

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Right Lower Quadrant Pain

Variant 1: Fever, leukocytosis, and classic presentation clinically for appendicitis in adults.

| Radiologic Procedure | Rating | Comments | RRL* |
|--|--------|---|----------------------------------|
| CT abdomen and pelvis with contrast | 8 | Use of oral or rectal contrast depends on institutional preference. | High |
| CT abdomen and pelvis without contrast | 7 | Use of oral or rectal contrast depends on institutional preference. | High |
| US abdomen RLQ | 6 | With graded compression. | None |
| US pelvis | 5 | | None |
| X-ray abdomen | 5 | | Med |
| MRI abdomen and pelvis with or without contrast | 4 | See comments regarding contrast in text under "Anticipated Exceptions." | None |
| X-ray contrast enema | 3 | | Med |
| NUC Tc-99m WBC scan abdomen and pelvis | 3 | | Med |
| Rating Scale: 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

Variant 2: Fever, leukocytosis; possible appendicitis, atypical presentation, adults and adolescents.

| Radiologic Procedure | Rating | Comments | RRL* |
|--|--------|---|----------------------------------|
| CT abdomen and pelvis with contrast | 8 | Use of oral or rectal contrast depends on institutional preference. | High |
| X-ray abdomen | 6 | | Med |
| US abdomen RLQ | 6 | With graded compression. | None |
| US pelvis | 6 | | None |
| CT abdomen and pelvis without contrast | 6 | Use of oral or rectal contrast depends on institutional preference. | High |
| MRI abdomen and pelvis with or without contrast | 5 | See comments regarding contrast in text under "Anticipated Exceptions." | None |
| X-ray contrast enema | 3 | | Med |
| NUC Tc-99m WBC scan abdomen and pelvis | 3 | | Med |
| Rating Scale: 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

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Clinical Condition: Right Lower Quadrant Pain

Variant 3: Fever, leukocytosis, pregnant woman.

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---------------|--|----------------------------------|
| US abdomen RLQ | 8 | With graded compression. Better in first and early second trimester. | None |
| MRI abdomen and pelvis without contrast | 7 | | None |
| US pelvis | 6 | | None |
| CT abdomen and pelvis with contrast | 6 | Use of oral or rectal contrast depends on institutional preference. | High |
| CT abdomen and pelvis without contrast | 5 | Use of oral or rectal contrast depends on institutional preference. | High |
| X-ray abdomen | 2 | | Med |
| X-ray contrast enema | 2 | | Med |
| NUC Tc-99mWBC scan abdomen and pelvis | 2 | | Med |
| <u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

Variant 4: Fever, leukocytosis, possible appendicitis, atypical presentation in children (less than 14 years of age).

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---------------|---|----------------------------------|
| US abdomen RLQ | 8 | With graded compression. | None |
| CT abdomen and pelvis with contrast | 7 | May be useful following negative US. Use of oral or rectal contrast depends on institutional preference. Consider limited RLQ CT. | High |
| X-ray abdomen | 6 | | Med |
| US pelvis | 5 | | None |
| CT abdomen and pelvis without contrast | 5 | Use of oral or rectal contrast depends on institutional preference. Consider limited RLQ CT. | High |
| MRI abdomen and pelvis with or without contrast | 5 | See comments regarding contrast in text under "Anticipated Exceptions." | None |
| X-ray contrast enema | 3 | | High |
| NUC Tc-99m WBC scan abdomen and pelvis | 2 | | Med |
| <u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

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RIGHT LOWER QUADRANT PAIN

Expert Panel on Gastrointestinal Imaging: Robert L. Bree, MD, MHSA¹; Max Paul Rosen, MD, MPH²; W. Dennis Foley, MD³; Spencer B. Gay, MD⁴; Thomas H. Grant DO⁵; Jay P. Heiken, MD⁶; James E. Huprich, MD⁷; Tasneem Lalani, MD⁸; Frank H. Miller, MD⁹; Pablo R. Ros, MD, MPH¹⁰; Gary S. Sudakoff, MD¹¹; Frederick L. Greene, MD¹²; Don C. Rockey, MD.¹³

Summary of Literature Review

Few comparative imaging studies evaluating right lower quadrant pain are available. Most imaging reports center on disease processes, such as appendicitis. Because appendicitis is the most common cause of right lower quadrant pain, the focus of this narrative is on appendicitis and the accuracy of imaging procedures in diagnosing appendicitis, although consideration of other diseases is, of course, included.

Acute appendicitis is the most common acute abdominal disorder that requires surgery [1]. In most patients with acute appendicitis, imaging may not be necessary, because the clinical presentation is sufficiently diagnostic to allow surgery [2]. To date, however, no prediction rules for identifying subjects with appendicitis have been validated. In the published studies for imaging in appendicitis, the selection criteria for imaging are not often stated, but in most investigations, subjects with definitive clinical exam findings of appendicitis undergo operation without imaging. In the reported imaging studies, an average of 45%-50% of imaged subjects had appendicitis, and 36% had nonspecific abdominal pain. Data on the overall effect of imaging on surgical treatment of appendicitis and patient outcome remain contradictory [3-11].

