Complete Summary

GUIDELINE TITLE

Renal failure.

BIBLIOGRAPHIC SOURCE(S)

Bush WH Jr, Choyke PL, Bluth RI, Casalino DD, Francis IR, Jafri SZ, Kawashima A, Kronthal A, Older RA, Papaincolaou N, Ramchandani P, Rosenfield AT, Sandler CM, Segal AJ, Tempany C, Resnick MI, Expert Panel on Urologic Imaging. Renal failure. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 8 p. [53 references]

GUIDELINE STATUS

This is the current release of the guideline.

It updates a previous published version: American College of Radiology, Expert Panel on Urologic Imaging. Radiologic investigation of causes of renal failure. Reston (VA): American College of Radiology (ACR); 2001. 8 p. (ACR appropriateness criteria). [51 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

** REGULATORY ALERT **

FDA WARNING/REGULATORY ALERT

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory and/or warning information has been released.

- May 23, 2007, Gadolinium-based Contrast Agents: The addition of a boxed warning and new warnings about the risk of nephrogenic systemic fibrosis (NSF) to the full prescribing information for all gadolinium-based contrast agents (GBCAs).

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Renal failure

GUIDELINE CATEGORY

Diagnosis
Evaluation
Screening

CLINICAL SPECIALTY

Family Practice
Internal Medicine
Nephrology
Radiation Oncology
Radiology
Urology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of radiologic examinations in the investigation of causes of renal failure

TARGET POPULATION

Patients with renal failure

INTERVENTIONS AND PRACTICES CONSIDERED

1. Ultrasound (US)
2. Nuclear medicine (NUC), renal scintigraphy

3. Magnetic resonance angiography (MRA)
4. Computed tomography (CT)
5. Invasive (INV)
    - Arteriography, digital subtraction angiography (DSA)
    - Phlebography
6. X-ray
    - Voiding cystourethrography (VCUG)
    - Kidneys, ureters, bladder (KUB)
    - Intravenous pyelogram (IVP)
7. Magnetic resonance imaging (MRI), body coil

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

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 peer-reviewed medical journals, and the major applicable articles were identified and collected.

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 for reaching agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. 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 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 percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, 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. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

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.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Renal Failure

Variant 1: Acute renal failure, unspecified.

Radiologic Exam Procedure	Appropriateness Rating	Comments
US, kidney	9	Preferably with Doppler methods.
NUC, renal scintigraphy	4	Global and differential function. Assess recoverability; distinguish from chronic.
MRA, kidney	4	Newer techniques with gadolinium are very effective for renal artery evaluation.
CT, kidney	3	Potentially helpful in trauma. Noncontrast helical CT more sensitive than KUB for calculi.
INV, kidney, arteriography, DSA	3	Potentially helpful in trauma, evaluation for renal artery occlusion. Consider aortography with CO_2 to avoid nephrotoxicity of iodinated contrast.
X-ray, bladder, voiding cystourethrography (VCUG)	2	See Anticipated Exceptions below.
X-ray, abdomen, KUB	2	Assess for calculi; however insensitive for 30% of calculi.
INV, kidney, phlebography	1	See Anticipated Exceptions below.
MRI, kidney, body coil	1	See Anticipated Exceptions below.
X-ray, kidney, intravenous urography, IVP	1	Problem of contrast nephrotoxicity.
Appropriateness Criteria Scale **1 2 3 4 5 6 7 8 9** **1 = Least appropriate 9 = Most appropriate**		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Chronic renal failure.

