling in the lower extremities, and fatigue. Blood pressure is now 188/100 mm Hg, blood urea nitrogen (BUN) is 67 mg/dL (baseline, 41 mg/dL), and serum creatinine level is 3.9 mg/dL (baseline, 1.9 mg/dL). Which of the following is the most likely mechanism by which celecoxib caused acute renal failure?**

  - Acute papillary necrosis with renal obstruction
  - Acute tubular necrosis from drug-induced nephrotoxicity
  - Drug reaction causing allergic interstitial nephritis
  - Hemodynamic renal insufficiency from loss of compensatory prostaglandins induced by cyclooxygenase-2 inhibition of celecoxib
- 2. A 31-year-old man with a 4-year history of HIV infection who takes zidovudine and lamivudine begins receiving indinavir to further reduce the viral load. He also continues taking trimethoprim-sulfamethoxazole 3 times weekly. Over the next 12 weeks, he develops nausea with vomiting, anorexia, and an episode of gross hematuria. Urinalysis results show hematuria and pyuria. Urine sediment examination shows crystals in various starburst and plate-like patterns. Serum BUN (54 mg/dL) and serum creatinine (2.5 mg/dL) are elevated. Indinavir is discontinued, and the patient receives an intravenous infusion of 0.9% saline.**

**Which of the following most likely caused his acute renal failure?**

  - Acute tubular necrosis caused by indinavir
  - Allergic interstitial nephritis caused by trimethoprim-sulfamethoxazole
  - Indinavir-associated crystal-induced renal failure
  - Obstructive uropathy from retroperitoneal nodes caused by HIV-associated lymphoma
- 3. A 71-year-old man with type 2 diabetes mellitus, gout, hypertension, hyperlipidemia, and chronic renal insufficiency (serum creatinine, 2.8 mg/dL) has chest pain and electrocardiographic changes consistent with myocardial ischemia. Prior to cardiac catheterization, he is given fluids intravenously to reduce contrast-associated renal injury. He receives 120 mL of noniodinated, low osmolarity contrast during the procedure and develops transient hypotension. Over the next few days, he develops severe hypertension, purple toes on the right foot, and gastrointestinal bleeding. His serum creatinine level increases to 6.5 mg/dL, necessitating hemodialysis. Which of the following most likely caused his renal failure?**

  - Cholesterol embolization to the small arteries and arterioles in the kidney
  - Congestive heart failure with prerenal azotemia
  - Ischemic acute tubular necrosis caused by hypotension during catheterization
  - Radiocontrast-induced nephrotoxicity
- 4. A 73-year-old woman with osteoarthritis and mild hypertension goes to her physician's office with**

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**new-onset lower back pain and progressively worsening fatigue. Physical examination reveals normal blood pressure and pale conjunctivae. The lower lumbar spine (L4–L5) is tender to palpation, and the ankles have 2+ pitting edema. Laboratory measurements are hemoglobin, 6.2 g/dL and serum creatinine, 4.8 mg/dL. Bone marrow biopsy results are consistent with multiple myeloma; a 24-hour urine collection shows 6.5 g of albumin and 1.2 g of monoclonal  $\kappa$  light chain. Renal biopsy employing light microscopy shows nodular lesions in the glomerulus. On electron microscopy, granular deposits are seen along the basement membranes and in the glomerular nodules. No fibrillar material is identified in the biopsy specimen. Which of the following most likely caused the patient's renal disease?**

- A) Hypertensive arteriolonephrosclerosis
- B) Light-chain deposition disease in the kidney
- C) Myeloma cast nephropathy
- D) Renal amyloidosis

#### EXPLANATION OF ANSWERS

1. **(D) Hemodynamic renal insufficiency from loss of compensatory prostaglandins induced by cyclooxygenase-2 inhibition by celecoxib.** Renal prostaglandins are synthesized in certain disease states to maintain renal blood flow, glomerular filtration rate, and salt, water, and potassium excretion. Chronic renal failure, reduced cardiac output, therapy with diuretic drugs, and hypertension depend on compensatory prostaglandin synthesis to maintain kidney function. Acute papillary necrosis can occur with nonsteroidal anti-inflammatory drug (NSAID) use but is often associated with gross hematuria and flank pain without acute renal failure. Direct tubular injury is not an acute effect of NSAIDs. Therapy with NSAIDs (eg, selective cyclooxygenase-2 inhibitors) blunts prostaglandin synthesis and impairs renal physiologic responses, causing acute renal failure, salt and water retention, and reduced potassium excretion. This effect is reversible with discontinuation of the NSAIDs. Allergic interstitial nephritis is unlikely to cause such rapid renal failure.
2. **(C) Indinavir-associated crystal-induced renal failure.** Indinavir, a protease inhibitor, is commonly used to treat HIV infection. This drug causes crystal formation within the renal tubules when urine pH is above 3.5. Crystallization in the urine may lead to intrarenal crystal deposition and renal insufficiency. Asymptomatic crystalluria is sometimes noted in the absence of other clinical or laboratory signs of renal disease. Renal calculi manifested by flank pain and hematuria and more rarely obstructive uropathy from stone-related obstruction may occur during indinavir therapy. Acute tubular necrosis has not been described as a complication. Allergic interstitial nephritis is not supported by the clinical presentation or the presence of crystals in the urine.
3. **(A) Cholesterol embolization to the small arteries and arterioles in the kidney.** Acute renal failure following an invasive procedure using radiocontrast material has a limited differential diagnosis. Congestive heart failure with impaired renal perfusion is unlikely because the patient showed no other evidence to support a clinical diagnosis of decompensated cardiac pump function. The transient bout of hypotension was not severe enough to cause acute renal failure from ischemic acute tubular necrosis. Contrast nephrotoxicity is possible in view of the underlying risk factors (ie, diabetes mellitus, renal failure), the amount of contrast dye utilized, and the temporal association of renal failure. Yet, the combination of acute renal failure with severe hypertension, purple toes, and gastrointestinal bleeding following an invasive vascular procedure most strongly suggests a diagnosis of cholesterol embolization to the kidneys, lower extremities, and gastrointestinal tract. Atherosclerotic debris mobilized from aortic plaques during the procedure is the source of cholesterol emboli in this circumstance.
4. **(B) Light-chain deposition disease in the kidney.** The combination of renal insufficiency, nephrotic proteinuria, and nodular glomerulosclerosis supports both light-chain deposition disease and light-chain (AL) amyloidosis as the most likely renal lesions. Light-chain deposition disease is more often associated with  $\kappa$  light chains, while amyloidosis is associated with  $\lambda$  light chains. The distinguishing feature in this case is the presence of granular deposits along the basement membranes and in the glomerular nodules on electron microscopy, which support a diagnosis of light-chain deposition disease. In contrast, AL amyloidosis is characterized by fibrillar deposits (8–10 nm in diameter) on electron microscopy. Hypertensive arteriolonephrosclerosis is extremely unlikely in the presence of nephrotic proteinuria and the noted histologic findings. Multiple myeloma cast nephropathy is not complicated by nephrotic proteinuria, and the classic lesions seen on renal biopsy are fractured proteinaceous casts in the distal tubular lumens, often associated with multinucleated giant cells.