Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria™ for imaging in acute pyelonephritis.

BIBLIOGRAPHIC SOURCE(S)

American College of Radiology (ACR), Expert Panel on Urologic Imaging. Imaging in acute pyelonephritis. Reston (VA): American College of Radiology (ACR); 2001. 4 p. (ACR appropriateness criteria). [17 references]

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Acute pyelonephritis

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Family Practice
Internal Medicine
Nephrology
Neurology
Urology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of radiologic examinations for imaging in acute pyelonephritis

TARGET POPULATION

Patients with acute pyelonephritis

INTERVENTIONS AND PRACTICES CONSIDERED

1. Excretory urography (intravenous pyelogram [IVP])
2. Abdominal plain film (kidneys, ureters, bladder [KUB])
3. Voiding cystourethrography (VCUG)
4. Renal ultrasound (US)
5. Computed tomography (CT) kidney with/without contrast
6. Computed tomography kidney, noncontrast
7. Technetium (Tc)-99m dimercaptosuccinic acid (DMSA) scan
8. Magnetic resonance imaging (MRI) kidney
9. Antegrade pyelography
10. Renal ultrasound + abdominal plain film
11. Excretory urography (normal renal function)
12. Abdominal plain film (stand alone)

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations for imaging in acute pyelonephritis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the Appropriateness Criteria. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria and the Chair of the ACR Board of Chancellors.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Clinical Condition: Acute Pyelonephritis

Variant 1: Uncomplicated patient.

Radiologic Exam Procedure	Appropriateness Rating	Comments
IVP	3	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.
KUB	2	See above.
VCUG	2	See above.
Renal ultrasound	2	See above.
CT kidney with/without contrast	2	See above.
CT kidney, noncontrast	2	See above.
Tc-99m DMSA scan	2	See above.
MRI kidney	1	See above.
Antegrade pyelography	1	See above.
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Abbreviations: IVP, excretory urography/intravenous pyelogram; KUB, abdominal plain film (kidneys, ureters, bladder); VCUG, voiding cystourethrography; CT, computed tomography; Tc, technetium; DMSA, dimercaptosuccinic acid; MRI, magnetic resonance image

Variant 2: Diabetes, immunocompromised.

Radiologic Exam Procedure	Appropriateness Rating	Comments
CT kidney with/without contrast	8	Overall best study to evaluate complications of pyelonephritis such as abscess or perinephric extension.
Renal ultrasound + KUB	6	Somewhat less sensitive than CT but used preferentially if there is compromised renal function. KUB to evaluate stones or air.
IVP (normal renal function)	4	Less sensitive than CT, but can be used to exclude obstruction.
MRI kidney	4	
CT kidney, noncontrast	3	Detects parenchymal abnormalities poorly without use of contrast.
Tc-99m DMSA scan	3	Cannot differentiate renal parenchymal disease from perinephric process.
VCUG	2	Not part of initial evaluation.
KUB (stand alone)	2	Insufficient information by itself to guide therapy.
Antegrade pyelography	1	Not an initial study.
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Variant 3: Complicated, other (i.e., history of stones, prior renal surgery, etc.)

Radiologic Exam Procedure	Appropriateness Rating	Comments
IVP	8	Best overall screening study for stones, obstruction, or anatomic abnormalities that may complicate infection in this group.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Renal US + KUB	6	May be used as an alternative study to above.
CT kidney with/without contrast	6	Less effective for demonstrating obstruction but useful for showing parenchymal complications.
MRI kidney	4	
CT kidney, noncontrast	3	Detects parenchymal abnormalities poorly without use of contrast.
VCUG	3	Not part of initial evaluation but may be used subsequently to demonstrate clinically suspected reflux.
Tc-99m DMSA scan	3	Cannot differentiate renal parenchymal disease from perinephric process.
KUB (stand alone)	2	Insufficient information by itself to guide therapy.
Antegrade pyelography	1	Not an initial study.
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Abbreviations: IVP, excretory urography/intravenous pyelogram; US, ultrasound; KUB, abdominal plain film (kidneys, ureters, bladder); CT, computed tomography; MRI, magnetic resonance image; VCUG, voiding cystourethrography; Tc, technetium; DMSA, dimercaptosuccinic acid

Inflammatory disease involving the urinary tract is among the most common infectious disorders affecting humankind. In most adults, the infection is confined to the lower urinary tract (LUT); the diagnosis is established by clinical or laboratory studies, and imaging studies are not required. When the kidney itself is involved or when there is difficulty in differentiating LUT infection from renal parenchymal involvement, imaging studies are often requested both for diagnosis and to plan management. Conditions that are thought to predispose a patient with LUT infection to renal involvement include vesicoureteral reflux, altered bladder function, congenital urinary tract anomalies, and the presence of renal calculi.

