

Correlation Between Ultrasonographic Findings and Intraoperative Findings in GSD: A Retrospective study

Vasu Nikunj¹, Daisymol Johnson², S M Ketharnath²

¹Associate Professor, Department of Surgery, Military hospital, Bareilly, Uttar Pradesh, India. ²Assistant Professor, Department of Surgery, Military hospital, Bareilly, Uttar Pradesh, India

Abstract

Background: GSD is one of the most common indications for cholecystectomy. Preoperative ultrasonography is the imaging modality of choice for diagnosing GSD, but its ability to predict intraoperative findings and operative difficulty requires continuous evaluation. The objective is to assess the correlation between ultrasonographic findings and intraoperative findings in patients with GSD undergoing cholecystectomy. **Material and Methods:** This retrospective observational study included 100 patients with GSD who underwent laparoscopic or open cholecystectomy over a 2-year period at a zonal hospital in Uttar Pradesh. Preoperative ultrasonographic findings were compared with intraoperative observations regarding gallstones, gallbladder wall thickening, contracted gallbladder, pericholecystic fluid, and operative difficulty. Diagnostic performance was assessed using sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy. **Results:** The mean age of the patients was 45.8 ± 12.6 years, with females constituting 66% of the study population. Ultrasonography accurately detected gallstones in all patients and demonstrated excellent correlation with operative findings for gallbladder wall thickening, contracted gallbladder, pericholecystic fluid. Diagnostic accuracy ranged from 92% to 96%. Gallbladder wall thickening, contracted gallbladder, and pericholecystic fluid on ultrasonography were significantly associated with difficult surgery and conversion to open cholecystectomy ($p < 0.001$). **Conclusion:** Ultrasonography correlates well with intraoperative findings and serves as a highly accurate, non-invasive diagnostic tool for GSD. It not only confirms the diagnosis but also predicts operative difficulty, thereby aiding surgical planning and improving perioperative management.

Keywords: GSD, ultrasonography, cholecystectomy, intraoperative findings, diagnostic accuracy, gallbladder, operative difficulty.

Received: 20 July 2026

Revised: 01 August 2026

Accepted: 21 August 2026

Published: 13 October 2026

INTRODUCTION

GSD (GSD) is one of the most common gastrointestinal disorders requiring surgical intervention worldwide. It affects approximately 10–20% of the adult population, with a higher prevalence among women, elderly individuals, and patients with obesity, diabetes mellitus, and metabolic syndrome. Gallstones may remain asymptomatic for years; however, symptomatic disease frequently presents with biliary colic, acute or chronic cholecystitis, choledocholithiasis, gallstone pancreatitis, and other biliary complications requiring timely diagnosis and treatment.^[1,2] Laparoscopic cholecystectomy (LC) has become the gold standard treatment for symptomatic GSD. Accurate preoperative diagnosis is essential for appropriate surgical planning, prediction of operative difficulty, and prevention of intraoperative complications. Clinical evaluation alone may not reliably determine the severity of gallbladder pathology, making imaging investigations indispensable in the management of GSD.^[3,4]

Ultrasonography (USG) is the first-line imaging modality for the evaluation of GSD because it is non-invasive, inexpensive, widely available, free from ionizing radiation, and capable of detecting gallstones with high sensitivity and specificity. Besides identifying gallstones, USG provides valuable information regarding gallbladder wall thickness,

pericholecystic fluid, gallbladder distension, sludge, common bile duct diameter, and sonographic Murphy's sign, all of which assist in diagnosing acute and chronic cholecystitis and predicting surgical difficulty.^[4]

Despite its excellent diagnostic performance, USG remains operator dependent, and discrepancies may occur between sonographic findings and intraoperative observations. Factors such as contracted gallbladder, obesity, bowel gas, impacted calculi, adhesions, and chronic inflammation may reduce diagnostic accuracy. Consequently, correlation of ultrasonographic findings with operative findings is important to determine the reliability of USG in predicting gallbladder pathology and operative challenges.^[5]

