

Comparison of Ultrasound and Computed Tomography in the Diagnosis of Acute Cholecystitis: A Retrospective Diagnostic Accuracy Study

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ABSTRACT

Background: Acute cholecystitis requires timely diagnosis and treatment. Ultrasound is the preferred first-line imaging modality, while CT is useful when ultrasound findings are inconclusive or complications are suspected. To examine the accuracy of ultrasound and computed tomography in the work of diagnosing acute cholecystitis.

Methods: The study was a retrospective diagnostic accuracy conducted at DHQ Rajanpur from 06 March 2026 to 06 June 2026. having approval from ethical review board (Ref. No. 45-A), dated 06-03-26. The study involving 150 suspected patients of acute cholecystitis, who had undergone both ultrasound and CT studies. The final reference standard diagnosis by using surgical findings in the presence and clinical-radiological correlation in non-operated cases was compared to imaging findings. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall accuracy parameters of diagnostic performance were computed. The sensitivity of ultrasound and CT was compared through McNemar test.

Results: 116 patients out of 150 (77.3%), were found to have acute cholecystitis. The sensitivity of ultrasound was found to be 72.4%, and specificity was found to be 88.2% and an overall diagnostic accuracy of 76.7%. The sensitivity (85.3%) and specificity (91.2%) of CT were higher and the general diagnostic accuracy was 86.7%. A statistically significant difference in sensitivity existed ($p = 0.021$), and CT had a better ability to detect complicated acute cholecystitis.

Conclusion: CT was more sensitive and diagnostic accurate than ultrasound. Ultrasound is still the modality of choice and CT offers useful complementary information in cases where the findings of ultrasound are not decisive or complications are suspected.

Keywords: Acute Cholecystitis, Ultrasonography, Tomography, X-Ray Computed, Diagnostic Imaging, Gallbladder Diseases, Diagnostic Accuracy.

INTRODUCTION

Acute cholecystitis is one of the most common causes of acute abdominal pain requiring emergency medical evaluation and surgical management. It usually happens as a complication of the gallstone disease when cystic duct is obstructed causing the gallbladder to distend, inflame, and also become infected.¹ Gallstone disease is characterized by a considerable percentage of the adult population in the whole world, and acute cholecystitis is developed by about 1-3 percent of the symptomatic cholelithiasis.² Otherwise, acute cholecystitis may evolve into severe complications gangrenous cholecystitis, gallbladder empyema, perforation, and generalized peritonitis. Early and correct diagnosis is thus critical to promote a timely treatment and prevent the disease progression and to minimize the morbidity of delayed intervention.³ Acute cholecystitis is

diagnosed through a mixture of clinical manifestation, laboratory and radiographic findings.

The typical presentation of patients is right upper quadrant pain in the abdomen, fever, leukocytosis, and positive Murphy sign.⁴ Nevertheless, clinical appearances cannot be used in many cases to make a final diagnosis due to the possibility that the symptoms can be confused with other hepatobiliary or gastrointestinal aetiologies including biliary colic, pancreatitis, or peptic ulcer disease.⁵ As such, imaging is important in the diagnosis, severity of the disease and complications that may arise. The ultrasound is considered to be the modality of first-line imaging in the assessment of the suspected acute cholecystitis.⁶ It is non-invasive, comparatively cheap, it is extremely common, and not associated with ionizing radiation. Besides this, ultrasound enables real time evaluation of the gallbladder and the structures



around it.⁷ According to typical sonographic appearances, which are indicative of acute cholecystitis, one should find thickening of the gallbladder wall to more than 3 mm thick, distention of the gallbladder, gallstones, pericholecystic fluid accumulation, and positive sonographic Murphy sign.⁸ Due to these benefits, ultrasound is frequently suggested as the first diagnostic test in patients who report about the right upper quadrant pain. Nevertheless, ultrasound has a number of limitations even though it is widely used.⁹

