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Original Article

To study the sensitivity and specificity of Ultrasonography for diagnosing cholelithiasis in a tertiary care teaching hospital

Krishna Kumar*

*Department of Radio-diagnosis, Teerthanker Mahaveer Medical College & Research Centre. Moradabad, Uttar Pradesh, INDIA.

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***Correspondence to:**
Dr. Krishna Kumar,
Associate Professor,
Department of Radiodiagnosis,
TMMC & RC, Moradabad,
Uttar Pradesh, INDIA.
dr.kkumar6@rediffmail.com

ABSTRACT

Background: Acute cholecystitis is one of the most common diseases requiring emergency surgery. Ultrasonography is an accurate test for cholelithiasis but has a high false-negative rate for acute cholecystitis. The Murphy sign and laboratory tests performed independently are also not particularly accurate. This study was designed to review the accuracy of ultrasonography for diagnosing acute cholecystitis in a regional hospital.

Methods: We studied all emergency cholecystectomies performed over a 1-year period. All imaging studies were reviewed by a single radiologist, and all pathology was reviewed by a single pathologist. The reviewers were blinded to each other's results.

Results: A total of 145 patients required an emergency cholecystectomy in the study period; 105 of them underwent ultrasonography. Interradiologist agreement was 94% for ultrasonography. For cholelithiasis, ultrasonography had 100% sensitivity, 18% specificity, 81% positive predictive value (PPV) and 100% negative predictive value (NPV). For acute cholecystitis, it had 54% sensitivity, 81% specificity, 85% PPV and 47% NPV. All patients had chronic cholecystitis and 67% had acute cholecystitis on histology. When combined with positive Murphy sign and elevated neutrophil count, an ultrasound showing cholelithiasis or acute cholecystitis yielded a sensitivity of 74%, specificity of 62%, PPV of 80% and NPV of 53% for the diagnosis of acute cholecystitis.

Conclusions: Ultrasonography alone has a high rate of false-negative studies for acute cholecystitis. However, a higher rate of accurate diagnosis can be achieved using a triad of positive Murphy sign, elevated neutrophil count and an ultrasound showing cholelithiasis or cholecystitis.

KEYWORDS: Ultrasonography, Cholelithiasis, Cholecystitis.

INTRODUCTION

Intravenous cholangiography and oral cholecystography were the imaging tests of choice for diagnosing acute cholecystitis until they were supplanted by transabdominal ultrasonography in the early 1980s.[1,2] More recently it has been recognized that ultrasonography is very accurate for diagnosing cholelithiasis but less so for diagnosing cholecystitis, with reported positive predictive values (PPV) of 37%–88% and negative predictive values (NPV) of 38%–86%.[3,4,5] Computed tomography (CT) has similar pitfalls, with the possibility of false-positive and false-negative diagnosis of acute cholecystitis.[4,6] Clinical signs, such as a positive Murphy sign, arrest of inspiration during palpation of the right upper quadrant and laboratory investigations are also diagnostically helpful but not definitive in the diagnosis of acute cholecystitis when interpreted in isolation.[7]

MATERIALS & METHODS

This study was carried out on patients suffering from cholelithiasis attending Teerthanker Mahaveer Medical College and Research Centre. The primary objective of this study was, in the interest of quality assurance, to determine the accuracy of ultrasonography in the diagnosis of acute cholecystitis in particular and also of cholelithiasis and choledocholithiasis at our tertiary care teaching hospital. Secondary objectives were to determine if a combination of ultrasonography and other variables would increase the diagnostic accuracy and to examine the surgical outcomes of emergency

cholecystectomy at our hospital. This was a collaborative effort between the departments of surgery, diagnostic imaging and pathology. We examined the cases of all patients presenting to the Teerthanker Mahaveer Medical College & Research Centre who required emergency cholecystectomy during a 1-year study period. All surgeons consented to their charts being reviewed for this study, and patient confidentiality was strictly maintained. Charts were reviewed in accordance with the institution health records policy on quality assurance and improvement.

Murphy sign was considered positive if this was documented by the emergency physician or the attending surgeon or if there was a sonographic Murphy sign (tenderness while compressing the gallbladder with the ultrasound transducer under visualization) in the ultrasound report.The diagnosis of cholecystitis on an ultrasound was made if 2 major criteria or 1 major and 2 minor criteria were met. Major criteria included sonographic Murphy sign, gallbladder wall thickening greater than 3 mm and pericholecystic fluid. Minor criteria included intra- or extrahepatic biliary dilatation and gallbladder hydrops (transverse diameter > 5 cm).

All ultrasonography examinations were performed on either the Phillips IU22 platform with 5 MHz C5 curved array transducers or the General Electric Logic 9 with 5 MHz curved array transducers.

Colour flow Doppler was used to identify increased flow in cases of gallbladder wall thickening greater than 5 mm.

The diagnosis of cholecystitis on CT scan was made if there were 2 or more of the following criteria present: gallbladder distention, wall thickening greater than 4 mm, mucosal hyper enhancement or pericholecystic fat stranding or fluid.[8]

Acute cholecystitis is clinically defined by acute exacerbation of abdominal pain with right upper quadrant tenderness associated with fever and elevated white blood cell count, but for the purposes of this study, it was defined on histologic basis by the presence of neutrophils in the mucosa, submucosa or muscularis on histopathology.