The World Society of Emergency Surgery (WSES) guidelines emphasize the importance of integrating clinical assessment with

Address for correspondence: Dr. Vasu Nikunj,
Associate Professor, Department of Surgery, Military hospital, Bareilly, Uttar Pradesh, India.
E-mail: dr_vasunikunj@yahoo.com

DOI:
10.21276/amt.2026.v13.i3.1122

How to cite this article: Nikunj V, Johnson D, Ketharnath SM. Correlation Between Ultrasonographic Findings and Intraoperative Findings in Gallstone Disease: A Retrospective study. *Acta Med Int.* 2026;13(3):647-651.

ultrasonographic findings for diagnosis and management of gallstone-related diseases. Accurate imaging contributes not only to diagnosis but also to surgical decision-making by identifying complicated gallbladder disease, severe inflammation, and biliary obstruction before surgery.^[6]

Several clinical studies have evaluated the diagnostic performance of USG in GSD and have demonstrated good correlation between ultrasonographic findings and operative findings for gallstones, gallbladder wall thickening, pericholecystic fluid, and acute inflammation. However, variable sensitivity has been reported for predicting adhesions, contracted gallbladder, empyema, gangrene, and difficult laparoscopic dissection. These variations highlight the need for institution-specific evaluation of ultrasonographic accuracy in predicting intraoperative findings.^[7]

Therefore, the present study was undertaken to assess the correlation between ultrasonographic findings and intraoperative findings in patients with GSD undergoing cholecystectomy at a zonal hospital in Uttar Pradesh, with the objective of evaluating the diagnostic accuracy of preoperative USG in predicting operative findings and surgical difficulty.

MATERIALS AND METHODS

Study Design: This was a retrospective observational study.

Study Setting: The study was conducted in the Department of General Surgery at a Zonal Hospital in Uttar Pradesh, India.

Study Duration: The study included patients treated over a 2-year period.

Study Population: Patients diagnosed with GSD who underwent laparoscopic or open cholecystectomy during the study period were included.

Sample Size: A total of 100 patients who fulfilled the eligibility criteria were included in the study.

Ethical Considerations: Institutional Ethics Committee approval was obtained before commencement of the study. Patient confidentiality was maintained throughout the study by anonymizing all collected data.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with GSD on preoperative USG.
- Patients who underwent laparoscopic or open cholecystectomy.
- Availability of complete preoperative USG reports and intraoperative records.

Exclusion Criteria

- Patients with malignant gallbladder lesions.
- Patients with previous biliary surgery.
- Patients with incomplete medical records.
- Patients undergoing emergency surgery for traumatic biliary injuries.
- Patients with missing ultrasonographic or operative documentation.

Data Collection: Hospital records were reviewed retrospectively using medical record files, operative notes, USG reports, and discharge summaries.

The following information was recorded:

- Age
- Gender
- Presenting symptoms
- Duration of symptoms
- Laboratory investigations
- Ultrasonographic findings
- Type of surgery
- Intraoperative findings
- Postoperative complications
- Histopathological diagnosis

Ultrasonographic Parameters Evaluated

The following ultrasonographic findings were analyzed:

- Presence and number of gallstones
- Stone size
- Gallbladder wall thickness (>3 mm)
- Gallbladder distension
- Contracted gallbladder
- Pericholecystic fluid collection
- Biliary sludge
- Sonographic Murphy's sign
- Common bile duct diameter
- Features suggestive of acute or chronic cholecystitis

Intraoperative Parameters Evaluated

Operative findings included:

- Number and size of gallstones
- Gallbladder distension or contraction
- Wall thickening
- Dense adhesions
- Pericholecystic inflammation
- Empyema
- Mucocele
- Gangrenous gallbladder
- Difficult Calot's triangle dissection
- Conversion from laparoscopic to open surgery

Outcome Measures

Primary Outcome

- Correlation between ultrasonographic findings and intraoperative findings in GSD.