Diagnostic accuracy of ultrasound has strong dependence on the operator experience, patient related factors like obesity, bowel gas and patient cooperation which could interfere with the efficient visualization of the gallbladder.¹⁰ In addition, ultrasound can be less sensitive to identify small areas of inflammatory alterations or complications of acute cholecystitis. Computed tomography (CT) has also developed to be a significant complementary imaging modality in assessment of acute cholecystitis.¹¹ CT gives a detailed visualization of cross-sectional images of the abdominal systems, and comprehensive evaluation of the gallbladder, tissues about it, and adjacent structures. The typical CT appearances of acute cholecystitis are thickening of the gallbladder wall, presence of pericholecystic fluid, inflammatory fat stranding, distension and enlargement of the gallbladder and abnormal and enhancement changes of the gallbladder wall.¹² CT is also effective in the identification of complications, including gangrenous cholecystitis, perforation, pericholecystic abscess, or extension of the inflammation to other organs. Moreover, CT may be useful in determining the alternative causes of abdominal pain following inconclusive findings of the ultrasound. CT is costlier than ultrasound because it is associated with exposure to ionizing radiation and has a relatively higher cost; however, its better sensitivity and wider diagnostic range frequently result in it becoming a useful problem-solving modality in difficult cases.¹³ A number of recent papers have compared the diagnostic efficacy of ultrasound and CT in suspected cases of acute cholecystitis. Although ultrasound is the most preferable first imaging equipment, other studies have shown that CT scan exhibit greater sensitivity in detecting inflammatory pathophysiology around the gallbladder.¹⁰

CT scan also be used to give a better visualization of complications and severity of disease. Nonetheless, diagnosed accuracy of ultrasound and CT differs in the studies reported because of the variability in the population of patients, imaging procedures, and clinical conditions. Specifically, secondary care hospital-based evidence and those with resource limitations in healthcare are still rather scarce. The relative diagnostic of these imaging modalities within the various clinical situations is also crucial in maximizing imaging approach and efficient utilization of healthcare facilities. Patients who have suspected cases of acute cholecystitis are under diagnostic examination in most clinical settings, and in the process, they undergo ultrasound and CT tests.¹⁴ Although this method can enhance the confidence of diagnostic tests, it can also cost more to the healthcare sector and put the patient at risk of excessive radiation without proper justification.¹⁵ Hence, it is necessary to identify the diagnostic quality and complementary functions of ultrasound and CT so that the rational imaging pathways of a patient with suspected inflammation of the gallbladder can be developed. Considering these facts, the current research was carried out to compare and assess the diagnostic efficiency of ultrasound and computed tomography in the process of detecting acute cholecystitis. This study will give evidence on the comparative diagnostic performance of ultrasound and CT by analyzing the imaging finding in the patients who had undergone both ultrasound and CT and comparing it with the end reference standard diagnosis. The results of the current research can be used in the

improvement of clinical decision-making and the optimization of imaging strategies in patients with suspected acute cholecystitis, especially in the secondary care medical setting.