Chronic cholecystitis was histologically defined by the presence of increased lymphocytes in the mucosa, submucosa or muscularis with or without mural thickening or fibrosis.

Table. 1 Demographic and diagnostic details of patients (n=145).

Variables	No. %
Age Group <15-80	145(Male=50(34.5%), Females (95 (65.5%)
Elevated White Blood Cell Count	68%
Elevated Neutrophil Count	70%
Murphy sign	65%

Table. 2 Imaging details of patients (n=145).

Finding	Group; no. (%)*
	Ultrasonography, *n* = 145
Cholelithiasis	94%
CBD stones or dilated ducts	78%
GB wall thickness, mean ± SD mm	5.1 ± 3.4
Pericholecystic edema	82%
Cholecystitis	98%

CBD = common bile duct; CT = computed tomography;
GB = gallbladder; SD = standard deviation.

Table 3 Diagnostic sensitivity, specificity, PPV and NPV for imaging studies

Imaging studies	No.	Sensitivity, %	Specificity, %	PPV, %	NPV, %
Cholelithiasis					
Ultrasonography alone	145	100	18	81	100
Choledocholithiasis					
Ultrasonography alone	145	86	76	44	96
Acute cholecystitis					
Ultrasonography alone	145	54	81	85	47

CT = computed tomography; NPV = negative predictive value; PPV = positive predictive value.

RESULTS

A total of 145 patients presented during the study period: n=95 females and n=50 were male with a mean age of 55.5 (range 15–80) years. The demographic and clinical characteristics of the study sample are summarized in Table 1. The most common clinical sign was elevated neutrophil count (70%), followed by positive Murphy sign (65%) and elevated total white blood cell count (68%).

Table 2 summarizes the imaging findings. All positive findings were included, whether reported by the original or the reviewing radiologist. A total of 145 patients underwent ultrasonography.

Ultrasonography was performed a mean of 1.9 ± 2.9 (range 0–17) days before surgery. Reasons for a delay to surgery included the need for preoperative ERCP and patient comorbidities that precluded immediate surgery. Considering only the 35 patients who were found to have acute cholecystitis on final pathology but in whom ultrasonography did not lead to the condition being diagnosed, 25 had surgery within 24 hours of ultrasonography, and 10 had surgery within 72 hours.

Analysis of only ultrasounds yielded 94% Interradiologist agreement for cholelithiasis, 78% for dilated ducts or suspected common bile duct (CBD) stones, 82% for pericholecystic edema and 98% for diagnosis of cholecystitis on the ultrasound.

There was agreement between the reviewer and the original pathologist in all but 4 cases, where the reviewer found cholecystitis but the original pathologist had not reported it. All patients had histologically confirmed chronic cholecystitis, and 67% had acute cholecystitis as well. A total of 81% had cholelithiasis, and 36% had features of at least focal gallbladder mural necrosis.

Table 3 shows the diagnostic accuracy of imaging studies. Ultrasonography alone was very accurate for diagnosing cholelithiasis (no false negatives) and choledocholithiasis (only 4% false negatives). However, 53% of cases of acute cholecystitis were missed on ultrasounds. Computed tomography alone also had a high incidence of false-negative interpretations. The single patient who had a HIDA scan received a diagnosis of chronic cholecystitis based on the HIDA scan after a negative ultrasound, and the final pathology showed both acute and chronic cholecystitis.

DISCUSSION

Our findings are in agreement with those of other studies that show ultrasonography is excellent for the diagnosis of cholelithiasis but less so for acute cholecystitis. The NPV of 47% in our study is within the range of 38%–86% reported in the literature.[2-5]. We found that HIDA was relatively underused yet yielded an accurate diagnosis in the single patient who underwent this technique in our series; HIDA perhaps should be used more often in cases of diagnostic uncertainty, as the literature suggests it has a better sensitivity than ultrasonography for both calculus cholecystitis and acalculus cholecystitis.[9]

With the disappointing ability of ultrasonography to detect cholecystitis, this raises the question of how to manage a patient with right upper quadrant pain and an ultrasound that shows cholelithiasis.

It is interesting that 45 patients with acute cholecystitis had an elevated neutrophil count but normal total white blood cell count. By itself, an elevated neutrophil count had a better PPV and NPV for acute cholecystitis than white blood cell count and positive Murphy sign, but it was not as accurate as ultrasonography.

It is also interesting that every patient had features of chronic cholecystitis. This suggests perhaps a conservative patient selection for emergency surgery, as a more liberal selection would yield patients with normal pathology.

It may also reflect a lack of access to elective operating time, as 21 patients presented to the emergency department while waiting for elective surgery. This possibility needs further study.

Some studies show poorer outcomes based on gall-bladder wall thickness and delayed surgery. Our study showed that wall thickness of 5 mm or more was associated with acute cholecystitis, necrosis and increased duration of surgery, but conversions, complications and length of stay were similar.

Of interest, our analysis showed that age 70 years or older was associated with a significant increase in conversions, complications and length of stay in hospital.

CONCLUSION

We have confirmed that ultrasonography is not as accurate for the diagnosis of acute cholecystitis as for cholelithiasis and that it is vital to also consider clinical parameters to make an accurate diagnosis. Moreover, we have demonstrated excellent surgical outcomes at our hospital and a potentially useful triad of diagnostic variables to improve diagnosis of acute cholecystitis: an ultrasound showing cholelithiasis or acute cholecystitis, elevated neutrophil count and positive Murphy sign.

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