Radiologic Exam Procedure	Appropriateness Rating	Comments
US, kidney	9	Preferably with Doppler methods.
MRA, kidney	6	Noninvasive evaluation of renal arteries as cause of renal failure.
X-ray, abdomen, KUB	3	Information about calcification, majority of calculi, occasionally renal size.
NUC, renal scintigraphy	3	Global and differential renal function; prognosis for recovery.
CT, kidney	3	Potentially helpful in trauma. Helical noncontrast CT for calculi.
X-ray, bladder, voiding cystourethrography (VCUG)	3	If reflux is suspected. Particularly appropriate in children.
INV, kidney, arteriography, DSA	2	Problem of contrast nephrotoxicity. CO_2 aortography an option. Newer MRA techniques preferred.
INV, kidney, phlebography	1	
X-ray, kidney, intravenous urography, IVP	1	
MRI, kidney, body coil	1	
Appropriateness Criteria Scale **1 2 3 4 5 6 7 8 9** **1 = Least appropriate 9 = Most appropriate**		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Renal failure is defined as the inability of the kidney to maintain homeostasis leading to azotemia or the accumulation of nitrogenous wastes; however, exact biochemical or clinical criteria for this diagnosis are not defined clearly. "Renal failure" is distinguished from "renal insufficiency," where renal function is abnormal but capable of sustaining essential bodily functions. Renal failure is defined as anuric when urine volume is less than 50 mL for 24 hours; oliguric when the volume is less than 500 ml for 24 hours; and nonoliguric when the volume is from 500-6,000 mL for 24 hours. Urine output above 6,000 mL is designated polyuric.

Causes of renal failure are conventionally separated into three categories: prerenal, intrarenal, and postrenal. Hypoperfusion is the cause of prerenal failure. Causes of intrarenal failure include acute tubular necrosis (ATN) and interstitial, glomerular, or small vessel disease. Obstruction is the usual postrenal cause of failure. Distinction between acute renal failure (ARF) and chronic renal failure (CRF) can often be made clinically. However, many patients are first seen with markedly elevated serum creatinine of unknown duration, so that classification into ARF or CRF is not possible.

There are significant limitations in using serum creatinine as an accurate measure of renal function, including decreased muscle mass and poor nutritional status. Creatinine clearance measures the ability of the glomerulus to filter creatinine from the plasma and approximates the glomerular filtration rate (GFR); there is a reasonable correlation between the 2-hour and 24-hour creatinine clearance ($r = 0.85$), but the error in calculation may vary from 10%-27%. Creatinine clearance of less than 60 mL/min may be termed renal insufficiency; less than 30 mL/min is renal failure. End-stage renal disease (ESRD) implies CRF of a degree (i.e., GFR<10-12 mL/min) such that life cannot be sustained long-term without dialysis. In ARF, the creatinine clearance is usually less than 25 mL/min. Unfortunately, creatinine clearance is often not helpful when the creatinine value is changing.

Acute renal failure can be broadly defined as a sudden decrease in renal function resulting in azotemia. It can develop in the setting of pre-existing renal insufficiency or can develop in a patient with previously normal kidneys. In a patient with previously undiagnosed renal failure, initial evaluation of renal size by gray-scale US is most helpful. If the kidneys are small and echogenic, the process of long-standing evaluation by US helps to identify a correctable cause of renal failure such as obstruction. If hydronephrosis is present, retrograde or antegrade relief of the obstruction is usually undertaken. If no hydronephrosis is evident and the patient does not have hypertension or other history to suggest renal artery stenosis, further work-up of small, echogenic kidneys is not warranted. Conversely, if the kidneys are of normal size with or without increased echogenicity, this may represent reversible renal failure, most often ARF, and a more extensive evaluation is initiated. Scintigraphy with a tubular secretion agent (e.g. Hippuran, MAG-3) can help assess the level of renal function as well as the potential reversibility of the process causing the renal failure. Therefore, in addition to the history, physical examination, and laboratory analysis of serum and urine, ultrasonography and radionuclide scintigraphy are imaging tools that are used early in the evaluation of the patient with previously undiagnosed renal failure. If renal artery stenosis or occlusion is suspected, magnetic resonance angiography (MRA) techniques can be used to avoid nephrotoxic iodinated contrast media.