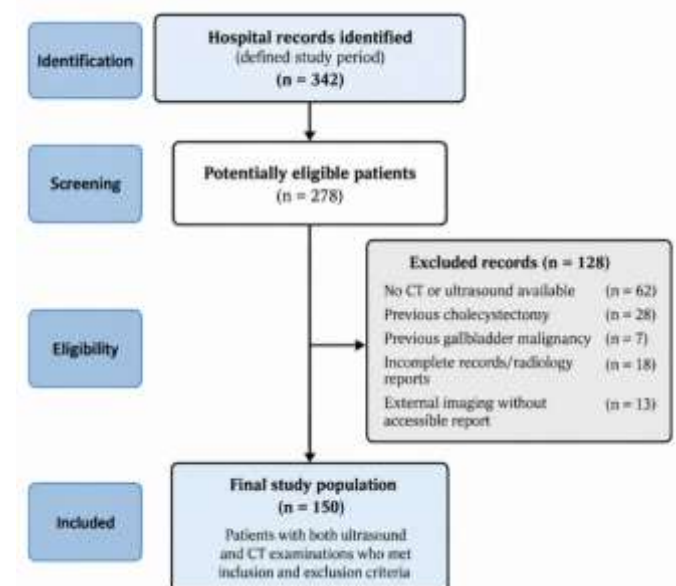
METHODOLOGY

This research was carried out as a diagnostic accuracy study based on a retrospective because of the need to compare the use of ultrasound (US) and computed tomography (CT) in the diagnosis of acute cholecystitis. The study was conducted at DHQ Rajanpur from 06 March 2026 to 06 June 2026. having approval from ethical review board (Ref. No. 45-A), dated 06-03-26. The study design was also based on the principles of the research on diagnostic accuracy, where the outcome of index tests (ultrasound and CT) was measured against the predetermined reference standard diagnosis. The retrospective type of design offered the possibility to analyze real-world clinical data and imaging results that are observed when managing patients in a standard routine.

This study was done according to the ethical principles of the Declaration of Helsinki. The study was a retrospective diagnostic accuracy conducted at DHQ, Rajanpur having approval (Ref. No. 45-A), dated 06-03-26. Since this study was a retrospective study, the DHQ Committee waived the informed consent requirement because of the anonymized medical records and lack of any direct patient contact. Data extraction was performed without any patient identifiers and confidentiality was ensured throughout the study.

The study population consisted of adult patients who presented with clinical features suggestive of acute cholecystitis and underwent diagnostic imaging during the study period. Hospital medical records and radiology databases were retrospectively reviewed to identify potentially eligible patients. Patients were considered eligible when they were 18-70 years of age, had clinical suspicion of acute cholecystitis, and had both abdominal ultrasound and CT examinations available for the same diagnostic episode, together with complete clinical and radiological records. After application of the predefined inclusion and exclusion criteria, 150 patient records were included in the final analysis. The patient identification, screening, exclusion, and final inclusion process is summarized in the STARD flow diagram is presented in Fig. (1).

Figure 1. STARD flow diagram of patient selection and inclusion in the study



Because the study required both ultrasound and CT examinations, the study cohort represents a selected group of patients who underwent further imaging rather than the entire population of patients evaluated for suspected acute cholecystitis. This selection may have introduced work-up or selection bias, because patients who underwent CT may have had equivocal ultrasound findings, greater clinical concern, more severe disease, or suspected complications. This study population was selected in that ultrasound and CT were required for inclusion, so the study population is not necessarily the population of patients who underwent evaluation for suspected acute cholecystitis. Some patients with CT might have been preferred for those with an unclear ultrasound, continuing clinical suspicion, worse disease or suspected complications. This differential selection could have resulted in work-up or selection bias and could have affected the diagnostic performance of both the imaging modalities used. This means that the estimates presented here should only be applied primarily to this selected population and should not be directly extrapolated to all patients with suspected acute cholecystitis.

The study was carried out by including patients who were clinically suspected of acute cholecystitis, had both ultrasound and CT scans as a part of diagnosis and were aged between 18 and 70 years of age. It was only included in the study of patients who had all the clinical records and radiological reports of both imaging modalities available. This made sure that sufficient information was provided that would allow proper comparison of diagnostic findings of ultrasound and CT.

The participants would not be included in the study when they had gone through cholecystectomy before because without the gallbladder, they could not be assessed of acute cholecystitis. Patients who had prior malignancy of the gallbladder were also excluded as the imaging appearance of malignant gallbladder disease is not similar to the one found in inflammatory diseases. Moreover, the analysis was performed only on cases whose medical record was not complete or without radiology reports to guarantee the trustworthiness and validity of the gathered data. Imaging studies that were done externally without access to diagnostic reports in the institution were also locked out.

Abdominal ultrasound examinations were performed using standard abdominal ultrasound equipment by radiologists or trained sonographers with approximately 5-10 years of experience in abdominal ultrasonography. The examination assessed gallbladder wall thickening (>3 mm), gallbladder distension, gallstones, pericholecystic fluid, and the sonographic Murphy sign. For the present analysis, an ultrasound examination was classified as positive for acute cholecystitis when the final radiological impression documented findings considered diagnostic or strongly suggestive of acute cholecystitis. An examination was classified as negative when the final radiological impression did not support acute cholecystitis. The classification was based on the original radiology report rather than retrospectively reinterpreting individual ultrasound findings.