Radiographic diagnosis is of limited value for diagnosing acute appendicitis, except in occasional circumstances when an appendicolith or other ancillary findings are identified. Although barium enema has been used historically to diagnose appendicitis, it depends on the negative finding of nonvisualization of the appendix and may be quite uncomfortable in patients with acute appendicitis. Nonetheless, barium small-bowel follow-

through or barium enema may be useful for other causes of right lower quadrant pain, including suspected small-bowel obstruction, infectious ileitis, and inflammatory bowel disease. Finally, use of Magnetic Resonance Imaging (MRI) for appendicitis has been reported in a few small case series, including in pregnant women [12].

Computed tomography (CT) is the most accurate study for evaluating patients without a clear clinical diagnosis of acute appendicitis [13,14]. In a meta-analysis of prospective studies of the accuracy of CT and ultrasound (US) in adolescents and adults, CT demonstrated superior sensitivity (0.94, 95% CI: 0.91 to 0.95) and specificity (0.95, 95% CI: 0.93 to 0.96) versus US (sensitivity 0.86, 95% CI: 0.83 to 0.88; specificity 0.81, 95% CI: 0.78 to 0.84) [15]. This analysis was based on studies of CT and US identified through December 2004, and included four studies that directly compared both modalities. The results of investigations of CT showed consistent results across all studies and institutions, while US investigations demonstrated heterogeneity, suggesting greater dependence on operator skill [16].

Another controversy is whether or not to use intravenous contrast in the CT evaluation of appendicitis. High accuracy has been reported for both techniques, and direct comparisons are lacking [17,18]. However, the majority of the available evidence is on CT with intravenous contrast. Institutional experience may be the best determinant of appropriateness of intravenous contrast. More recently, emergency physicians and surgeons have suggested eliminating oral contrast from protocols for evaluating patients with suspected appendicitis in order to expedite evaluation and have a better preparation for surgery. There is as yet no proof that this protocol will have the same accuracy as those with oral contrast. A compromise position might be to use rectal contrast to opacify the bowel surrounding the appendix, particularly in thin patients. Both CT and US may be effective in detecting causes of pain unrelated to appendicitis. CT has been reported to show a nonappendicitis cause of abdominal pain in 20% of subjects, versus 15% for US. The range of diseases studied includes inflammatory bowel disease, infectious bowel disease, small-bowel obstruction, acute gynecological conditions, and others.

CT appears superior to sonography in evaluating patients with periappendiceal abscess, especially when the abscesses become large [19]. CT can be used to choose among different therapeutic options, including antibiotic treatment (with small abscesses), percutaneous drainage (with one to three well-defined medium-sized abscesses), and surgery (with extensive abnormality not amenable to percutaneous drainage) [20,21].

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CT and US have been less well evaluated in children than in adults. Many large prospective studies include subjects of all ages, despite the potential differences in imaging accuracy between children and adults due to smaller body size and less body fat in children. This makes it difficult to determine the accuracy of imaging in different subgroups. Further, the increased radiosensitivity of children makes the use of ionizing radiation of more concern for them. A systematic literature review through July 2004 revealed eight prospective evaluations of US for appendicitis in children [22]. The pooled sensitivity of graded compression US was 91% (95% CI: 89%-93%), and the specificity was 97% (95% CI: 95%-99%). Only a single prospective study of CT in children was identified, reporting a sensitivity of 95% and a specificity of 98%. There is also a small literature on the use of US as an initial imaging study, followed by CT for equivocal cases [23-25]. Such combined protocols demonstrate a sensitivity of 95% (95% CI: 83%-100%) and specificity of 93% (95% CI: 87%-97%). These results suggest that although CT is more accurate, US may also be appropriate in experienced hands, particularly if equivocal results are followed up by CT [26-30].

Nuclear medicine imaging with WBC scans has also been reported for evaluating right lower quadrant pain [31].

Evaluation of the accuracy of imaging in pregnant women has received little attention in the literature. In general, ionizing radiation from CT should be avoided during pregnancy, and US is clearly a safer imaging option [32]. In the appropriate clinical setting, MRI can be accurate in excluding appendicitis where the US exam does not visualize a normal appendix [12].

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF), also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF [33-35], a syndrome that can be fatal. Further studies are necessary to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (eg, >0.2mM/kg) and to agents in which the gadolinium is least strongly chelated. The FDA has recently issued a “black box” warning concerning these contrast agents

(http://www.fda.gov/cder/drug/InfoSheets/HCP/gcca_200705HCP.pdf).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated GFR <30 mL/min/1.73m²), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s) [34].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

| Relative Radiation Level Designations | |
|---------------------------------------|-------------------------------|
| Relative Radiation Level | Effective Dose Estimate Range |
| None | 0 |
| Minimal | < 0.1 mSv |
| Low | 0.1-1 mSv |
| Medium | 1-10 mSv |
| High | 10-100 mSv |

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