Teaching Editorial

Diagnosing Acute Right Upper Quadrant Pain: Tc-99m IDA or Ultrasound?

The acute onset of right upper quadrant pain in a previously healthy individual is a complaint commonly encountered by primary physicians. The diagnosis in such cases is often difficult because the list of differential diagnostic possibilities includes all of the many pathological processes that may involve any abdominal or pelvic organ. Also, cardiac and pulmonary diseases may occasionally present as right upper abdominal pain.

Although the diagnostic possibilities are many, one of the major concerns is that the pain may be hepatobiliary in origin. With the clinical presentation of acute right upper quadrant pain, acute cholecystitis must be considered since it is a common and potentially life-threatening disease. Because several diagnostic radiologic techniques, including oral cholecystography and intravenous cholangiography, are often inappropriate, the clinician will consider either ultrasound or hepatobiliary scintigraphy as the initial diagnostic test. Frequently these two modalities are complementary and both examinations may be necessary. But which one should the referring clinician order first? Which test is more likely to give the correct diagnosis first and eliminate the other? Understandably, clinicians are often uncertain and confused when faced with this; the imaging experts themselves—radiologists and nuclear medicine specialists—do not always agree upon the most appropriate diagnostic procedure.

Acute cholecystitis occurs when obstruction of both the gallbladder outflow tract and cystic duct leads to inflammation of the gallbladder wall. In approximately 95% of patients with acute cholecystitis, gallstones (cholelithiasis) are present in the inflamed gallbladders, and one or more gallstones, or edema related to these stones, results in cystic duct obstruction. However, the presence of gallstones in the gallbladder does not necessarily imply that acute cholecystitis is the cause of pain, since gallstones may be present in the gallbladder but not occlude the cystic duct. Indeed, gallstones are present in 10% of the American population, and the prevalence may be as high as 30% in the elderly (*1*).

Ultrasound

Ultrasound has found wide acceptance in the diagnosis of gallbladder disease. Recent technologic improvements, real-time scanning and its widespread availability, and ease of performance of abdominal ultrasound examinations have accounted for this. Although ultrasound accurately detects gallstones, it does not usually demonstrate cystic duct stones. Demonstration of gallstones implies a diseased gallbladder. However, the presence of known gallstones or chronic gallbladder disease does not prove that acute right upper quadrant pain is necessarily related to a gallstone obstructing the cystic duct and causing acute cholecystitis.

Several studies have evaluated the merits of ultrasound in patients with acute right upper quadrant pain. Laing et al. (*2*) performed ultrasound examinations in 52 patients with acute right upper quadrant pain and suspected acute cholecystitis. They found that acute cholecystitis

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was the cause of the pain in one-third of the patients. Another one-third of the patients had gallstones without acute cholecystitis (chronic cholecystitis) and the remaining one-third had no gallbladder disease. Thus, since two-thirds of the patients would have produced normal Tc-99m IDA studies without yielding information as to the real cause of the pain, they felt that ultrasound, because of its multiorgan imaging capabilities, was the preferred modality. In addition, they suggested that ultrasound can accurately diagnose acute cholecystitis by considering the ultrasonic examination positive for acute cholecystitis if the patient has obvious gallstones and demonstrates maximal abdominal tenderness in the region of the gallbladder when pressure is exerted with the ultrasound transducer. Other suggested indicators of acute cholecystitis on ultrasound examination are the presence of abnormal gallbladder wall thickening, or anechoicity, and gallbladder dilatation. Using these criteria, 17 of 18 patients with acute cholecystitis were diagnosed correctly by ultrasound (sensitivity of 94%), and 29 of 34 without acute cholecystitis were correctly identified (specificity of 85%).

In this same study (*2*), the overall accuracy of ultrasound in detection of gallbladder disease was 96%. Ultrasound's ability to demonstrate a diseased gallbladder without necessarily determining whether it is acute or chronic has relevance, since the treatment of acute or chronic cholecystitis is ultimately surgical. However, the timing of surgery is important; the mortality of elective cholecystectomy in an otherwise healthy patient is 0.1 to 3% but is 11–17% for emergency surgery for acute cholecystitis in the elderly (*1*). Thus, differentiation of acute from chronic cholecystitis is of value to the surgeon and ultrasound does not usually allow this differentiation.

Tc-99m IDA Imaging

Hepatobiliary imaging with one of the Tc-99m-labeled iminodiacetic acid (IDA) compounds is an alternative method of evaluating patients with suspected acute cholecystitis. The diisopropyl derivative (DISIDA), an FDA-approved radiopharmaceutical, is useful in patients with very high serum bilirubin values ($>$ 30 mg/dl) (*3*). Approximately 3–5 mCi of Tc-99m DISIDA is administered intravenously to a patient who has fasted for at least 2 hr. Imaging is performed with a large field of view scintillation camera. An anterior abdominal image is obtained (one million counts) immediately after administration of the radiopharmaceutical and normally demonstrates prompt accumulation of tracer within hepatocytes. Thereafter, anterior images are obtained every 5 min for 30 min or until definite gallbladder and small intestinal activity is identified. A right lateral image is often helpful in delineating the gallbladder. If the gallbladder is not seen, imaging every 15–30 min for up to 4 hr may be necessary to rule out delayed gallbladder visualization. Normal Tc-99m DISIDA examinations demonstrate gallbladder activity within less than 1 hr and usually within 10–30 min.

