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 statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray contrast enema	3		Med
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 statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray contrast enema	3		Med
Tc-99m WBC scan abdomen and pelvis	3		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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
Tc-99m WBC scan abdomen and pelvis	2		Med
Rating Scale: 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 statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray contrast enema	3		High
Tc-99m WBC scan abdomen and pelvis	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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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].

CT and US have been less well evaluated in children than in adults. Many large prospective studies include subjects

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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) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [33].

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

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Evidence Table

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