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Clinical Presentation, Imaging, and Management of Acute Cholecystitis

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Acute cholecystitis (AC) is a life-threatening emergency that commonly occurs as a complication of gallstones. Severe right upper quadrant pain, abdominal guarding, fever, and a positive Murphy's sign with an elevated white blood cell count are the classical clinical manifestations of AC. Although ultrasonography is typically the initial diagnostic examination in patients with suspected AC, computed tomography and magnetic resonance imaging are commonly performed to identify complications; cholescintigraphy is recommended in patients with equivocal findings on the other imaging modalities, as this technique has the highest diagnostic accuracy in the diagnosis of AC. Imaging studies are also helpful in the timely detection of complications associated with AC. Although laparoscopic cholecystectomy is considered the gold-standard treatment for AC, percutaneous gallbladder drainage with or without cholecystostomy tube placement is a safe, effective management technique for surgically high-risk patients with multiple medical conditions. This treatment can be used as either a bridging therapy, with elective cholecystectomy performed at a later time after improvement of the patient's condition, or as definitive treatment in surgically unfit patients. Radiologists play a pivotal role in the initial diagnosis and management of patients with AC.
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Introduction

Acute inflammation of the gallbladder secondary to cystic duct obstruction in patients with gallstones is known as acute cholecystitis (AC). AC is a common clinical problem accounting for up to 5% of emergency room visits and 9% of hospital admissions.[1] Up to 10% of patients with AC, especially those in critical care units, do not have stones or sludge in the gallbladder; inflammation of the gallbladder in this group of patients without any cystic duct obstruction is known as acute acalculous cholecystitis (AAC).[2] AAC is typically associated with high morbidity and mortality if it is not managed in a timely manner.[3-5]

Severe right upper quadrant pain, fever, and positive Murphy's sign with an elevated white blood cell count on laboratory examination are diagnostic of AC; however, imaging studies, including ultrasound (US), computed tomography (CT), magnetic resonance (MR) imaging, and cholescintigraphy, play an important role in the confirmation of the diagnosis and detection of associated complications.[6] Each imaging technique has varied sensitivity and specificity values in the diagnosis of AC and has a different role to play in management; for example, whereas US is widely used for an initial examination in all patients suspected to have AC, MR imaging is reserved for patients who may have biliary obstruction.[6] Although laparoscopic cholecystectomy is the treatment of choice for patients with AC, image-guided percutaneous gallbladder drainage (PT-GBD) with or without cholecystostomy tube placement is an effective therapy for select patients with multiple medical comorbidities precluding them from undergoing surgery. In addition, the interventional radiologist plays a pivotal role in the treatment of complications from cholecystectomy and cholecystostomy.

In this article, we will review the pathophysiology, clinical features, complications, and imaging findings of AC with special emphasis on the role of each imaging technique in the management of patients with AC. Then, we will present the "ins" and "outs" of cholecystostomy tube placement, including anticipated complications and how to tackle them.

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Pathophysiology, Clinical Features, and Complications

Cystic duct obstruction secondary to an impacted gallstone with associated bile stasis is the initial event in the development of AC; this leads to sustained high pressure within the gallbladder lumen that impairs normal mucosal blood flow and subsequent ischemia. Chemical mediators such as lysolecithin are released within the stagnant bile, damaging ischemic mucosa, and leading to chemical cholecystitis with accumulation of inflammatory infiltrate and gallbladder wall edema.[2] Although bacterial infection is uncommon within the first 48 hours, the risk of infection may increase to 70% by the end of the first week if treatment is not initiated. *Escherichia coli*, *Enterobacter* organisms, *Klebsiella* organisms, and *Enterococcus* organisms are the most commonly identified organisms in patients with AC.[7] Depending on the type and severity of infection, there may be significant necrosis of the gallbladder wall with subsequent perforation and pericholecystic abscess formation.[7] Again, the combination of bile stasis plus ischemia is responsible for AAC development. Patients receiving total parenteral nutrition and those with recent trauma, surgery, shock of any kind, burns, sepsis, or critical illness are at an increased risk of developing bile stasis and inspissation, which can cause toxic destruction of the gallbladder epithelium.[8] This results in the activation of similar pathophysiologic events as in patients with AC. Low-volume states such as congestive cardiac failure, fever, and dehydration may also directly cause gallbladder wall ischemia and play a central role in AAC pathogenesis.[9]

