Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 8
Open Access

Correlation of Preoperative Ultrasonography Data with Intraoperative Findings in Cholelithiasis: A Clinical Informatics–Based Predictive Analysis

Dr Sanika Vijay Shirke [1], Dr Bhargavi Vijayanandam Voorakalli[2], Dr Lisha Suraj[3]

[1]Junior Resident, Department of General Surgery, MGM Medical College and Hospital, Navi Mumbai, Maharashtra, India.

Email. Id- sanikavshirke@gmail.com

[2]Senior Resident, Department of General Surgery, MGM Medical College and Hospital, Navi Mumbai, Maharashtra, India.

[3]Professor, Department of General Surgery, MGM Medical College and Hospital, Navi Mumbai, Maharashtra, India

Cite this paper as: Dr Sanika Vijay Shirke , Dr Bhargavi Vijayanandam Voorakalli, Dr Lisha Suraj (2024) Correlation of Preoperative Ultrasonography Data with Intraoperative Findings in Cholelithiasis: A Clinical Informatics–Based Predictive Analysis. *Frontiers in Health Informatics*, *Vol.13, No.8*, 8043-8048

ABSTRACT

Background: Cholelithiasis is one of the most common gastrointestinal disorders requiring surgical intervention worldwide. Laparoscopic cholecystectomy remains the gold-standard treatment for symptomatic gallstone disease due to reduced postoperative pain, shorter hospital stay, and faster recovery compared with open surgery. However, altered anatomy, inflammation, adhesions, or trouble recognizing tissues inside Calot's triangle may make surgery challenging. Gallstones are often diagnosed and gallbladder pathology is assessed with preoperative ultrasonography (USG). Gallbladder wall thickness, common bile duct diameter, gallbladder distension, and stone features are examples of structured ultrasonographic data that may indicate intraoperative difficulties. Objective: To evaluate the correlation between preoperative ultrasonographic findings and intraoperative observations in patients undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis. Methods: A retrospective observational study was conducted at MGM Medical College and Hospital, Navi Mumbai, from April to December 2025. Eighty-two patients diagnosed with symptomatic cholelithiasis who underwent laparoscopic cholecystectomy were included in the study. Preoperative ultrasonographic parameters including gallbladder wall thickness, gallbladder lumen characteristics, distension, common bile duct diameter, number and size of stones, presence of bile sludge, and pericholecystic collection were recorded. These imaging variables were compared with intraoperative findings such as stone characteristics, gallbladder inflammation, adhesions, and operative difficulty. Statistical analysis was performed using SPSS version 24. Sensitivity, specificity, and predictive values were calculated, with $p < 0.05$ considered statistically significant. Results: Ultrasonography demonstrated very high sensitivity (99%) for detection of gallstones. Sensitivity and specificity for predicting stone number were 65.2% and 88%, respectively. Gallbladder wall thickness ≥3 mm showed high sensitivity (92.6%) but low specificity (20.8%) for predicting intraoperative inflammation. Increased common bile duct diameter was associated with operative difficulty in several cases. Ultrasonographic signs of acute cholecystitis correlated with dense adhesions and distorted Calot's triangle anatomy during surgery. Conclusion: Preoperative ultrasonography provides clinically useful predictive indicators for operative difficulty in laparoscopic cholecystectomy. Integration of structured imaging variables into surgical planning may improve preoperative risk stratification and operative preparedness..

Keywords: Cholelithiasis; Ultrasonography; Laparoscopic cholecystectomy; Gallbladder wall thickness; Common bile duct; Predictive analysis**.**

INTRODUCTION

Cholelithiasis, or gallstone disease, represents one of the most common hepatobiliary disorders worldwide and is a frequent cause of abdominal pain requiring surgical treatment. Gallstones are thought to afflict 10–15% of individuals worldwide, however the frequency varies among populations (1). Gallstones can cause biliary colic, dyspepsia, nausea, and complications such acute cholecystitis, pancreatitis, or choledocholithiasis, although many people have no symptoms at all (2). Since its inception in the late 20th century, laparoscopic cholecystectomy has emerged as the gold standard for treating symptomatic cholelithiasis (3). Laparoscopic techniques provide several advantages over open surgery, such as less discomfort following surgery, less surgical scars, shorter hospital stays,

and quicker recovery (4). Despite these advantages, inflammatory changes, adhesions, or deformed anatomy surrounding Calot's triangle can occasionally make the treatment technically difficult (5).