Acute Renal Failure

Over 75% of patients with ARF will have either prerenal azotemia (PRA) or ATN (parenchymal, intrarenal process) as the cause. Prerenal causes of ARF relate to hypoperfusion or hypovolemia. Clinical suspicion of ARF usually leads to a fluid challenge with central monitoring and correction of the hypovolemic state, which in turn corrects the renal failure. A common exception to this approach is the patient with heart failure or liver failure. Acute renal artery occlusion in a solitary kidney or solitary functioning kidney is an uncommon cause of lack of response to

the therapeutic trial of intravascular fluid; imaging techniques are used to define the cause of hypoperfusion.

A high ratio of blood urea nitrogen (BUN) to creatinine (Cr) has long been considered a marker of PRA. In addition, a characteristic laboratory finding in PRA is avid sodium retention, with urine sodium concentration of less than 20 mEq/L. Meta-analysis of various laboratory studies in an attempt to differentiate PRA from ATN reveals that most determinations (urine/plasma creatinine index, urine/plasma urea, or urinary sodium) are often nonspecific or unreliable. Still, most experienced clinicians find that when urine output is less than 500 ml/24 hr, determination of urinary fractional excretion of sodium is helpful.

Duplex Doppler sonography has been suggested to distinguish acute prerenal failure from ATN (intrarenal failure). Compared with traditional gray scale ultrasonography, which shows normal kidneys in most patients with ATN, duplex Doppler sonography shows an elevated resistive index (RI) in 96% of patients with ATN; false negatives include nephrotoxic drug-induced ATN. Acute tubular necrosis has a higher RI than prerenal ARF, but there is some overlap in that 20% of patients with prerenal ARF had resistive indices over 0.75. Hepatorenal syndrome is a distinct form of prerenal failure that is associated with an elevated RI. Tubulo-interstitial causes of intrarenal ARF usually have an elevated RI. Acute glomerular-based processes will often have a normal RI, whereas chronic glomerular processes typically show an elevated RI. Consequently, Doppler sonography cannot replace renal biopsy. Although there is a weak linear relationship between the RI and serum Cr, the RI returns to normal before serum Cr in ARF; RI may be useful in predicting the course of ARF.

Trauma presents a unique constellation of prerenal, intrarenal, and/or postrenal causes of ARF. In major trauma centers, body CT is used increasingly for initial abdominal trauma assessment of causes of renal failure such as renal artery occlusion, kidney trauma, and clot obstruction occurring bilaterally or in a solitary kidney. Nephrotoxic drugs and ATN following prolonged shock with precipitation of hemoglobin and/or myoglobin in the tubules are other causes of ARF that may cause abnormal CT findings.

Obstruction is an uncommon cause of ARF but may occur in the oncology patient, the trauma patient, or the patient with a solitary kidney. Gray-scale ultrasonography is the most effective way to exclude subacute or chronic obstruction. Regular gray-scale US is not accurate in the minimally dilated obstructive situation, such as with retroperitoneal metastatic tumor or idiopathic retroperitoneal fibrosis, where ureter encasement interferes with peristalsis; in one series, 4%-5% of patients with obstruction showed minimal or no upper tract dilation. Duplex Doppler sonography is less effective in acute obstruction since obstruction for longer than 6 hours is necessary to show a consistently elevated RI; false negatives (i.e., normal RI) occur in patients who are examined earlier than 6 hours after the onset of obstruction. Furthermore, RI measurements are often normal in patients with acute intermittent obstruction. The patient with a renal transplant can present with acute renal failure. Because one study found an elevated RI in 85% of transplanted kidneys with obstruction, a normal RI should argue strongly against obstruction, unless a ureteral leak is also present. In addition to obstruction, an elevated RI can also be found in rejection and ATN;

therefore, RI measurements are not useful in the differential diagnosis of these entities.