Abdominal CT examinations were performed using a standard multidetector CT scanner and interpreted by radiologists with approximately 5-15 years of experience in abdominal imaging and CT interpretation. CT examinations were performed according to the institutional imaging protocol. CT examinations were assessed for gallbladder distension, gallbladder wall thickening, pericholecystic inflammatory changes, pericholecystic fluid, gallstones, and inflammatory fat stranding. A CT examination was classified as positive for acute cholecystitis when the final radiological impression supported or was diagnostic of acute cholecystitis and negative when the final impression did not support the diagnosis. The ultrasound and CT report was taken as it was originally written and reviewed. The interpretation for each imaging modality was made on the basis

of the radiology report and there was no re-interpretation or re-reading of the images for the purposes of this study. As the study was based on routinely generated clinical radiology reports, it was not possible to identify the extent of the blinding of the original imaging interpreters to clinical information and/or findings from the other imaging modality. The time interval between ultrasound and CT was recorded when available. Both examinations were considered part of the same diagnostic episode.

A composite reference standard was used to establish the final diagnosis of acute cholecystitis. In cases which underwent cholecystectomy, intraoperative impressions and pathological examination of the excised gallbladder was used as a reference. The highest level of diagnostic confirmation was obtained when there was histopathological evidence of acute inflammatory changes. A definitive diagnosis was made by comprehensive clinical follow-up in patients not operated upon who were evaluated according to clinical symptoms, examination, blood tests, treatment response and radiology. Complete clinical history and imaging findings confirmed the diagnosis and a consensus diagnosis was made by the treating surgical team. This composite standard reference was selected as some patients were not suitable for, and/or unethical to, undergo surgery for confirmation. The same methods were used in previous retrospective diagnostic accuracy studies of imaging techniques in acute cholecystitis.¹⁶

A standardized data collection form that was created to address this study was used to obtain data through a review of hospital records. Demographic data such as age and sex of the patient were noted together with clinical presentation and radiographic results. The findings of the radiological ultrasound and CT were recorded according to the interpretations that were given in the official radiology reports. The surgical observations and histopathological observations were documented on patients who were subjected to operative management. Anonymization of all data collected was done before the analysis in order to preserve patient confidentiality.

The main aim of this study was to compare and contrast the accuracy of ultrasound and CT to identify acute cholecystitis. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) and general diagnostic performance of the respective imaging modalities were determined. These measures enabled an overall assessment of the capability of ultrasound and CT in the ability to identify the correct patients with and without acute cholecystitis.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 24.0. Continuous variables were summarized using means and standard deviations, while categorical variables were presented as frequencies and percentages. Diagnostic performance was assessed using two-by-two contingency tables constructed against the composite reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated. In addition, the positive likelihood ratio (LR+) and negative likelihood ratio (LR-) were calculated to provide additional measures of diagnostic performance. Ninety-five percent confidence intervals (95% CIs) for sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were calculated using the exact binomial (Clopper-Pearson) method. Because ultrasound and CT were performed in the same patients, their paired diagnostic results were compared using McNemar's test. The test specifically evaluated the discordant paired results between ultrasound and CT. A two-sided p-value <0.05 was considered statistically

significant. A priori sample-size or statistical power calculation was performed because this was a retrospective record-based study. The sample size was determined by the number of eligible patient records available during the predefined study period after application of the prespecified inclusion and exclusion criteria.

RESULTS

150 patient records satisfying the inclusion criteria were used in this retrospective study on diagnostic accuracy. The patients were between the ages of 19 and 70 years with mean age of 46 ± 13.7 years. Out of the study population, 86 (57.3%) of the patients were females and 64 (42.7%) were males which gave a female-to-male ratio of 1.34:1. The most recorded presenting symptom was right upper quadrant abdominal pain, which was found in 134 patients (89.3%), followed by fever in 82 patients (54.7%), and a positive clinical Murphy's sign in 71 patients (47.3%). Table 1 summarizes the demographic and clinical characteristics of the study population.

Table 1. Baseline Clinical Characteristics and Imaging Findings of the Study Population (n = 150).

