American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Right Upper Quadrant Pain**

Variant 1: **Fever, elevated WBC, positive Murphy sign.**

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	9		None
X-ray abdomen	5		Med
CT abdomen with or without contrast	5		Med
NUC cholescintigraphy	4		Low
X-ray upper GI series	3		Med
X-ray contrast enema	3		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: **Suspected acalculous cholecystitis.**

Radiologic Procedure	Rating	Comments	RRL*
NUC cholescintigraphy	8		Low
CT abdomen with or without contrast	6		Med
X-ray abdomen	6		Med
US abdomen	4	Repeat within 24 hours.	None
X-ray upper GI series	3		Med
X-ray contrast enema	3		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 3: **No fever, normal WBC.**

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	8		None
CT abdomen with or without contrast	7		Med
NUC cholescintigraphy	6		Low
X-ray abdomen	4		Med
X-ray contrast enema	4		Med
X-ray upper GI series	3		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

An 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 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.

Clinical Condition: **Right Upper Quadrant Pain**

Variant 4: **No fever, normal WBC, ultrasound shows only gallstones.**

Radiologic Procedure	Rating	Comments	RRL*
NUC cholescintigraphy	8		Low
CT abdomen with or without contrast	6		Med
X-ray abdomen	4		Med
X-ray contrast enema	4		Med
X-ray upper GI series	3		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 5: **Hospitalized patient with fever, elevated WBC, and positive Murphy sign.**

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	9		None
NUC cholescintigraphy	7		Low
CT abdomen with or without contrast	7		Med
X-ray abdomen	6		Med
NUC cholescintigraphy with cholecystokinin	6		Low
US abdomen with cholecystokinin	5		None
INV cholangiography percutaneous cholecystostomy	5	Particularly in ICU patients, this can be both diagnostic and therapeutic.	IP
X-ray contrast enema	4		Med
X-ray upper GI series	3		Med
INV ERCP	3		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

An 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 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.

Expert Panel on Gastrointestinal Imaging: Robert L. Bree, MD, MHSA[1]; Max Paul Rosen, MD, MPH[2]; W. Dennis Foley, MD[3]; Spencer B. Gay, MD[4]; Thomas H. Grant DO[5]; Jay P. Heiken, MD[6]; James E. Huprich, MD[7]; Tasneem Lalani, MD[8]; Frank H. Miller, MD[9]; Pablo R. Ros, MD, MPH[10]; Gary S. Sudakoff, MD[11]; Frederick L. Greene, MD[12]; Don C. Rockey, MD.[13]

Summary of Literature Review

Acute right upper quadrant pain is a very common presenting symptom in patients presenting to hospital emergency rooms and in the occasional patient hospitalized for chronic disease or trauma. The primary diagnosis to be established is acute cholecystitis (AC), and the primary mode of treatment is laparoscopic cholecystectomy. It has been suggested empirically and by scientific evidence that approximately one-third of patients with presumptive diagnosis of AC will not be confirmed as having AC on follow-up. Of patients who have surgery for AC, 20%-25% may have a different diagnosis. These studies, of course, were primarily performed in the era before modern imaging. Additionally, because there are data indicating that surgery in AC leads to better outcomes, there is preference among surgeons to make a diagnosis based on the presence of gallstones and clinical findings and to perform early laparoscopic cholecystectomy. In fact, it might be necessary to redefine the patient outcomes of AC rather than rely on strict histologic criteria when, in the early stages of the disease, the histologic abnormalities may be minimal. In the otherwise healthy patient, imaging intervention may be only minimally necessary, but in more complicated patients a more complex protocol might be appropriate [1-3].

The evidence-based diagnosis of AC was studied in a meta-analysis published in 2003 [4]. No clinical or laboratory finding had a high or low enough likelihood ratio to predict its presence or absence. This study further supports the evidence that imaging studies are essential for the diagnosis. Much of the literature defining the role of imaging studies in evaluating patients with acute right upper quadrant pain is from the 1980s. When ultrasound (US) began to be used for these patients, it became obvious that it was destined to replace intravenous cholangiography and oral cholecystography for gallbladder evaluation. An initial study in 1981 defined the sonographic Murphy sign as focal gallbladder tenderness, which, along with sludge and gallbladder thickening, enabled physicians to separate acute from chronic cholecystitis in patients who harbored stones [5]. Unfortunately, the sonographic Murphy sign does have a low specificity for AC [6].