For surgical planning and patient counseling, it is crucial to identify the variables that predict operational difficulties. The importance of preoperative imaging in predicting intraoperative difficulties has been emphasized in a number of publications (6,7). Because of its accessibility, affordability, and excellent diagnostic accuracy for gallstone detection, ultrasound is the initial imaging modality used to assess gallbladder disease (8). Ultrasonography offers a number of structured imaging characteristics in addition to stone identification that may be correlated with surgical results (7,9). Gallbladder wall thickness, gallbladder distension, stone size and quantity, bile sludge presence, common bile duct diameter, and pericholecystic fluid are important ultrasonographic characteristics. Pericholecystic fluid and thickened gallbladder walls may be signs of inflammation, which can make surgery more challenging (6). Similarly, choledocholithiasis or related biliary blockage may be indicated by dilatation of the common bile duct (10)..

Structured radiological factors can be included into decision-support systems to evaluate operating risk in light of the growing interest in clinical informatics and predictive analytics in surgical practice. These predictive techniques can lower conversion rates to open surgery, increase operative safety, and assist surgeons in anticipating challenging dissections (9,11).
However, despite widespread use of ultrasonography, the degree to which specific ultrasonographic findings correlate with intraoperative observations remains a subject of ongoing research (6,7). In environments with limited resources, when ultrasonography is sometimes the only imaging modality available, it is especially important to comprehend these relationships.

Therefore, the present study aimed to evaluate the correlation between preoperative ultrasonographic findings and intraoperative observations in patients undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis. Additionally, the study analyzes how structured imaging data could be used as prognostic markers of surgical difficulties.

MATERIALS AND METHODS

Study Design: This study was conducted as a retrospective observational clinical study.

Study Setting and Duration: The study was carried out at the Department of General Surgery, MGM Medical College and Hospital, Navi Mumbai, India. Data were collected from April 2025 to December 2025.

Inclusion Criteria

Patients were included if they:

Were diagnosed with symptomatic cholelithiasis

Underwent laparoscopic cholecystectomy

Had a documented preoperative ultrasonography report

Were aged above 18 years

Exclusion Criteria

Patients were excluded if they:

Had suspected gallbladder malignancy

Underwent open cholecystectomy primarily

Had incomplete imaging or operative records

Had previous biliary tract surgery

Sample Size: A total of 82 patients fulfilling the eligibility criteria were included in the study.

Data Collection: Preoperative ultrasonography reports were reviewed and the following variables were extracted:

Gallbladder wall thickness

Gallbladder lumen and distension

Number of gallstones

Stone size

Presence of bile sludge

Common bile duct diameter

Pericholecystic collection

Intraoperative findings documented in operative notes included:

Stone number and size

Gallbladder inflammation

Adhesions around Calot's triangle

Difficulty in dissection

Anatomical distortion

The ultrasonographic parameters were correlated with intraoperative observations to determine predictive value.

Statistical Analysis: Data were analyzed using SPSS version 24. Descriptive statistics were used to summarize patient characteristics. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated for ultrasonographic parameters in predicting intraoperative findings. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of **82 patients** undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis were included in the study.

Table 1: Demographic Characteristics of Patients

Variable	Frequency	Percentage
Male	28	34.1
Female	54	65.9
Age <30 years	16	19.5
30–50 years	46	56.1
>50 years	20	24.4

Table 1 presents the demographic profile of the study population. A total of 82 patients undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis were included in the study. Among them, females constituted the majority of the participants with 54 patients (65.9%), while males accounted for 28 patients (34.1%).

In terms of age distribution, the largest proportion of patients belonged to the 30–50 years age group, comprising 46 individuals (56.1%). Patients aged more than 50 years accounted for 20 cases (24.4%), whereas younger patients aged below 30 years constituted 16 cases (19.5%). Overall, the findings indicate a higher prevalence of symptomatic cholelithiasis among females and individuals in the middle-aged group.