Hepatobiliary imaging with Tc-99m IDA does not provide enough resolution to demonstrate gallstones. It can, however, accurately demonstrate cystic duct obstruction (*4*) indirectly since absence of gallbladder visualization is the abnormality on Tc-99m IDA imaging. Nonfilling of the gallbladder in a previously healthy, fasting patient who demonstrates normal hepatic uptake and excretion of the tracer through the common bile duct into the intestine has a greater than 95% probability of representing cystic duct obstruction, and thus acute cholecystitis (*1,4,5*). However, care should be taken to assure that the patient has not eaten for 2 hr before the Tc-99m IDA examination began since recent food intake may cause false positive results to occur. Furthermore, patients who are alcoholics or who are on total par-

enteral nutrition (*6*) or who have severe intercurrent illness (*7*) often demonstrate false positive studies.

Another problem that is frequently encountered is delayed visualization of the gallbladder. Weissmann et al. (*3*) have found that delayed appearance of tracer within the gallbladder (defined as gallbladder visualization between 1 and 4 hr) usually represents chronic cholecystitis. If the study is terminated too early, then what is thought to be nonvisualization (acute cholecystitis) may really be chronic cholecystitis manifesting as delayed gallbladder visualization. In these patients, clinical presentation is very important since the differentiation between acute and chronic cholecystitis cannot always be determined from imaging results alone in a patient who shows mildly delayed but otherwise normal gallbladder visualization.

Discussion and Comparison

Ultrasound is clearly indicated if in addition to the gallbladder other organs such as the right kidney or pancreas also need to be imaged. It is also indicated if information regarding the presence or absence of gallstones is desired. Some investigators (*8,9*), however, have not found it as accurate in diagnosing acute cholecystitis as Laing and colleagues (*2*) have found. A retrospective study of 24 patients with proven acute cholecystitis and 30 control patients without biliary tract disease demonstrated no correlation between the degree of gallbladder wall thickening or gallbladder wall anechoicity as detected by ultrasound and the pathological severity of the inflammatory process (*8*).

Freitas et al. (*9*) have recently evaluated the ability of static gray-scale and real-time ultrasound to predict acute cholecystitis. They found that static scanning was about 80% sensitive and 60% specific. With real-time, the specificity did not change but the sensitivity increased to 96%. However, the predictive value of an abnormal real-time ultrasound scan for acute cholecystitis was only 36%. In light of this, ultrasound does not appear to be the modality of choice to diagnose acute cholecystitis. By contrast, the predictive value of an abnormal Tc-99m IDA study is 76 to 97%, depending on the criteria used to diagnose acute cholecystitis. This suggests that Tc-99m IDA imaging is considerably more accurate to diagnose acute cholecystitis than ultrasound but ultrasound is the superior test in diagnosing chronic cholecystitis.

Many factors other than statistical accuracy, sensitivity, and specificity are involved in determining which imaging study is appropriate. An important issue concerns the prevalence of acute cholecystitis in patients presenting with right upper quadrant pain. Whereas some studies have reported that only 13–34% of patients presenting with right upper quadrant pain actually have acute cholecystitis (*2*), a recent prospective study found greater than 50% of such patients have the disease (*10*). If the lower percentage range is the prevalence studied, 66–87% of the Tc-99m IDA examinations would be normal and would not yield the diagnosis. Thus, other imaging studies would have to be performed. The referring physician, then, is faced with this question: how important is it to know that this patient does *not* have acute cholecystitis? Because of the increased morbidity and mortality associated with nonoperative or delayed operative treatment of acute cholecystitis (*5*), this can be very important to know.

Other factors can be considered when comparing the two imaging modalities. Ultrasound is less expensive than cholescintigraphy; also, it is not associated with ionizing radiation whereas hepatobiliary scintigraphy is. In general, ultrasound takes less time to perform than the scintigraphic study. However, ultrasound requires more technical expertise than the radio-

nuclide method for an accurate examination. Finally, the most appropriate test depends on which examination the clinician feels more comfortable accepting, as well as which test the imaging physician feels more comfortable performing and interpreting.

Hepatobiliary cholescintigraphy appears to be well-accepted by clinicians (*11*). A recent prospective study of 36 patients with acute abdominal pain demonstrated that Tc-99m IDA scintigraphy was efficacious. Further, referring physicians changed their therapeutic plans in 30% of patients because of the results obtained from cholescintigraphy (*10*).

In conclusion, either a Tc-99m IDA hepatobiliary study or an ultrasound exam is an acceptable first procedure in patients presenting with acute right upper quadrant pain. If, however, the clinical suspicion of acute cholecystitis is high, and if it is important for the clinician to know if acute cholecystitis is present, then Tc-99m IDA scintigraphy is preferred. It is rapid, accurate, widely available and efficacious, and has become a useful and important diagnostic test in patients with acute right upper quadrant abdominal pain.

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