In 1982, a study of the accuracy of scintigraphy with HIDA compared with sonography indicated similar excellent results in 91 patients suspected of having AC. The overall accuracy of US was 88%, and for scintigraphy it was 85% [7].

A study of 194 patients published in 1983 using strict criteria for pathologic diagnosis of AC and liberal criteria for US diagnosis (presence of stones) showed that when scintigraphy was compared with US, sensitivities were high for both but specificity of US dropped to 64%, with a positive predictive value of only 40%. The sonographic Murphy sign was not analyzed, nor was there correlation with clinical data [8].

Since these studies, other scattered articles in the radiologic literature have debated the role of US and scintigraphy in the diagnosis of AC. One criticism of scintigraphy is the time to perform the study (up to 4 hours to separate acute from chronic cholecystitis). The time can be diminished with the use of IV morphine, but the yield in otherwise healthy patients may not be significant because they will have the same outcome, a laparoscopic cholecystectomy. Some may argue that AC should be defined by the relief of symptoms following cholecystectomy. Authors often recommend US or scintigraphy, or both, for diagnosing AC; however, it is accepted that scintigraphy continues to have higher sensitivity and specificity than US. The role of scintigraphy remains for the individual surgeon or emergency physician to determine in an individual case [7-11].

Complications of AC include gangrene, empyema, and perforation. The sonographic Murphy sign may be absent when gangrenous AC is present, and other features such as pericholecystic fluid, gallbladder wall thickening, and dilated gallbladder are important in this group of patients [12].

With the routine use of laparoscopic cholecystectomy, the importance of preoperative or intraoperative detection of nonobstructing, asymptomatic common duct stones remains controversial. Common duct stones are present in 10%-20% of patients with AC. One approach to

[1]Principal Author and Panel Chair, University of Washington, Seattle, Wash; [2]Panel Vice-Chair, University of Pennsylvania, Philadelphia, Pa; [3]Froedtert Hospital East, Milwaukee, Wis; [4]University of Virginia Health Science Center, Charlottesville, Va; [5]Northwestern University Feinberg School of Medicine/NMH, Chicago, Ill; [6]Mallinckrodt Institute of Radiology, Saint Louis, Mo; [7]Mayo Clinic, Rochester, Minn; [8]Inland Imaging Associates, Seattle, Wash; [9]Northwestern University Feinberg School of Medicine/NMH, Chicago, Ill; [10] Brigham & Women's Hospital/Harvard, Boston, Mass; [11]Froedtert Hospital, Milwaukee, Wis; [12]Carolinas Medical Center, Charlotte, NC, American College of Surgeons;[13]University of Texas, Southwest Medical Center, Dallas, Texas, American Gastroenterological Association.

Reprint requests to: Department of Quality & Safety, American College of Radiology, 1891 Preston White Drive, Reston, VA 20191-4397.

An 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 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.

predicting common duct stones uses the size of the gallstones present, with patients having multiple stones less than 5 mm in diameter more likely to have common duct stones than those with multiple larger stones or single large stones [13]. In patients at higher risk for common duct stones, preoperative study with endoscopic retrograde cholangiopancreatography (ERCP) may be warranted [14].

The patient with acalculous cholecystitis is more problematic. The use of sonography and scintigraphy has been advocated, including using cholecystokinin to attempt to evaluate gallbladder contraction [15]. The absence of stones, particularly in the patient presenting to the emergency room, should be confirmed with a follow-up examination if symptoms persist. Otherwise, acalculous cholecystitis seen in hospitalized patients as well as in a small percentage of patients presenting to the emergency room may be a diagnosis of exclusion. Computed tomography (CT) has a role in evaluating these critically ill patients [16]. In patients in intensive care units, several centers perform percutaneous cholecystostomies. Others are less aggressive, or cholecystostomies are performed surgically.

Other clinical conditions that can simulate AC and present with acute right upper quadrant pain include chronic cholecystitis, peptic ulcer, pancreatitis, gastroenteritis, bowel obstruction, and many others. In this group of patients, CT and barium studies of the upper and lower gastrointestinal tract can be useful to identify alternative diagnoses.