Pathologically, inflammatory disease of the kidney generally occurs as the result of ascending infection from the LUT (whether or not radiologically, demonstrated vesicoureteral reflux is present) by gram-negative enteric pathogens (usually Escherichia coli) and is known as acute pyelonephritis. This name accurately reflects the underlying pathologic condition present (i.e., infection involving both the renal parenchyma and the renal pelvis). In the majority of patients,

uncomplicated pyelonephritis is readily diagnosed clinically and responds quickly to treatment with appropriate antibiotics. If the treatment is started late, the patient is immunocompromised, or, for other poorly understood reasons, small microabscesses that form during the acute phase of pyelonephritis may coalesce to form an acute renal abscess. If such an abscess then ruptures into the perinephric space, a perirenal abscess is formed. If the infection is confined to an obstructed collecting system, the infection is referred to as pyelonephrosis. Patients with underlying diabetes are of particular concern. Not only are they more vulnerable to the development of a complication from acute pyelonephritis, but it is also more difficult to establish the diagnosis on clinical grounds in diabetics, since as many as 50% will not have the typical flank tenderness that helps to differentiate pyelonephritis from LUT infection in an otherwise healthy patient.

Prior to the advent of cross-sectional imaging, radiologic studies performed in patients with uncomplicated pyelonephritis were normal in most cases. In the early 1970s, however, a subgroup of patients was identified with acute pyelonephritis, commonly with underlying diabetes, who did not respond quickly to therapy and in whom urography showed anatomic and severe functional abnormalities. In order to differentiate such patients from those with garden-variety pyelonephritis, a new term, acute bacterial nephritis, was coined. With the advent of cross-sectional imaging, a whole new lexicon of terminology evolved to describe various degrees of parenchymal involvement with pyelonephritis. Recently, the Society of Uroradiology has spearheaded an attempt to simplify the terminology used to describe imaging findings in patients with pyelonephritis. They have recommended that all patients with renal infection be referred to as having acute pyelonephritis, with only the additional modifiers unilateral or bilateral, focal or diffuse, focal swelling or no focal swelling, and renal enlargement or no enlargement used to describe the extent of the process.

Traditionally, excretory urography (intravenous pyelogram [IVP]) has been the primary diagnostic modality for imaging patients with renal infection. The rationale for performing urography is not to diagnose acute pyelonephritis but to look for an underlying anatomic abnormality (i.e., anomaly) that may have predisposed the patient to the infection; to search for a process such as a calculus, papillary necrosis, or obstruction that may prevent a rapid therapeutic response; or to diagnose a complication of the infection such as a renal or perinephric abscess. As such, many urologists routinely order an excretory urogram in all patients with clinical pyelonephritis within the first 24 hours after initiation of therapy. There is now reasonably good evidence that routine urography does not alter the clinical care in 90% of patients with pyelonephritis.

There is almost universal agreement that precontrast and postcontrast computed tomography (CT) is the imaging study of choice to diagnose patients with atypical pyelonephritis or to look for a potential complication of the infection such as a renal or perinephric abscess or a renal emphysema. In most of the studies comparing CT with ultrasound (US), much of the superiority of CT lay in its ability to detect parenchymal abnormalities in patients with pyelonephritis that are generally missed by US but do not alter the patient's therapy. Proponents of ultrasound are quick to point out its advantages; namely, low risk, relatively low expense, lack of ionizing radiation, and, most importantly, the fact that it does not require the use of contrast material. Recent technical advances in US such as

tissue harmonic imaging and the use of US contrast agents have been shown to increase the sensitivity of US to subtle parenchymal abnormalities in pyelonephritis, but further work in this area is needed before definite recommendations can be made. Conventional gray-scale US has been considered the method of choice to diagnose pyelonephrosis (i.e., low-level echoes within the collecting system), but CT can also suggest this diagnosis. The most specific test to diagnose pyelonephrosis, however, is needle aspiration of the collecting system, which is generally performed as a prelude to percutaneous nephrostomy.