After US excludes obstruction, it is suggested that renal scintigraphy with technetium-labeled MAG-3 or I-131 labeled OIH be performed. Progressive parenchymal accumulation without significant excretion is suggestive of ATN. Absent uptake suggests more serious conditions such as acute cortical necrosis and acute glomerulonephritis. In acute renal failure, GFR is more affected than renal blood flow, hence Tc 99m DTPA accumulation is decreased, and this agent is less able to distinguish acute from chronic renal disease. Quantitative studies with the tubular agents I-131 OIH or Tc 99m MAG-3, however, can be used. These methods assess effective renal plasma flow (ERPF) and the degree of renal function, and they also have prognostic significance. Patients with ERPF greater than 125 ml/min and good uptake usually completely recover or markedly improve. Acute tubular necrosis, hepatorenal syndrome, and acute interstitial nephritis belong in the category with good prognosis. Patients with low uptake have a poor prognosis and eventually require dialysis or transplantation.

Clinical evaluation and volume replacement resolve the majority of pre-renal causes of renal failure. Ultrasonography evaluates for obstruction and renal size, and it can provide a measure of renal perfusion. Some suggest that duplex Doppler sonography can supplant radionuclide scintigraphy, MRA, or contrast angiography in evaluating the renal arteries; however, these results have not been reproduced in many centers. Newer MRA techniques offer improved images of the main and segmental renal arteries. MRI can also provide direct assessment of renal blood flow. Scintigraphy is useful for renal perfusion and for determining ERPF, which helps assess recoverability of function in ARF. CT is used to evaluate the trauma patient and supplement technically unsatisfactory or equivocal sonography. Excretory urography has no role in investigating ARF.

Chronic Renal Failure

Chronic renal failure (CRE) often presents insidiously and is characterized by a steady decrease in glomerular filtration rate (GFR). Causes of CRF that lead to ESRD and result in transplantation are (in decreasing frequency): chronic glomerulonephritis, diabetic nephropathy, hypertensive nephropathy, polycystic renal disease, chronic pyelonephritis, and renal calculi.

The most common causes of CRF in children are chronic glomerulonephritis and pyelonephritis. Ultrasound best differentiates between obstruction and intrinsic parenchymal disease. In children with small-scarred kidneys, VCUG is performed. For adults with ESRD and urinary tract infection (UTI) or calculi, evaluation with VCUG, urodynamics, and retrograde pyelography is also advised.

Patients with ESRD on dialysis develop cysts, hemorrhage, and neoplasia. Evaluation for cystic change in these patients is done optimally with CT, which showed 60% of cysts, whereas sonography showed only 18%. Although solid renal masses in these patients were shown equally well by sonography and CT, the ability of CT to detect acquired cystic disease and the need to follow for possible neoplasm warrants use of CT as screening after 3 years of dialysis. Early enhanced CT is recommended. In acquired cystic disease, follow-up imaging with

CT seems advisable only in selected populations. Alternatively MRI and ultrasound can be used.

Analgesic nephropathy accounts for about 3% of patients on chronic dialysis and often results in papillary necrosis. Calcification along the papillary line and a "wavy" renal contour are the most common radiographic findings. Evaluation of calcification and renal contour is effectively done with renal tomography and sonography, but most easily with noncontrast CT. Noncontrast helical CT is also more sensitive and specific than plain radiography for ureteral calculi.

Hypertensive nephropathy is now one of the most common causes of ESRD and in one study accounted for 25% of all patients. Atherosclerotic renal artery stenosis presenting as CRF accounted for 14% of patients older than 50 in another study. Reports on the ability of duplex Doppler sonography to detect renal artery stenosis (RAS) vary widely; some reports are as high as 90%, whereas others show poor results. Over one-third of patients evaluated with earlier Doppler methodology had an unsatisfactory exam. With use of a posterior or posterolateral translumbar approach and analysis of intrarenal vessel waveforms, duplex Doppler sonography has been reported to detect significant (over 70%) RAS as a cause of renal failure, with a sensitivity of 95% and specificity of 97%. Examinations were almost always technically feasible and accomplished within half an hour. One study found it effective in evaluating RAS, but only when the renal artery stenosis (RAS) was 80% or greater. Usually, high-grade stenoses are associated with renal failure. A subsequent study was not able to reproduce results adequately to support the use of duplex Doppler sonography as a screening test for RAS. Duplex Doppler sonography for diagnosis of RAS is very operator-dependent.