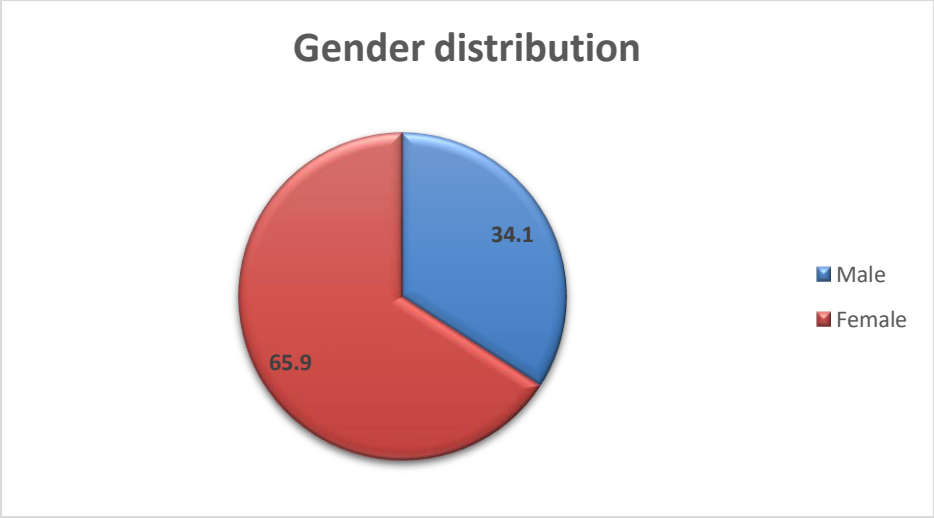

Figure 1A: Gender distribution

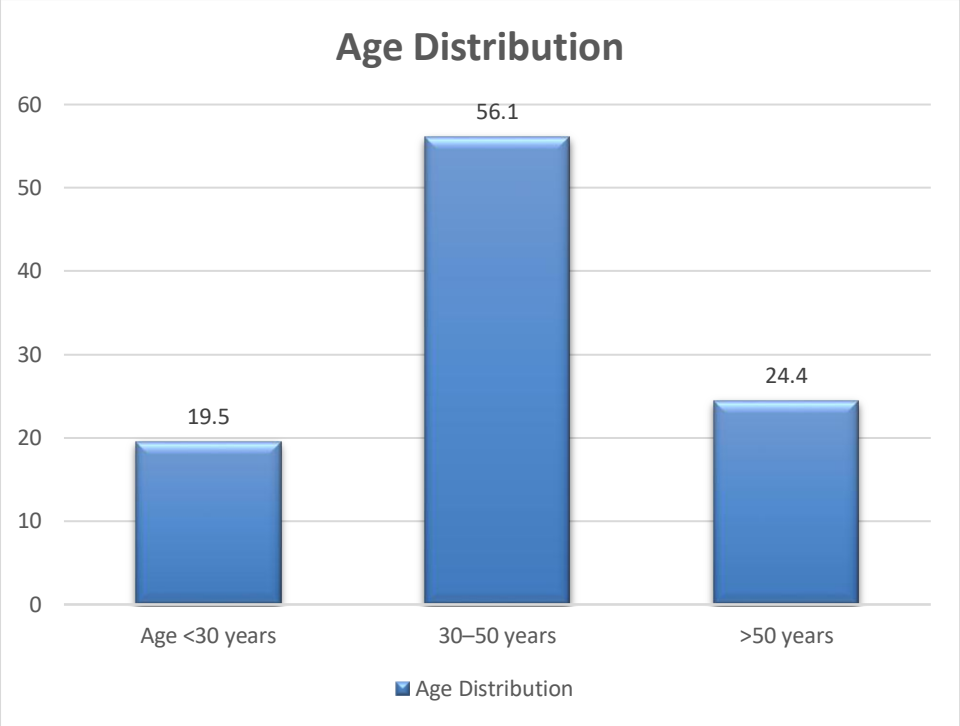

Figure 1B: Age distribution

Table 2: Correlation of Ultrasonographic Findings with Intraoperative Observations

Parameter	Sensitivity (%)	Specificity (%)
Gallstone detection	99	100
Stone number	65.2	88
Gallbladder wall thickness	92.6	20.8
CBD diameter	70	75

Table 2 shows the diagnostic performance of preoperative ultrasonographic parameters in predicting intraoperative findings during laparoscopic cholecystectomy. Excellent diagnostic accuracy was established by ultrasonography's very high sensitivity (99%) and specificity (100%) for gallstone identification. Ultrasonography had a modest sensitivity (65.2%) and a moderately high specificity (88%) when it came to predicting the number of stones. When it came to detecting inflammatory alterations, gallbladder wall thickness showed a high sensitivity (92.6%) but a relatively poor specificity (20.8%). When compared to intraoperative observations, the common bile duct (CBD) diameter assessment demonstrated a modest predictive ability with a sensitivity of 70% and specificity of 75%. These results imply that some ultrasonographic markers might be helpful predictors of operating results and possible surgical challenges.