Variable	Frequency (n)	Percentage (%)
Sex		
Male	64	42.7
Female	86	57.3
Clinical Features		
Right upper quadrant pain	134	89.3
Fever	82	54.7
Positive Murphy's sign	71	47.3
Ultrasound Findings		
Gallbladder wall thickening	104	69.3
Gallstones	97	64.7
Gallbladder distension	78	52.0
Pericholecystic fluid	45	30.0
Sonographic Murphy sign	29	19.3
Computed Tomography Findings		
Gallbladder distension	111	74.0

Pericholecystic inflammation	102	68.0
Gallbladder wall thickening	96	64.0
Pericholecystic fluid	58	38.7
Gallstones	89	59.3

Ultrasound investigations revealed several imaging findings associated with acute cholecystitis. Thickening of gallbladder wall (>3 mm) was most common and was found in 104 patients (69.3%). The other frequent results were the presence of gallstones in 97 patients (64.7%), and distension of gallbladder in 78 patients (52.0%). Pericholecystic fluid was observed in 45 (30.0%) patients and positive sonography Murphy sign in 29 (19.3%) patients.

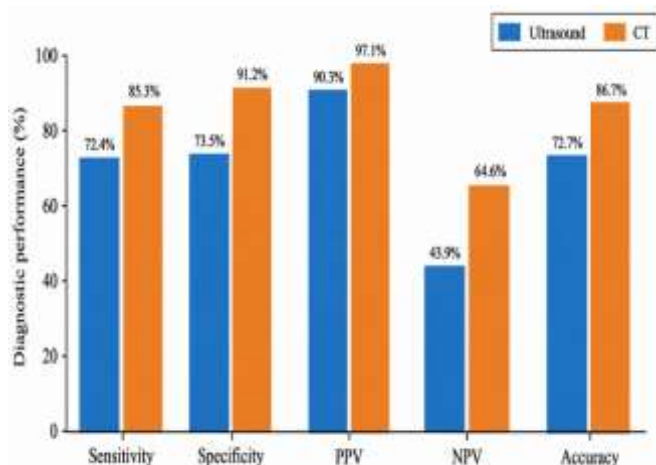
The radiologic characteristics of acute cholecystitis were observed in the computed tomography with numerous features. Gallbladder distension was seen most frequently (in 111 patients; 74.0%), then pericholecystic inflammatory changes (in 102 patients; 68.0%), and finally in 96 patients (64.0%), there was a gallbladder wall thickening. Other CT results were pericholecystic fluid in 58 patients (38.7%), and gallstones in 89 patients (59.3%).

The patients used in the study (150) of whom 87 patients (58.0%) in total acquired cholecystectomy as a clinical procedure. Intraoperative confirmation of acute cholecystitis was made in 73 patients (83.9 percent) and 14 patients (16.1 percent) showed chronic inflammatory pathology or nothing in their acute cholecystitis. Histopathological reports were made on 79 surgical specimens out of which 68 cases were proved to have acute cholecystitis and 11 cases were proved having chronic cholecystitis with no acute inflammation. The ultimate diagnosis in patients that did not receive surgery (63 patients; 42.0%), was made by means of clinical assessment together with the CT imaging results, as per the study protocol. In general, the ultimate reference standard diagnosis detected 116 cases of patients with acute cholecystitis (77.3%), and 34 cases of patients without acute cholecystitis (22.7%). This is a combined surgical and clinical-radiological diagnosis and thus served as the reference standard of calculating the diagnostic performance of ultrasound and computed tomography in the following analyses.