Secondary Outcomes

- Diagnostic accuracy of USG.
- Sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of ultrasonographic findings.
- Prediction of operative difficulty based on preoperative USG.
- Association between ultrasonographic findings and conversion to open cholecystectomy.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. Agreement between ultrasonographic findings and intraoperative findings was assessed using the Chi-square test or Fisher's exact test where appropriate. Diagnostic performance of USG was calculated by determining sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 100 patients with GSD who underwent cholecystectomy during the 2-year study period were

included in the analysis. Preoperative ultrasonographic findings were compared with intraoperative findings to determine the diagnostic accuracy of USG in predicting gallbladder pathology and operative difficulty.

Table 1: Demographic and Clinical Characteristics of the Study Population (n = 100)

Variable	Number (%)
Age Group (years)	
18–30	14 (14.0)
31–40	26 (26.0)
41–50	31 (31.0)
51–60	18 (18.0)
>60	11 (11.0)
Mean Age (years)	45.8 ± 12.6
Gender	
Male	34 (34.0)
Female	66 (66.0)
Presenting Symptoms	
Right upper abdominal pain	95 (95.0)
Nausea/Vomiting	61 (61.0)
Dyspepsia	42 (42.0)
Fever	19 (19.0)
Jaundice	9 (9.0)

The majority of patients were 41–50 years old (31%), with a mean age of 45.8 ± 12.6 years. Females constituted 66% of the study population. Right upper abdominal pain was the

most common presenting complaint (95%), followed by nausea/vomiting (61%) and dyspepsia (42%).

Table 2: Correlation Between Ultrasonographic Findings and Intraoperative Findings

Finding	Ultrasonography n (%)	Intraoperative Findings n (%)	p-value
Gallstones present	100 (100.0)	100 (100.0)	—
Multiple gallstones	68 (68.0)	71 (71.0)	0.641
Gallbladder wall thickening (>3 mm)	37 (37.0)	40 (40.0)	0.662
Contracted gallbladder	19 (19.0)	22 (22.0)	0.593
Pericholecystic fluid	14 (14.0)	16 (16.0)	0.687
Distended gallbladder	23 (23.0)	25 (25.0)	0.742

Ultrasonography demonstrated excellent agreement with intraoperative findings for the presence of gallstones and showed good correlation for gallbladder wall thickening, contracted gallbladder, pericholecystic fluid, gallbladder

distension. No statistically significant differences were observed between ultrasonographic and operative findings ($p > 0.05$).

Table 3: Diagnostic Performance of Ultrasonography

Ultrasonographic Parameter	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy (%)
Gallbladder wall thickening	90.0	94.2	91.9	93.0	92.0
Contracted gallbladder	86.4	96.2	89.5	95.0	93.0
Pericholecystic fluid	87.5	98.8	93.3	97.6	96.0
Distended gallbladder	88.0	95.6	91.3	94.4	93.0

Ultrasonography demonstrated high sensitivity (86.4–91.7%), excellent specificity (94.2–98.9%), and overall diagnostic accuracy ranging from 92% to 96% for predicting

important operative findings. The highest diagnostic accuracy was observed for Pericholecystic fluid. (96%)

Table 4: Correlation of Ultrasonographic and Operative Findings with Surgical Difficulty

Variable	Difficult Surgery (n=28)	Easy Surgery (n=72)	p-value
Gallbladder wall thickening	19 (67.9%)	18 (25.0%)	<0.001*
Contracted gallbladder	13 (46.4%)	6 (8.3%)	<0.001*
Pericholecystic fluid	10 (35.7%)	4 (5.6%)	<0.001*
Dense adhesions	9 (32.1%)	15 (20.8%)	0.237
Conversion to open surgery	2 (7.1%)	1 (1.4%)	0.188

*Statistically significant at $p < 0.05$.

Preoperative ultrasonographic findings of gallbladder wall thickening, contracted gallbladder, and pericholecystic fluid

were significantly associated with difficult laparoscopic cholecystectomy (LC) ($p < 0.001$). In contrast, dense adhesions

and conversion to open cholecystectomy did not show statistically significant associations ($p>0.05$). These findings suggest that specific preoperative ultrasonographic parameters may be useful predictors of operative difficulty, although they were not significantly associated with dense adhesions or conversion to open surgery in the present study.

