Staghorn Renal Calculus, Obstruction, and Inflammatory Changes

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Case Presentation
A 42-year-old woman with a past medical history of hypertension and poorly controlled type 2 diabetes presented to the emergency department with left flank pain, nausea and vomiting, subjective fevers, hematuria, and dysuria. She was initially treated at an outside facility with antibiotics without improvement. CT of the abdomen and pelvis was performed (Figures A-D), followed by appropriate image-guided intervention (Figure E).

FIGURES A-E. Unenhanced axial CT images through the upper (A) and lower (B) renal poles demonstrate bilateral staghorn calculi (B) with enlarged fluid-filled calyces and gas within both the dilated collecting system and a retroperitoneal abscess collection on the left (A, arrows). Coronal (C) and axial (D) unenhanced CT images through the lower abdomen and pelvis demonstrate the extension of extra-renal and retroperitoneal inflammatory changes and abscess formation (arrows). Fluoroscopic image following placement of a left retroperitoneal abscess drain and nephrostomy tube with contrast injection (E) reveals extravasation of contrast through the inferior renal pole (arrow) with a possible connection to the retroperitoneal abscess inferiorly.
Key Imaging Findings

Staghorn calcification, obstruction, and inflammatory changes

Differential Diagnosis

Xanthogranulomatous pyelonephritis
Renal tuberculosis
Pyonephrosis

Discussion

Patients with persistent flank pain and clinical signs and symptoms of infection despite appropriate conservative treatment need further imaging evaluation. Cross-sectional imaging, particularly CT and US when dealing with renal pathology, is instrumental in determining the underlying cause of the presenting signs and symptoms, evaluating for potential complications, and treatment planning for potential intervention. In a patient with an obstructed staghorn calculus, the primary considerations include xanthogranulomatous pyelonephritis, renal tuberculosis, and pyonephrosis.

Xanthogranulomatous Pyelonephritis

Xanthogranulomatous pyelonephritis (XGP) is a chronic destructive granulomatous process of the kidney related to recurrent bacterial urinary tract infections with an atypical, incomplete immune response. The entity is rare, accounting for 1% of chronic pyelonephritis. It is usually diffuse but can also be focal. Although XGP may affect any age group, it is most common in middle-aged women with a history of diabetes. Patients present with nonspecific symptoms of fever, malaise, and weight loss. Urinary symptoms include dysuria, urinary frequency, hematuria and pyuria.1-4

CT is the imaging modality of choice for assessment for two primary reasons. First, it is helpful for evaluating the extent of infection; second, it is useful for preoperative planning. On CT, the affected kidney is enlarged with renal calculi (typically staghorn calculi) with or without obstructive hydronephrosis. The calyces are dilated with infectious debris and often demonstrate rim enhancement. Classically, this is described as a “bear paw” sign. There can be fat deposits within the inflammatory mass, but these are not consistently present.2,4

Definitive treatment is surgical, with partial or total nephrectomy depending on whether the infection is focal or diffuse, respectively. However, a percutaneous nephrostomy tube is often placed for emergent decompression and as a bridge to surgery. Additionally, percutaneous nephrostomy may allow time to evaluate renal function.1,3

Renal Tuberculosis

The genitourinary tract represents the most common extrapulmonary site of tuberculosis and results from hematogenous spread of the primary infection. As is expected, it is more prevalent in developing countries and among immunocompromised patients. Symptoms are again nonspecific and include fever, malaise, flank pain and hematuria.2,5

CT is the primary imaging modality in evaluating the extent of disease. Typically, the infection begins with irregularity of the calyces, papillary necrosis, and formation of granulomas in the renal cortex. Progression of the infection leads to rupture of the granulomas into the collecting system, papillary cavitation, caliectasis, and eventual destruction of the renal parenchyma. The immune response induces fibrosis and calcification within the parenchyma. The calcifications vary from rim-like calcifications at the papillae to radiodense replacement of portions or all of the renal parenchyma. Additionally, distortion of the collecting system results in contraction of the renal pelvis and stricture formation (infundibular, ureteropelvic junction [UPJ], and ureteral). This process perpetuates the possibility of obstruction and further incites renal damage.2,5

Treatment involves emergent decompression with percutaneous nephrostomy or ureteral stenting to preserve kidney function, followed by treatment of the underlying cause of obstruction. If the kidney is completely nonfunctional at diagnosis, nephrectomy may be performed.2,6

Diagnosis

Xanthogranulomatous pyelonephritis

Summary

Patients with flank pain, constitutional symptoms, and urinary complaints that have failed conservative management or have worrisome clinical signs or symptoms, require further evaluation with imaging. CT and US are the mainstay for initial evaluation of renal pathology. CT in particular plays an important role in both evaluating the extent of disease and for interventional/operative planning. In the setting of staghorn renal calculi with obstruction, some unique clinical and...

Pyonephrosis

Pyonephrosis refers to a dilated, infected renal collecting system. This is most commonly seen in diabetic or immunocompromised patients. Pyonephrosis occurs secondary to an obstructive calculus or tumor, as a sequela of pyelonephritis, or as a complication of surgery. Patients often present with fever and flank pain, but may occasionally be asymptomatic.2,6

In suspected cases, US is more sensitive and specific than CT in diagnosing pyonephrosis vs simple hydrocephrosis. Infectious material within the collecting system is easier to see on US where it may manifest as echogenic debris, septations and/or fluid-fluid levels. On CT, there may be increased attenuation within the dilated collecting system. If the patient is able to receive contrast, delayed images may show layering contrast material in the nondependent position compared to the purulent fluid. CT is better than US in determining the cause of obstruction, as well as evaluating the perinephric and extrarenal extent of infection.2,6

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Differential Diagnosis

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Patients with flank pain, constitutional symptoms, and urinary complaints that have failed conservative management or have worrisome clinical signs or symptoms, require further evaluation with imaging. CT and US are the mainstay for initial evaluation of renal pathology. CT in particular plays an important role in both evaluating the extent of disease and for interventional/operative planning. In the setting of staghorn renal calculi with obstruction, some unique clinical and...
imaging features discussed in this case review help distinguish between XGP, renal tuberculosis, and pyonephrosis. Imaging not only aids correct diagnosis, but it also helps determine the need for emergent intervention, potentially salvaging renal function.

References