The final reference standard diagnosis was used in assessing the diagnostic power of ultrasound in the diagnosis of acute cholecystitis and was based on the surgical findings where applicable and CT scan with clinical correlation in the non-operated cases. The ultrasound performed the correct identification of 84 true-positive cases of acute cholecystitis and 25 true-negative cases. Nonetheless, the number of false-negative was 32, and the number of false-positive was 9. According to these results, ultrasound had a sensitivity of 72.4% (95% CI: 63.3–80.2) and specificity of 73.5% (95% CI: 55.9–86.9). The positive predictive value (PPV) of ultrasound was 90.3%, meaning that the majority of patients had acute cholecystitis according to the reference standard among patients with a positive ultrasound. Negative ultrasound had a negative predictive value of 43.9%, which suggests that a normal ultrasound examination was not reliable at excluding acute cholecystitis in this selected population. The diagnostic accuracy of the ultrasound was 72.7%. The final reference standard diagnosis to identify acute cholecystitis by computed tomography (CT) was assessed on the

basis of the surgical diagnosis in cases where the patients underwent surgery, and the combination of CT with clinical examination in cases that were not operated. CT had a correct true-positive of 99 cases of acute cholecystitis and a true-negative of 31 cases. There were however 17 false-negatives and 3 false-positives. On the basis of these findings, CT was found to have a sensitivity of 85.3% (95% CI: 77.4-91.2) and specificity of 91.2% (95% CI: 76.3-98.1). The predictive value (PPV) of CT was positive at 97.1%, which means that there was a high probability of positive CT results of patients having acute cholecystitis.

Fig. (2). Comparative diagnostic performance of ultrasound and computed tomography for acute cholecystitis.



The negative predictive value (NPV) was 64.6% which implies that a percentage of patients who have negative CT may be having the disease. The general diagnostic quality of CT was 86.7%. The cross tabulation of CT results with respect to the reference standard diagnosis with the comparative diagnostic performance of ultrasound and CT being shown in Fig. (2) and Table 2.

Table 2. Comparative Diagnostic Performance of Ultrasound and Computed Tomography for Acute Cholecystitis.

Diagnostic Parameter	Ultrasound	Computed Tomography
True positive (TP), n	84	99
False positive (FP), n	9	3
True negative (TN), n	25	31
False negative (FN), n	32	17
Sensitivity, %	72.4	85.3
Specificity, %	73.5	91.2
Positive predictive value (PPV), %	90.3	97.1
Negative predictive value (NPV), %	43.9	64.6

Overall diagnostic accuracy, %	72.7	86.7
Positive likelihood ratio (LR+)	2.73	9.68
Negative likelihood ratio (LR-)	0.38	0.16
95% CI for sensitivity	63.3-80.2*	77.4-91.2*
95% CI for specificity		76.3-98.1*
McNemar test, p-value		0.021*

*The confidence intervals and McNemar result.

A comparison of the ultrasound and computed tomography results was conducted on the patients who have undergone both imaging methods. Paired ultrasound and CT results were compared among the 150 patients who underwent both imaging examinations. The concordant and discordant results were reconstructed from the patient-level dataset, and the paired difference in diagnostic classification was assessed using McNemar's test. On the other hand, 6 patients were positive on ultrasound and negative on CT, and 18 patients had both positive and negative results on ultrasound and CT. In general, CT detected more cases of true-positive than ultrasound. The ultrasound had a sensitivity of 72.4% (95% CI: 63.3-80.2) and CT had a higher sensitivity of 85.3% (95% CI: 77.4-91.2). The increased sensitivity of the two imaging modalities was statistically significant as per McNemar test ($p = 0.021$). These results suggest that CT has a better diagnostic sensitivity of identifying acute cholecystitis especially in the cases where the ultrasound result is inconclusive. Nevertheless, ultrasound is a considerable first-line imaging modality because it is accessible, less expensive and does not use ionizing radiations.

Complicated acute cholecystitis was identified in 18 patients (12.0%). Gangrenous cholecystitis was the most frequent complication, occurring in 9 patients, followed by gallbladder empyema in 6 patients and gallbladder perforation in 3 patients. CT demonstrated a greater ability than ultrasound to identify these complicated cases, particularly when pericholecystic inflammatory changes or findings suggestive of gallbladder perforation were present. These differences in diagnostic detection are summarized in Table 3.

Table 3. Distribution of Complicated Acute Cholecystitis Cases.

Complication	Frequency (n)	Percentage (%)
Gangrenous cholecystitis	9	6.0
Gallbladder empyema	6	4.0
Gallbladder perforation	3	2.0
Total complicated cases	18	12.0

These results imply that CT offers more diagnostic information

not only in the confirmation of acute cholecystitis but also in the description of how severe and what complications it has, which can be used in the further treatment.