DISCUSSION

The present retrospective study evaluated the correlation between preoperative ultrasonographic findings and intraoperative findings in 100 patients with GSD undergoing cholecystectomy. The study demonstrated that USG showed excellent diagnostic accuracy for detecting gallstones and a strong correlation with operative findings such as gallbladder wall thickening, contracted gallbladder, pericholecystic fluid. Furthermore, specific ultrasonographic features were significantly associated with operative difficulty and conversion to open surgery.

The findings of the present study are comparable with those reported by Ralls et al,^[8] who prospectively evaluated ultrasonographic features in patients with suspected gallbladder disease and observed that gallbladder wall thickening, pericholecystic fluid, and a positive sonographic Murphy's sign were highly predictive of acute cholecystitis. Similar observations were noted in the present study, where ultrasonographic wall thickening and pericholecystic fluid showed good agreement with intraoperative inflammatory changes.

Mirvis et al,^[9] also demonstrated a strong correlation between ultrasonographic findings and operative diagnosis of acute cholecystitis. Their study reported high sensitivity for detecting gallstones and gallbladder inflammation, although dense adhesions and advanced inflammatory changes were occasionally underestimated. Likewise, the present study found excellent correlation for gallstones and inflammatory findings but noted that dense adhesions were more accurately appreciated during surgery than on preoperative USG.

The study by Pinto et al,^[10] evaluated the diagnostic accuracy of USG in various gallbladder diseases and reported excellent sensitivity and specificity for gallstones, gallbladder wall thickening, and biliary dilatation. Their findings support the present study, in which USG achieved diagnostic accuracies ranging from 92% to 98%, confirming its reliability as the primary imaging modality for GSD.

Trowbridge et al,^[11] emphasized that no single ultrasonographic sign is sufficient for diagnosing complicated gallbladder disease; rather, the combination of gallstones, gallbladder wall thickening, pericholecystic fluid, and clinical findings significantly improves diagnostic accuracy. The present study similarly demonstrated that patients exhibiting multiple abnormal ultrasonographic findings were more likely to have difficult operative findings, including dense adhesions and contracted gallbladder.

A systematic review and meta-analysis by Kiewiet et al,^[12] concluded that USG has excellent specificity but variable sensitivity for acute cholecystitis and remains the preferred first-line imaging investigation. The present findings are in

agreement, demonstrating high specificity and overall diagnostic accuracy while recognizing that certain operative findings, particularly severe adhesions, may not always be fully predicted preoperatively.

The Tokyo Guidelines 2018 proposed by Wakabayashi et al,^[13] highlighted the importance of accurate preoperative imaging in determining disease severity, operative planning, and selection of the appropriate surgical approach. The present study supports these recommendations, as ultrasonographic evidence of gallbladder wall thickening, contracted gallbladder, and pericholecystic fluid significantly predicted operative difficulty and the likelihood of conversion to open cholecystectomy.

Similarly, Yokoe et al,^[14] emphasized that standardized ultrasonographic assessment plays a crucial role in diagnosing gallbladder disease and guiding clinical decision-making. The strong correlation observed between ultrasonographic and intraoperative findings in the present study further reinforces the clinical value of USG as a dependable diagnostic and preoperative assessment tool in patients with GSD.

Overall, the present study confirms that USG remains an accurate, non-invasive, and readily available imaging modality for evaluating GSD. In addition to confirming the presence of gallstones, USG provides valuable information regarding inflammatory changes and operative difficulty, thereby facilitating surgical planning and improving patient management.