Severe, steady, and prolonged right upper quadrant and epigastric pain with associated fever, nausea, vomiting, and anorexia is the most common clinical presentation of AC. On physical examination, patients typically appear ill, tachycardic, and febrile with voluntary and involuntary abdominal guarding and may have a positive Murphy's sign.[2] A meta-analysis concluded that none of the various studied clinical signs and symptoms of AC had a statistically significant positive or negative likelihood ratio; among all, a positive Murphy's sign had the highest likelihood ratio of 2.8 with 65% sensitivity and 87% specificity.[1] Leukocytosis with an increased number of band forms is the most common laboratory abnormality, seen in up to 60% of patients, and a positive bacterial culture has been reported in one-half to two-thirds of patients with AC.[5,7] Elevated total bilirubin and alkaline phosphatase levels are not common in a patient with uncomplicated AC and should raise concern for biliary obstruction.[1] The combination of history, clinical signs, laboratory values, and imaging findings should be used in diagnosing AC and excluding other etiologies of right upper quadrant pain. On the other hand, patients with AAC demonstrate a variable clinical presentation that depends on the underlying predisposing conditions. Vague abdominal pain, leukocytosis, and unexplained fever with associated jaundice in a critically ill patient in the intensive care unit should raise suspicion for AAC, and US should be performed immediately.[9]

Patients with AC or AAC can develop complications if the condition is not treated in a timely manner; however, complications are more commonly seen in patients with AAC and in patients of advanced age, those with multiple comorbidities, and those with a delayed presentation.[1] Gangrenous cholecystitis (gallbladder empyema) with subsequent perforation is the most common complication. Other common complications include gallbladder mucocele formation, emphysematous cholecystitis, hemorrhagic cholecystitis, pericholecystic abscess, cholecystoenteric fistula, gallstone ileus, Mirizzi syndrome, and peritonitis.[10,11]

Role of Imaging

The role of diagnostic imaging in the management of patients with AC and AAC is 2-fold: establish the diagnosis in suspected individuals on the basis of clinical and laboratory findings and detect complications.[6] Although multiple imaging modalities are available for the diagnosis of AC, their sensitivity, specificity, and diagnostic accuracy values differ considerably, and each has a unique role to play in the management of the condition. Both clinicians and radiologists should be aware of the advantages and drawbacks of each imaging technique so that they can select the appropriate study that is tailored to the needs of the particular patient in question.[6]

US is the most commonly used initial imaging technique in cases of suspected AC based on clinical features. US has sensitivity and specificity values of 82% and 81%, respectively, for the diagnosis of AC.[6] US is a fast, readily available technique that is often diagnostic for AC; additionally, this imaging modality may exclude some nonbiliary causes for right upper quadrant pain. US findings of AC include cholelithiasis, gallbladder sludge, and distended gallbladder with wall thickening (more than 3-5 mm), wall edema, pericholecystic fluid, and presence of a positive sonographic Murphy's sign (Fig. 1).[12] The gallbladder may be decompressed in cases of perforated AC and there will be associated pericholecystic or perihepatic fluid collections; intraluminal gas bubbles may be seen with emphysematous cholecystitis.[11] Among all findings, gallbladder wall thickening is the most reliable diagnostic feature for AC: a cutoff of 3.5 mm yields 80% sensitivity and 99% specificity, whereas a cutoff of 3 mm affords 100% sensitivity with a trade-off of 90% specificity.[9] However, clinical decisions should not be based solely on US findings, as the diagnostic accuracy of US leaves substantial room for error. In patients with clinically equivocal findings, cholescintigraphy should be considered.[6] Patients with AAC show US findings similar to those seen with AC with the exception of an absence of gallstones and sludge within the gallbladder.[9]

Cholescintigraphy using 99mTc-hepatic iminodiacetic acid (HIDA) is a useful imaging technique to establish the diagnosis of AC and has the highest diagnostic accuracy of all imaging techniques, with a sensitivity of 96% and a specificity of 90% for the diagnosis of AC.[6,13] Intravenous

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