DISCUSSION

Acute cholecystitis is a surgical emergency that has to be properly diagnosed to avoid the development of gangrene, perforation, and sepsis. Imaging is important in the establishment of the diagnosis and the management. Ultrasound in the current study had a sensitivity of 72.4% and specificity of 88.2% and computed tomography had a higher sensitivity (85.3%), specificity (91.2%), which implies that CT is better than ultrasound in the diagnosis of acute cholecystitis. The results confirm the adjunctive functions of ultrasound and CT in the diagnostic process of patients who present with possible inflammation of the gallbladder.

The diagnosis quality of ultrasound identified in our study aligns with the results of the latest systematic reviews and meta-analyses.² As an example, the pooled sensitivity of ultrasound was found to be about 70-75% and the specificity was over 85% in the diagnosis of acute cholecystitis.¹⁷ In the same vein, Wu et al. proved the sensitivity of point-of-care ultrasound was approximately 73% and a specificity of over 90% and ultrasound is a first-line imaging option in emergency departments.¹⁸ The findings of the current research lie in this area and substantiate the usefulness of ultrasound as a preliminary diagnosis method. However, the sensitivity of ultrasound can be influenced by a number of factors such as experience of the operator, patient body habitus and presence of bowel gas that can blur the image of the gallbladder. Pericholecystic fluid may also be observed in other inflammatory or systemic conditions and is therefore not specific to acute cholecystitis. According to Patel et al., the sonographic Murphy sign enhances the diagnostic specificity, but it has a low sensitivity in the diagnostic test alone.¹⁹ The most common ultrasound results in the current research were the thickened gallbladder wall and cholelithiasis that are already well-known signs of acute cholecystitis reported in recent imaging surveys.²⁰

In this study, CT demonstrated higher sensitivity and overall diagnostic accuracy than ultrasound. These findings are in accordance with a number of contemporary comparative studies. According to Gerbasi et al. CT was more sensitive than ultrasound in the diagnosis of acute cholecystitis, especially in the assessment of inflammatory alterations around the gallbladder.²¹ Similarly, de Oliveira et al. also found that CT often revealed other inflammatory results that were not seen on ultrasound, which increased diagnostic confidence.²² Cifuentes et al. in a systematic review also found that CT tends to have a higher sensitivity as compared to ultrasound but with the same specificity.²³ The other crucial observation during this study was that there is a better accounting of complicated acute cholecystitis using CT imaging. In the present study, the complications identified included gangrenous cholecystitis, empyema of the gallbladder and perforation of the gallbladder, which were found in 12 per cent of the patients. CT offers a better image of pericholecystic inflammatory changes, fat stranding, and fluid collections, which cannot be easily discerned using an ultrasound. The previous literature has also emphasized the use of CT in the detection of complicated disease and the severity of the inflammation.^{24,25} Clinical significance of accurately identifying such complications is that it can affect the decision-making process of the surgery and the urgency of this procedure.

Although the present study shows that CT is more sensitive to diagnosis, ultrasound remains an essential element as the first routine imaging procedure in the case of suspected acute cholecystitis. Ultrasound is highly accessible, comparatively cheap and does not have an ionizing radiation. Various researches

have highlighted the clinical significance of ultrasound in the emergency room. As an illustration, Wilson et al. revealed that ultrasound conducted in case of an emergency by physicians could quickly detect the pathology of the gallbladder and inform the early management process.²⁶ Likewise, Joyce et al. noted that point-of-care ultrasound can conduct timely bedside assessment and enhance the efficiency of diagnosing patients with right upper quadrant pain.²⁷ The diagnostic assessment of gallbladder disease has also been enhanced over the last few years by the development of technological inventions in imaging and computational analysis. Studies have recently investigated deep learning techniques based on gall bladder (GB) ultrasound images to detect and classify acute GB disease automatically. Ge et al. built a deep-learning model that utilized the ultrasound single-view cine images and reported preliminary encouraging performance in differentiating acute cholecystitis that requires urgent intervention from imaging of the gall bladder that does not need urgent intervention.²⁸ Even though these technologies are not fully developed yet, they could be efficient in improving the consistency of diagnosis and minimizing operator reliance in the future.