Renal scintigraphy with technetium 99m DTPA and an angiotensin-converting enzyme inhibitor (ACEI) has high sensitivity and specificity in detecting RAS in patients with normal or near-normal renal function. Its utility is also reported preserved in patients with renal insufficiency. However, it becomes less accurate in patients with renal failure because DTPA is a pure glomerular agent and there is a variable response to ACEI in patients with low baseline renal function (e.g., GFR less than 15 ml/min). On the other hand, scintigraphy with technetium 99m MAG-3, because it is secreted by the tubules as well as filtered by glomeruli, is similar to iodine 131 Hippuran; it is more effective in patients with renal failure. However, scintigraphy with ACEI does not indicate the presence of RAS, but only activation of the renin-angiotensin system; conversely, a negative test does not exclude RAS but only absence of activation. Global and differential renal function can be used to estimate prognosis for recovery. Whereas visualization of the kidney is nonspecific, nonvisualization of the kidneys indicates a poor prognosis.

MRA is able to demonstrate, with high sensitivity and specificity, atherosclerotic narrowing of the orifice and proximal renal artery. Aortic or proximal renal artery disease is the usual culprit when atherosclerosis causes renal failure, making MRA a helpful imaging modality. Newer ultrafast MRA techniques using intravenous gadolinium agents during breath-held imaging provide excellent images of the entire renal artery and often the segmental branches. Gadolinium agents have less nephrotoxicity than conventional iodinated contrast media and, therefore, are available when contrast-enhanced imaging is necessary. Angiography with iodinated contrast material and digital subtraction (DSA) technique remains the

gold standard, but its use must be carefully considered because of the risk of contrast nephrotoxicity. Some institutions use carbon dioxide as the "contrast" agent and thereby can avoid the toxicity associated with iodinated contrast media.

Urinary obstruction as a cause of CRF is best evaluated by US. If azotemia is secondary to obstructive uropathy, hydronephrosis will almost always be demonstrable. US has sensitivity approaching 100% in moderate to severe hydronephrosis. There may be a false positive rate of up to 26%, caused by such entities as vesicoureteral reflux, full bladder, renal sinus cysts, and normal vessels in the renal sinus; however, vascular structures causing confusion can be resolved with duplex Doppler sonography or color duplex Doppler sonography. When kidneys fail secondary to chronic obstruction, resistive indices may return to normal.

Newer and future techniques of determining renal function in patients with renal failure include determination of clearance of small doses (10 ml) of nonradioactive low osmolar contrast media (LOCM) (iohexol), dynamic MR imaging with gadolinium DTPA, and MR imaging with ultrasmall particles of iron oxide (USPIO).

Chronic renal failure is often due to intrinsic renal disease such as diabetes and/or hypertension. Obstruction is the most important cause to be excluded initially, and this is done best by US. If RAS is a possible consideration, various modalities are available. Although angiography is the gold standard, it usually requires potentially nephrotoxic contrast medium. Radionuclide scintigraphy is helpful in measuring ERPF and defining renal artery compromise, though ACEI-modified renography becomes less effective in patients with renal failure. Duplex Doppler sonography, even using newer techniques, has not proved to be a reliable method to screen for RAS, but does seem to be effective in identifying high-grade stenoses; newer MRA techniques with gadolinium now rival arteriography for evaluating the renal artery; and because ischemic nephropathy is a significant contributor to renal failure, MRA is assuming a more prominent role in evaluation.