In summary, the diagnosis of AC can often be made clinically, with confirmation of gallstones necessary to confirm the need for laparoscopic cholecystectomy. A study has yet to be performed that relates cholecystectomy performed with this scenario to patient outcomes. Scintigraphy costs more, takes longer, and gives higher sensitivity and specificity than US, but it cannot contribute to a diagnosis if the etiology is not within the biliary tract. False positives can occur in patients with high bilirubin levels and severe intercurrent illnesses. False negatives are rare in AC. These guidelines should allow the radiologist, emergency physician, and surgeon to be comfortable in choosing an expedient modality or combination of modalities to make this important diagnosis.

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
*RRL assignments are not included for some examinations. The RRL assignments for the IP (in progress) exams will be available in future releases.	

References

1. Gill PT, Dillon E, Leahy AL, Reeder A, Peel AL. Ultrasonography, HIDA scintigraphy or both in the diagnosis of acute cholecystitis? *Br J Surg* 1985; 72(4):267-268.
2. Schofield PF, Hulton NR, Baildam AD. Is it acute cholecystitis? *Ann R Coll Surg Engl* 1986; 68(1):14-16.
3. Hanbidge AE, Buckler PM, O'Malley ME, Wilson SR. From the RSNA refresher courses: imaging evaluation for acute pain in the right upper quadrant. *Radiographics* 2004; 24(4):1117-1135.
4. Trowbridge RL, Rutkowski NK, Shojania KG. Does this patient have acute cholecystitis? *JAMA* 2003; 289(1):80-86.
5. Laing FC, Federle MP, Jeffrey RB, Brown TW. Ultrasonic evaluation of patients with acute right upper quadrant pain. *Radiology* 1981; 140(2):449-455.
6. Bree RL. Further observations on the usefulness of the sonographic Murphy sign in the evaluation of suspected acute cholecystitis. *J Clin Ultrasound* 1995; 23(3):169-172.
7. Ralls PW, Colletti PM, Halls JM, Siemsen JK. Prospective evaluation of 99mTc-IDA cholescintigraphy and gray-scale ultrasound in the diagnosis of acute cholecystitis. *Radiology* 1982; 144(2):369-371.
8. Samuels BI, Freitas JE, Bree RL, Schwab RE, Heller ST. A comparison of radionuclide hepatobiliary imaging and real-time ultrasound for the detection of acute cholecystitis. *Radiology* 1983; 147(1):207-210.
9. Alobaidi M, Gupta R, Jafri SZ, Fink-Bennet DM. Current trends in imaging evaluation of acute cholecystitis. *Emerg Radiol* 2004; 10(5):256-258.
10. Kalimi R, Gecelter GR, Caplin D, et al. Diagnosis of acute cholecystitis: sensitivity of sonography, cholescintigraphy, and combined sonography-cholescintigraphy. *J Am Coll Surg* 2001; 193(6):609-613.
11. Ralls PW, Colletti PM, Lapin SA, et al. Real-time sonography in suspected acute cholecystitis. Prospective evaluation of primary and secondary signs. *Radiology* 1985; 155(3):767-771.
12. Simeone JF, Brink JA, Mueller PR, et al. The sonographic diagnosis of acute gangrenous cholecystitis: importance of the Murphy sign. *AJR* 1989; 152(2):289-290.
13. Costi R, Sarli L, Caruso G, et al. Preoperative ultrasonographic assessment of the number and size of gallbladder stones: is it a useful predictor of asymptomatic choledochal lithiasis? *J Ultrasound Med* 2002; 21(9):971-976.
14. Coppola R, Riccioni ME, Ciletti S, et al. Selective use of endoscopic retrograde cholangiopancreatography to facilitate laparoscopic cholecystectomy without cholangiography. A review of 1139 consecutive cases. *Surg Endosc* 2001; 15(10):1213-1216.

An 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 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.

15. Raduns K, McGahan JP, Beal S. Cholecystokinin sonography: lack of utility in diagnosis of acute acalculous cholecystitis. *Radiology* 1990; 175(2):463-466.

16. Bennett GL, Rusinek H, Lisi V, et al. CT findings in acute gangrenous cholecystitis. *AJR* 2002; 178(2):275-281.

An 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 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.