

**Internal Medicine Clerkship**  
Case Discussions

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**Acute Kidney Injury**  
Student Guide

**Objectives:**

1. Identify characteristics and relevant review of systems that may indicate a specific etiology of acute kidney injury including fevers and arthralgia.
2. Assess past medical history for risk factors and predisposing conditions including causative medications and toxin exposures.
3. Identify key physical exam findings that assess volume status (including orthostatic blood pressure measurement, jugular venous pressure, and presence of edema) and assess presence of uremic symptoms (including pericardial rub and asterixis).
4. Identify and interpret key laboratory and imaging tests and list indications, benefits, test characteristics, risks, and costs of testing:
  - a. Identify presence of acute kidney injury including patients with rising serum creatinine or decrease urine output.
  - b. Determine underlying etiology including urinalysis with microscopic evaluation, urine chemistries, chemistry panel, and renal ultrasound.
5. Develop and prioritize a differential diagnosis including common and non-to-miss diagnoses:
  - a. Distinguish pre-renal, intra-renal, and post-renal causes:
    - i. Describe pre-renal causes including ineffective circulating volume.
    - ii. Describe intra-renal causes including glomerular, tubular, interstitial, and vascular etiologies.
    - iii. Describe post-renal causes including ureteral obstruction and bladder outlet obstruction.
6. Describe a rational and evidence-based approach to treating a patient with acute kidney injury:
  - a. Describe treatment of acute conditions including hyperkalemia and fluid deficit.
  - b. Describe treatment based on etiology including relieving obstruction in bladder outlet obstruction and withdrawal of causative medications in active interstitial nephritis.
7. Describe the long-term renal prognosis for patients with acute kidney injury.
8. List clinical interventions that may prevent acute kidney injury in patients at increased risk including discontinuation of causative medications, prevention of hypotension, and judicious use of iodinated contrast.

**Clinical Case 1:**

A 26-year-old male was admitted to the hospital complaining of generalized muscle soreness. He had completed the Boston Marathon three days prior to admission. He has become progressively anorexic and lethargic. He also noticed a decreasing amount of urine output over the past three days.

Medical history: No past medical history.

Social history: He denied alcohol and illicit drug use.

Meds: None. No supplements.

Allergies: None known

Updated 4/12/24 MRE

Family history: Unremarkable for renal disease.

Physical Exam:

Well-developed, well-nourished male appearing lethargic

BP 135/70, HR 84, RR 20, 98.9F, weight 80 kg

HEENT – within normal limits

Cardiac – S1, S2 without S3, S4, murmur or rub

Pulmonary – clear to auscultation and percussion

Abdomen – Supple and non-tender, NABS

Extremities – ttp b/l with 2+ edema b/l

Neuro – no focal deficits. He was oriented to person, place and time, but was somnolent and had difficulty performing simple mathematical calculations.

Laboratory Data:

Sodium 138 meq/L

Potassium 7.0 meq/L

Chloride 101 meq/L

Total CO<sub>2</sub> 15

BUN 150 mg/dl

Creatinine 10 mg/dl

Glucose 100 mg/dl

Calcium 7.0 mg/dl

Phosphorus 8.0 mg/dl

Albumin 3.5 g/dl

Arterial Blood Gas: pH 7.35/28/105/15

Urine:

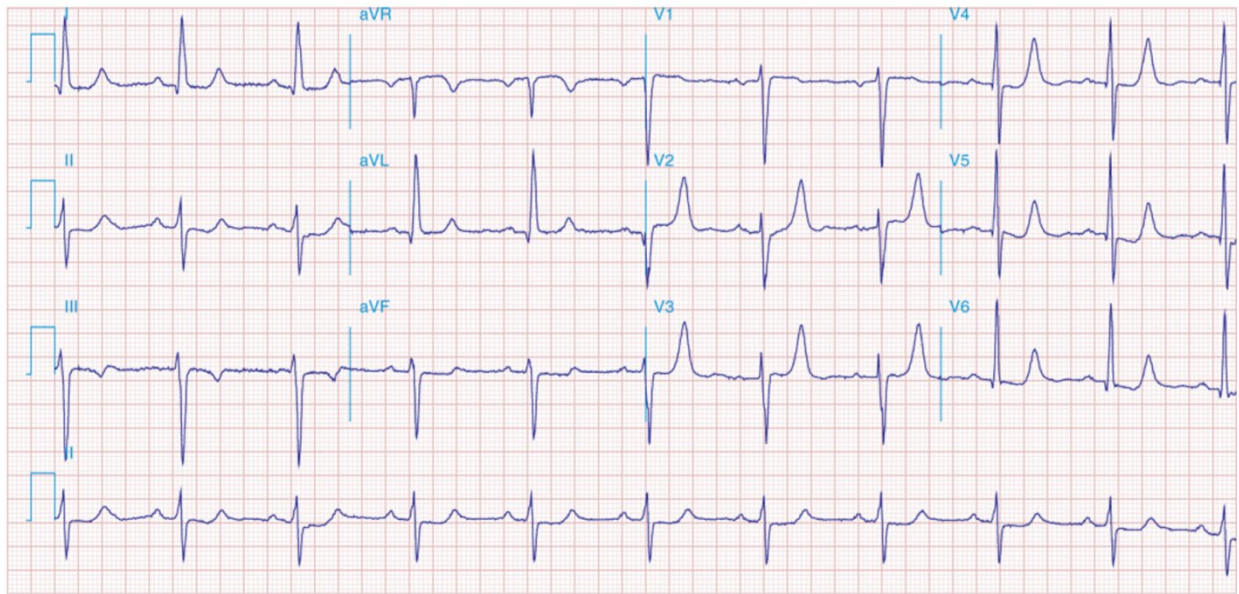
Specific gravity 1.015, pH 6.0, protein 2+, blood 4+, ketones (negative), glucose (negative) 2-5 RBC/HPF, 0-2 WBC/HPF