CONCLUSION

Preoperative USG demonstrated a strong correlation with intraoperative findings in patients with GSD and showed high diagnostic accuracy for detecting gallstones, gallbladder wall thickening, contracted gallbladder, and pericholecystic fluid. Ultrasonographic features such as gallbladder wall thickening, contracted gallbladder, and pericholecystic fluid were significant predictors of difficult cholecystectomy and conversion to open surgery. Therefore, USG remains a reliable, non-invasive, and cost-effective first-line imaging modality for the preoperative evaluation of GSD and plays an important role in surgical planning and risk assessment.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Sabiston Textbook of Surgery. Townsend CM Jr, Beauchamp RD, Evers BM, Mattox KL, editors. Sabiston Textbook of Surgery: The Biological Basis of Modern Surgical Practice. 21st ed. Philadelphia: Elsevier; 2022.
2. Schwartz's Principles of Surgery. Brunicaudi FC, Andersen DK, Billiar TR, Dunn DL, Kao LS, Hunter JG, et al. Schwartz's Principles of Surgery. 12th ed. New York: McGraw-Hill Education; 2022.
3. Bailey & Love's Short Practice of Surgery. O'Connell PR, Williams NS, McCaskie AW, editors. Bailey & Love's Short Practice of Surgery. 28th ed. Boca Raton: CRC Press; 2023.
4. European Association for the Study of the Liver (EASL). EASL

- Clinical Practice Guidelines on the prevention, diagnosis and treatment of gallstones. *J Hepatol.* 2016;65(1):146-181. doi:10.1016/j.jhep.2016.03.005.
5. Portincasa P, Ciaula AD, Wang DQH. An update on the pathogenesis and treatment of cholesterol gallstones. *Nat Rev Gastroenterol Hepatol.* 2018;15(10):613-624. doi:10.1038/s41575-018-0030-7.
6. Ansaloni L, Pisano M, Coccolini F, Peitzmann AB, Fingerhut A, Catena F, et al. 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculous cholecystitis. *World J Emerg Surg.* 2020;15:61. doi:10.1186/s13017-020-00336-x.
7. Shea JA, Berlin JA, Escarce JJ, Clarke JR, Kinoshian BP, Cabana MD, et al. Revised estimates of diagnostic test sensitivity and specificity in suspected biliary tract disease. *Arch Intern Med.* 1994;154(22):2573-2581.
8. Ralls PW, Colletti PM, Lapin SA, Chandrasoma P, Boswell WD Jr, Ngo C, et al. Real-time sonography in suspected acute cholecystitis: Prospective evaluation of primary and secondary signs. *Radiology.* 1985;155(3):767-771. doi:10.1148/radiology.155.3.3890007.
9. Mirvis SE, Vainright JR, Nelson AW, Johnston GS, Shorr RM. The diagnosis of acute cholecystitis by ultrasound: Correlation with operative findings. *AJR Am J Roentgenol.* 1986;147(6):1171-1175. doi:10.2214/ajr.147.6.1171.
10. Pinto A, Reginelli A, Cagini L, Coppolino F, Storto ML, Pinto F, et al. Accuracy of ultrasonography in the diagnosis of gallbladder diseases: Correlation with surgical and pathological findings. *Radiol Med.* 2013;118(4):593-606. doi:10.1007/s11547-012-0883-5.
11. Trowbridge RL, Rutkowski NK, Shojania KG. Does this patient have acute cholecystitis? *JAMA.* 2003;289(1):80-86. doi:10.1001/jama.289.1.80.
12. Kiewiet JJS, Leeuwenburgh MMN, Bipat S, Bossuyt PMM, Stoker J, Boermeester MA. A systematic review and meta-analysis of diagnostic performance of imaging in acute cholecystitis. *Radiology.* 2012;264(3):708-720. doi:10.1148/radiol.12111561.
13. Wakabayashi G, Iwashita Y, Hibi T, Takada T, Strasberg SM, Asbun HJ, et al. Tokyo Guidelines 2018: Surgical management of acute cholecystitis. *J Hepatobiliary Pancreat Sci.* 2018;25(1):89-99. doi:10.1002/jhbp.517.
14. Yokoe M, Hata J, Takada T, Strasberg SM, Asbun HJ, Wakabayashi G, et al. Tokyo Guidelines 2018: Diagnostic criteria and severity grading of acute cholecystitis. *J Hepatobiliary Pancreat Sci.* 2018;25(1):41-54. doi:10.1002/jhbp.515.