Several limitations should be considered when interpreting the findings of this study. First, the retrospective design limited the availability and standardization of clinical, imaging, and follow-up information and prevented control over the timing and sequence of imaging examinations. Second, the study was conducted at a single center, which may limit the generalizability of the findings to other hospitals, healthcare systems, patient populations, and imaging practices. Third, inclusion was restricted to patients who underwent both ultrasound and CT. This may have introduced selection or work-up bias because patients receiving both examinations may have differed systematically from patients who were evaluated with ultrasound alone. For example, CT may have been requested because of equivocal ultrasound findings, persistent clinical suspicion, greater disease severity, or suspected complications. Consequently, the diagnostic performance estimates should not be interpreted as representing all patients with suspected acute cholecystitis. Fourth, a composite reference standard was used because histopathological confirmation was not available for patients managed conservatively. Surgical and histopathological findings were therefore available only for patients who underwent cholecystectomy, whereas patients managed without surgery were classified according to clinical, laboratory, treatment-response, and radiological follow-up. This introduces the possibility of differential verification bias and incorporation-related limitations, particularly because CT findings contributed to the clinical-radiological assessment of some non-operated patients. Finally, retrospective interpretation of official radiology reports may have introduced observer-related variability, and information regarding the experience and blinding of individual imaging interpreters may not have been uniformly available. These limitations should be considered when comparing the observed diagnostic performance of ultrasound and CT. Larger prospective multicenter studies using standardized imaging protocols, predefined interpretation criteria, blinded image assessment, and a uniform reference standard are warranted.

Future studies ought to be conducted on bigger multicenter prospective studies to ascertain the diagnostic efficacy of ultrasound and CT in various populations of patients. Publication of ultrasound diagnostic criteria might also improve the reproducibility and minimize variability in ultrasound diagnostic criteria by operator. Moreover, new technologies including image interpretation with the help of artificial intelligence, the further development of CT reconstruction methods, and multimodal imaging can contribute to improving the early diagnose and

characterization of acute cholecystitis. The combination with the clinical decision-support systems might further enhance the accuracy of the diagnosis and streamline the management of patients in the emergency and surgical units.

CONCLUSION

In this retrospective single-center study, CT demonstrated higher observed sensitivity and overall diagnostic accuracy than ultrasound for the diagnosis of acute cholecystitis. However, these findings do not imply that CT should replace ultrasound as the first-line imaging modality. Ultrasound remains an appropriate initial investigation because of its accessibility, lower cost, and absence of ionizing radiation, whereas CT may provide valuable complementary information when ultrasound findings are inconclusive or when complicated disease is suspected. The results should be interpreted in light of the potential selection and verification biases associated with inclusion of patients who underwent both examinations and the use of a composite reference standard. Prospective multicenter studies using standardized imaging protocols, blinded interpretation, and a common reference standard are needed to confirm the comparative diagnostic performance of ultrasound and CT.

Ethical Approval

The study was approved by the Ethical Review Board of DHQ Rajanpur (Reference No. 45-A; approval date: 6 March 2026). As this was a retrospective diagnostic accuracy study involving previously collected clinical and radiological data, patient confidentiality was maintained throughout the study, and the data were handled in accordance with applicable ethical requirements. The requirement for informed consent was determined in accordance with the decision of the Ethical Review Board and applicable institutional policies.

Data Availability

Data will be available upon request.

Author Contributions

Conceptualization: Fabiha Zainab

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All authors contributed to the research in accordance with their stated roles, approved the final version of the manuscript, and agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the research are appropriately investigated and resolved.

Informed Consent

As this was a retrospective study based on anonymized hospital records, informed consent was waived by the institutional review authority.

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Conflict of Interest

Declared none.

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Declaration of AI-Assisted Language Editing

Grammarly was used solely as an AI-assisted language refinement tool to improve readability and correct grammatical and punctuation errors. The authors retain full responsibility for the manuscript's accuracy, integrity, and originality.

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