Na 35 meq/L, creatinine 56 mg/dl

UOSM 320.

Renal ultrasound – right kidney 10.8 cm, left kidney 11.0 cm. Normal echogenicity without calculi or hydronephrosis.

EKG is below:



Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition  
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#### Questions:

1. 1. Interpret the EKG above. What accounts for the changes noted? What other findings on EKG are often seen in a patient with severe acute kidney injury?
2. What are the three broad categories acute kidney injury can be divided into?
3. Utilizing the urine and blood chemistry values, how can one distinguish between prerenal azotemia and intrinsic renal disease? Calculate the fractional excretion of sodium.
4. Based on the information provided, what is the most likely etiology of the patient's renal failure? What additional tests would be helpful in confirming the diagnosis?
5. In addition to the patient's clinical condition, what are other common causes of acute intrinsic kidney failure?

6. How would you interpret the renal ultrasound findings in this case?
7. What are the indications for dialysis in general?
8. What are the indications for dialysis specifically in this patient?
9. How would you acutely manage the hyperkalemia in this patient?
10. This patient has hyperkalemia, hypocalcemia, and hyperphosphatemia. What factor(s) are responsible for these derangements?

### **Clinical Case 2:**

74yo with hx of hypertension, diabetes, heart failure with reduced ejection fraction of 30%, and benign prostatic hypertrophy who is brought to the emergency room by his family with lethargy, decreased oral intake, and fever for two days. They note his temperature at home reached 101.0 F. His current medications include carvedilol 12.5mg BID, losartan 25mg daily, furosemide 40mg BID, metformin 1000mg BID, and tamsulosin 0.4mg daily. His family reports he has been compliant with these medications.

#### **Physical Exam:**

Older, frail appearing male

BP 101/58, pulse 98, respirations 20, temp 101.4F

HEENT notable for dry mucous membranes and poor dentition

Cardiac – borderline tachycardic, + S4 and 2/6 systolic murmur heard best at the RUSB

Pulmonary – clear to auscultation and percussion

Abdomen – Supple and non-tender

Extremities – venous stasis changes noted with trace LEE b/l

Neuro – drowsy but able to respond to questions. No focal deficits noted on exam

#### **Laboratory Data:**

Sodium 128 meq/L

Potassium 5.4 meq/L

Chloride 110 meq/L

Total CO2 18

BUN 150 mg/dl

Creatinine 4.2 mg/dl (baseline 1.8)

Glucose 168 mg/dl

Calcium 8.2 mg/dl

Updated 4/12/24 MRE

Phosphorus 4.0 mg/dl  
Albumin 3.7 g/dl

WBC 12.8 k/UL  
Granulocyte 8.0 k/mm<sup>3</sup>  
Hgb 11.6 gm/dl  
Plt 450 k/UL

Urine:

Specific gravity 1.6, pH 5.8, protein 1+, blood 1+, ketones 2+, glucose (negative), 2-5 RBC/HPF, 10-20 WBC/HPF, + leukocyte esterase, + nitrates, + hyaline casts, 3+ bacteria  
Na 20 meq/L, creatinine 100 mg/dl, urea 400mg/dl

**Questions:**

1. Based on the information provided, what is the most likely etiology of the patient's renal failure?  
Discuss FeNa versus FeUrea.
2. How would you treat this patient? Would you make any changes to his medications?
3. What is this patient's prognosis for his acute kidney injury?

The patient is treated appropriately, his mental status improves, his fevers resolve, and his urine output increases. On day three of his hospital stay, the nurse notes that his urine output has started to decline again. His vitals have remained stable, a repeat urinalysis is negative, and his white blood cell count has normalized. His creatine improved from 4.2mg/dl to 2.0mg/dl but is now 2.3mg/dl.

4. What do you suspect is happening to the patient currently, and how would you evaluate him?

A post void residual is completed and shows a volume of 250mL. A renal ultrasound shows mild bilateral hydronephrosis.

5. How would you manage the patient at this point?

**References:**

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