When does acute pyelonephritis require imaging?

A previously healthy 44-year-old woman presents to the emergency department with 1 day of fever, flank pain, dysuria, and persistent nausea and vomiting. Her temperature is 38.7°C (101.7°F), heart rate 102 beats per minute, and blood pressure 120/70 mm Hg. She has costovertebral angle tenderness. Laboratory testing reveals mild leukocytosis and a normal serum creatinine level; urinalysis shows leukocytes, as well as leukocyte esterase and nitrites. She has no personal or family history of nephrolithiasis. Urine cultures are obtained, and she is started on intravenous antibiotics and intravenous hydration to treat pyelonephritis.

Is imaging indicated at this point? And if so, which study is recommended?

**Key Features**

Acute pyelonephritis, infection of the renal parenchyma and collecting system, most often results from an ascending infection of the lower urinary tract. It is estimated to account for 250,000 office visits and 200,000 hospital admissions each year in the United States.1

Lower urinary tract symptoms such as urinary frequency, urgency, and dysuria accompanied by fever, nausea, vomiting, and flank pain raise suspicion for acute pyelonephritis. Flank pain is a key, nearly universal feature of upper urinary tract infection in patients without diabetes, though it may be absent in up to 50% of patients with diabetes.1

Additional findings include costovertebral angle tenderness on physical examination and leukocytosis, pyuria, and bacteriuria on laboratory studies.

doi:10.3949/ccjm.86a.18096
ACUTE PYELONEPHRITIS

**Do the history, physical examination, and results of initial laboratory testing indicate acute pyelonephritis?**

- Yes
- No

**Imaging is not recommended if for diagnostic confirmation only**

**Is one of the following present?**

- Diabetes
- Immune compromise
- Recent urologic or renal procedure
- History of urolithiasis or anatomic abnormality
- Urine pH ≥ 7.0
- Glomerular filtration rate ≤ 40 mL/min/1.73 m²

- Yes
- No

**Initial imaging is recommended because of the higher risk of complications**

**Imaging is recommended if fever or leukocytosis persists after 72 hours of antibiotic therapy**

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**TREATMENT FAILURE**

In a retrospective review of 62 patients hospitalized for acute renal infection, Soulen et al found that the most reliable indicator of complicated acute pyelonephritis was the persistence of fever and leukocytosis at 72 hours. Another small prospective study of patients with uncomplicated pyelonephritis reported a time to defervescence of no more than 4 days.

In accordance with the Appropriateness Criteria and based on the best available evidence, imaging is recommended in all patients who remain febrile or have persistent leukocytosis after 72 hours of antibiotic therapy. In such cases, there should be high suspicion for a complication requiring treatment.

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**OPTIONS FOR IMAGING**

**Computed tomography**

Computed tomography (CT) of the abdomen and pelvis with contrast is considered the study of choice in complicated acute pyelonephritis. CT can detect focal parenchymal abnormalities, emphysematous changes, and anatomic anomalies, and can also define the extent of disease. It can also detect perinephric fluid collections and abscesses that necessitate a change in management.

A retrospective study in 2017 found that contrast-enhanced CT done without the usual noncontrast and excretory phases had an accuracy of 90% to 92% for pyelonephritis and 96% to 99% for urolithiasis, suggesting that reduction in radiation exposure through use of only the contrast-enhanced phase of CT imaging may be reasonable.

**Magnetic resonance imaging**

Magnetic resonance imaging (MRI) is increasingly acknowledged as effective in the
evaluation of renal pathology, including the diagnosis of pyelonephritis; but it lacks the level of evidence that CT provides for detecting renal abscesses, calculi, and emphysematous pyelonephritis.2,8,9

Though it is more costly and time-consuming than CT with contrast enhancement, MRI is nevertheless the imaging study of choice if iodinated contrast or ionizing radiation must be avoided.

MRI typically involves a precontrast phase and a gadolinium contrast-enhanced phase, though there are data to support diffusion-weighted MRI when exposure to gadolinium poses a risk to the patient, such as in pregnancy or renal impairment (particularly when the estimated GFR is < 30 mL/min/1.73 m²).10

Ultrasonography
Conventional ultrasonography is appealing due to its relatively low cost, its availability and portability, and the lack of radiation and contrast exposure. It is most helpful in detecting hydronephrosis and pyonephrosis rather than intrarenal or perinephric abscesses.2,9

Color and power Doppler ultrasonography may improve testing characteristics but not to the level of CT; in one study, sensitivity for detection of pyelonephritis was 33.3% with ultrasonography vs 81.0% with CT.11

Recent studies of ultrasonography with contrast enhancement show promising results,2 and it may ultimately prove to have a similar efficacy with lower risk for patients, but this has not been validated in large studies, and its availability remains limited.

Ultrasonography should be considered for patients in whom obstruction (with resulting hydronephrosis or pyonephrosis) is a primary concern, particularly when contrast exposure or radiation is contraindicated and MRI is unavailable.2

Abdominal radiography
While emphysematous pyelonephritis or a large staghorn calculus may be seen on abdominal radiography, it is not recommended for the assessment of complications in acute pyelonephritis because it lacks sensitivity.2

■ RETURN TO THE CASE SCENARIO

The patient in our case scenario meets the clinical criteria for uncomplicated pyelonephritis and is therefore not a candidate for imaging. Intravenous antibiotics should be started and should lead to rapid improvement in her condition.

ACKNOWLEDGMENT: The authors would like to thank Dr. Lisa Blacklock for her review of the radiology section of this paper.

■ REFERENCES


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