Acute Kidney Injury With Massively Enlarged Noncystic Kidneys

Tajamul H. Mir, MD, DM, Alok Sharma, MD, Syed Nisar, MD, Afaaq A. Khan, MD, Tabinda A. Shah, MD, and Nisar A. Wani, MD

Clinical Presentation

A 17-year-old girl was admitted to the hospital with a 10-day history of bilateral flank pain radiating to the back, associated with low-grade fever without urinary symptoms. She had no significant medical history and denied exposure to any medications in the recent past. Findings on physical examination included an oral temperature of 100°F, pulse rate of 90 beats/min, and blood pressure of 100/70 mm Hg without postural decrease on sitting up. She had conjunctival pallor. The chest and cardiovascular examination had unremarkable findings. On abdominal examination, there was fullness in both lumbar regions; both kidneys, which were firm in consistency and tender on deep pressure, could be felt down to the umbilical region.

Laboratory studies revealed hemoglobin level of 7.3 g/dL and white blood cell count of 7,300/μL with normal differential. Platelet count was 400 × 10^3/μL. Peripheral-blood film was normal. The following values were shown: serum urea nitrogen, 77 mg/dL; serum creatinine, 1.8 mg/dL; sodium, 141 mEq/L; potassium, 3.9 mEq/L; calcium, 8.5 mg/dL; phosphorus, 4.3 mg/dL; uric acid, 8.4 mg/dL; and serum albumin, 3 g/dL. Urine microscopy and dipstick test results were normal. Arterial blood gas revealed metabolic acidosis with respiratory compensation (pH 7.09; Pco2, 17 mm Hg; and bicarbonate, 7.2 mmol/L).

Abdominal ultrasonography revealed markedly enlarged kidneys with heterogeneous echotexture. There was no abdominal lymphadenopathy or hepatosplenomegaly. Noncontrast computed tomography of the abdomen revealed bilateral diffusely enlarged kidneys without cysts, with slight hyperdense attenuation and bulging kidney outlines (Fig 1).

During the patient’s hospital stay, her glomerular filtration rate worsened further with serum creatinine level peaking at 4.6 mg/dL on hospital day 10. A therapeutic trial of intravenous pulse methylprednisolone, 500 mg/d for 5 days was followed by oral prednisolone, 40 mg/d, which led to a significant improvement in the patient’s condition.
significant improvement in glomerular filtration rate over the next 11 days (Fig 2). A kidney biopsy was performed (Fig 3).

- What is the differential diagnosis of the laboratory and imaging studies in this patient?
- What does the kidney biopsy show?
- What is the most likely diagnosis given the clinical presentation and biopsy findings?
- What could be the most likely mechanism of the acute kidney injury in this patient?

Discussion

What is the differential diagnosis of the laboratory and imaging studies in this patient?
Given the patient’s symptoms of flank pain and fever with enlarged kidneys, acute pyelonephritis must be considered. However, this degree of kidney enlargement would be very unlikely and she was not “toxic” appearing. Urinalysis did not suggest the presence of infection. A rare entity of bilateral diffuse renal malakoplakia due to defective phagolysosomal activity of monocytes and macrophages in the face of a bacterial infection of the kidneys could present with massively enlarged kidneys, but there was no history of prior kidney infection. Another even rarer entity, megalocytic interstitial nephritis, could be considered but this typically is also associated with obvious infection. Perinephric and renal extramedullary hematopoiesis in cases of bone marrow dysplasia have been reported to induce marked kidney enlargement. Beckwith-Wiedemann and other overgrowth syndromes may also produce bilateral kidney enlargement and other associated visceromegaly but are congenital disorders that should have been previously diagnosed. Isolated leukemia or lymphomatous infiltration of the kidneys is another known cause of massively enlarged kidneys with acute kidney injury (AKI).

What does the kidney biopsy show?
The glomerulus appears normal. The tubulointerstitial area is almost entirely replaced by sheets of infiltrating atypical monomorphic, round cells with scant cytoplasm, and hyperchromatic nuclei.

What is the most likely diagnosis given the clinical presentation and biopsy findings?
The most likely clinical diagnosis would be leukemic or lymphomatous infiltration of the kidneys causing pain due to enlargement and AKI. Immunofluorescence studies were negative for immune deposits. On immunohistochemistry, the infiltrating cells showed 100% positivity for CD10, Pax5, and Tdt (terminal deoxynucleotidyl transferase) and 98% positivity for Ki 67. These findings were consistent with the diagnosis of leukemic infiltration of kidneys by lymphoblasts of B-cell lineage, suggestive of acute lymphoblastic leukemia. Ki 67 positivity of the infiltrating cells indicates a rapid and uncontrolled cell turnover. Repeat peripheral-blood film analysis, bone marrow aspiration, and flow cytometry confirmed the diagnosis.

Although acute lymphoblastic leukemia is a relatively common hematologic malignancy in this age group with varied clinical presentations, the presence of massively enlarged kidneys due to leukemic infiltration with or without kidney failure is rare.2-4

What could be the most likely mechanism of the AKI in this patient?
In patients with hematologic malignancies, obstructive uropathy, tumor lysis syndrome, hypercalcemia, sepsis, volume depletion, and paraprotein- and immune-mediated kidney injury must be considered. In this patient with massive kidney enlargement, it is likely that the AKI was due to high intrarenal interstitial pressure compromising glomerular filtration and tubular function. In addition, the invading leukemia or lymphoma cells cause vascular and tubular compression and injury. Cytokine release may also play a role.

In most patients with leukemia or lymphoma, kidney infiltration is clinically silent but may, as in this patient, present with flank pain and AKI due to infiltration of the kidneys leading to distension of the kidney capsule and pain. Massive kidney involvement in lymphoma has been reported as the presenting sign of the disease.5

Final Diagnosis

Acute lymphoblastic leukemia presenting with massive leukemic infiltration of the kidneys with acute kidney injury.

Article Information

Authors’ Full Names and Academic Degrees: Tajamul H. Mir, MD, DM(Nephrology), Alok Sharma, MD, Syed Nisar, MD, Afaaq A. Khan, MD, Tabinda A. Shah, MD, and Nisar A. Wani, MD
Authors’ Affiliations: Department of Nephrology, Khyber Medical Institute, Nowpora, Srinagar (THM, TAS); Department of Renal Pathology, Dr Lal PathLab/National Reference Laboratory, New Delhi (AS); and Departments of Medical Oncology (SN), Clinical Hematology (AAK), and Radiodiagnosis (NAW), Khyber Medical Institute, Nowpora, Srinagar, India.

Address for Correspondence: Tajamul H. Mir, MD, DM(Nephrology), Department of Nephrology, Lupus Clinic, Room No. 126, Khyber Medical Institute, Nowpora, Khyam Chowk (Munvar Abad), Srinagar, Jammu & Kashmir 190001, India

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