Summary

1. Ultrasound is the first imaging study for evaluating the patient with previously undiagnosed renal failure. It helps the clinician separate chronic ESRD from potentially reversible ARF or CRF by defining renal size, echogenicity, presence or absence of hydronephrosis, and cystic disease. Duplex Doppler sonography can define renal flow; however, the specific utility of duplex Doppler sonography in evaluating the patient with renal failure needs further investigation.
2. Radionuclide scintigraphy provides an assessment of global and differential renal function and potential reversibility of renal failure.
3. If the US is equivocal for obstruction or cystic disease, add CT.
4. CT is of value in the trauma patient with ARF.
5. If the blood pressure is elevated or in the clinical setting of prominent peripheral atherosclerotic vascular disease, add MRA when duplex Doppler sonography or ACEI scintigraphy is positive or nondiagnostic in the patient with renal failure who is not a candidate for contrast angiography.

Anticipated Exceptions

Although body coil MRI or renal phlebography may be indicated to evaluate for renal vein thrombosis as an unusual cause of ARF, newer MRA techniques are suggested. Voiding cystourethrography may be indicated if vesicoureteral reflux is suspected as a contributing factor in ARF.

Abbreviations

- CT, computed tomography
- DSA, digital subtraction angiography
- IVP, intravenous pyelogram
- KUB, kidneys, ureters, bladder
- MRA, magnetic resonance angiography
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- US, ultrasonography
- VCUG, voiding cystourethrography

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

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

Selection of appropriate radiologic imaging procedures for investigation of causes of renal failure

Subgroups Most Likely to Benefit

- Bladder x-ray, voiding cystourethrography (VCUG) is particularly appropriate in children.
- Gray-scale ultrasonography is the most effective way to exclude subacute or chronic obstruction in the oncology patient, the trauma patient, or the patient with a solitary kidney.
- Computed tomography (CT) is of value in the trauma patient with acute renal failure (ARF).

POTENTIAL HARMS

- *Duplex Doppler sonography* is less effective in acute obstruction since obstruction for longer than 6 hours is necessary to show a consistently

elevated resistive index (RI); false negatives (i.e., normal RI) occur in patients who are examined earlier than 6 hours after the onset of obstruction
- *Ultrasound (US)* may have a false positive rate of up to 26%, caused by such entities as vesicoureteral reflux, full bladder, renal sinus cysts, and normal vessels in the renal sinus.

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 co-existent 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.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Bush WH Jr, Choyke PL, Bluth RI, Casalino DD, Francis IR, Jafri SZ, Kawashima A, Kronthal A, Older RA, Papaincolaou N, Ramchandani P, Rosenfield AT, Sandler CM, Segal AJ, Tempany C, Resnick MI, Expert Panel on Urologic Imaging. Renal failure. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 8 p. [53 references]

ADAPTATION

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

DATE RELEASED

1995 (revised 2005)

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

Committee on Appropriateness Criteria, Expert Panel on Urologic Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: William H. Bush, Jr, MD (*Principal Author*); Peter L. Choyke, MD (*Panel Chair*); Edward I. Bluth, MD; David D. Casalino, MD; Isaac R. Francis, MD; S. Zafar H. Jafri, MD; Akira Kawashima, MD, PhD; Alan Kronthal, MD; Robert A. Older, MD; Nicholas Papanicolaou, MD; Parvati Ramchandani, MD; Arthur T. Rosenfield, MD; Carl Sandler, MD; Arthur J. Segal, MD; Clare Tempany, MD; Martin I. Resnick, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

It updates a previous published version: American College of Radiology, Expert Panel on Urologic Imaging. Radiologic investigation of causes of renal failure. Reston (VA): American College of Radiology (ACR); 2001. 8 p. (ACR appropriateness criteria). [51 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

GUIDELINE AVAILABILITY

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

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the ACR Web site.

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

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (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 on June 29, 2001. This summary was updated by ECRI on September 8, 2004. The updated information was verified by the guideline developer on October 8, 2004. This summary was updated by ECRI on February 8, 2006. This summary was updated by ECRI Institute on May 17, 2007 following the U.S. Food and Drug Administration (FDA) advisory on Gadolinium-based contrast agents. This summary was updated by ECRI Institute on June 20, 2007 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents.

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Date Modified: 10/13/2008