Recently there has been increased interest in the diagnosis of acute pyelonephritis utilizing technetium (Tc) 99m dimercaptosuccinic acid (DMSA) renal scintigraphy, particularly in children. Recent studies have shown this technique to be much more sensitive for the detection of pyelonephritis than ultrasound. This is important in children since differentiating lower urinary tract (LUT) infection from pyelonephritis is more difficult in the pediatric population and since it is the young who are more vulnerable to permanent renal damage from renal inflammatory disease. One recent study, however, suggests that these benefits do not extend to adults.

Various other imaging studies are of value in selected patients. Magnetic resonance (MR) imaging is felt to be useful in patients in whom the use of iodinated contrast material must be avoided, (i.e., those with azotemia or contrast sensitivity), but case controlled studies documenting its efficacy have yet to be published. One potential disadvantage of MR is its inability to detect smaller calculi. Retrograde pyelography is of value in patients with severe infection and obstruction that cannot be demonstrated noninvasively. Antegrade pyelography can be used as an alternative to the retrograde study. Voiding cystourethrography is used to demonstrate vesicoureteral reflux but is generally only routinely performed in children.

Otherwise healthy patients with uncomplicated pyelonephritis probably need no radiologic work-up if they respond to antibiotic therapy within 72 hours. If there is no response to therapy, urography is probably the most cost-effective starting point for evaluation. Diabetics or other immunocompromised patients should probably be evaluated within 24 hours of diagnosis, with precontrast and postcontrast computed tomography. Ultrasound should be reserved for patients in whom pyelonephrosis is suspected and those patients for whom exposure to contrast or radiation is hazardous. All other adult patients (i.e., males and patients with a history of stones or other urologic conditions, prior urologic surgery, repeated episodes of pyelonephritis, etc.) probably deserve early evaluation with urography.

Anticipated Exceptions

The first-line study in pregnant patients should be ultrasonography. Patients with azotemia, pregnancy, suspected vesicoureteral reflux, or an accelerated clinical course (i.e., sepsis) may all need more aggressive evaluation.

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate evaluation of radiologic exam procedures for imaging in acute pyelonephritis

POTENTIAL HARMS

One potential disadvantage of magnetic resonance (MR) is its inability to detect smaller calculi.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other coexistent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

American College of Radiology (ACR), Expert Panel on Urologic Imaging. Imaging in acute pyelonephritis. Reston (VA): American College of Radiology (ACR); 2001. 4 p. (ACR appropriateness criteria). [17 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1995 (revised 2001)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria™.

GUIDELINE COMMITTEE

ACR Appropriateness Criteria™ Committee, Expert Panel on Urologic Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Names of Panel Members: Carl M. Sandler, MD, Principal Author, University of Texas-Houston, Houston, Tex; Jeffrey H. Newhouse, MD, Panel Chair, Columbia-Presbyterian Medical Center, New York, NY; Edward I. Bluth, MD, Ochsner Foundation Hospital, New Orleans, La; William H. Bush, Jr, MD, University of Washington School of Medicine, Seattle, Wash; Peter L. Choyke, MD, National Institutes of Health, Bethesda, Md; Syed Z. Jafri, MD, William Beaumont Hospital, Royal Oak, Mich; Robert A. Older, MD, University of Virginia Medical Center,

Charlottesville, Va; Arthur T. Rosenfield, MD, Yale-New Haven Hospital, New Haven, Conn; Arthur J. Segal, MD, Rochester General Hospital, Rochester, NY; Clare Tempany, MD, Brigham & Women's Hospital, Boston, Mass; Martin I. Resnick, MD, University Hospital of Cleveland, Cleveland, Ohio, American Urological Association

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline. It updates a previous version: Sandler CM, Amis ES, Bigongiari LR, Bluth EI, Bush WH, Choyke PL, Fritzsche P, Holder L, Newhouse JH, Segal AJ, Resnick MI, Rutsky EA. Imaging in acute pyelonephritis. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):677-81.

All Appropriateness Criteria™ topics are reviewed annually and updated as appropriate.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

Portable Digital Assistant (PDA): ACR Appropriateness Criteria™ - Anytime, Anywhere (PDA version) is available from the ACR Web site.

Print copies: Available from the American College of Radiology, Department of Quality & Safety, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- American College of Radiology ACR Appropriateness Criteria™ introduction. Reston (VA): American College of Radiology; 6 p. Available in Portable Document Format (PDF) from the ACR Web site.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on May 6, 2001. The information was verified by the guideline developer as of June 29, 2001. This summary was

updated by ECRI on September 7, 2004. The updated information was verified by the guideline developer on October 8, 2004.

COPYRIGHT STATEMENT

Date Modified: 11/15/2004