Intraoperative indicators of inflammation and adhesions were more common in patients with gallbladder wall thickness ≥3 mm. In a similar vein, situations involving bile sludge and pericholecystic fluid were linked to more challenging operations.

About 85% of patients had increased common bile duct diameter, which was sometimes associated with complicated surgical findings.

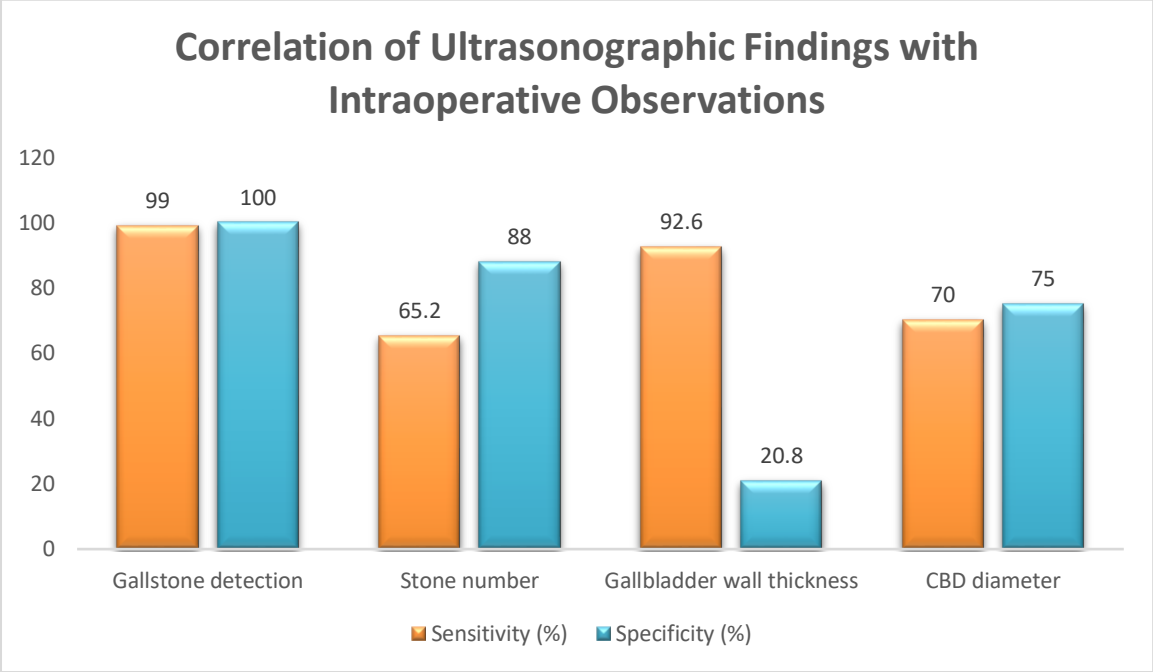

Figure 2: Correlation of Ultrasonographic Findings with Intraoperative Observations

DISCUSSION

The present study evaluated the correlation between preoperative ultrasonographic findings and intraoperative observations in patients undergoing laparoscopic cholecystectomy. Ultrasonography demonstrated excellent sensitivity for gallstone detection, which is consistent with previously reported diagnostic accuracy rates exceeding 95% (1,8).

Gallbladder wall thickness was shown to be one of the most valuable ultrasonographic indicators in predicting intraoperative difficulties. High sensitivity for identifying inflammatory alterations was demonstrated by a gallbladder wall thickness of more than 3 mm. Acute cholecystitis or chronic inflammation are frequently indicated by thickened gallbladder walls, which can cause dense adhesions and deform Calot's triangle after surgery (10, 6).

The correlation between acute cholecystitis ultrasonographic characteristics and surgical difficulty was another significant finding. Bile sludge and pericholecystic fluid frequently signify active inflammation and may be associated with challenging dissection during laparoscopic surgery. Thus, in these situations, surgeons should be more cautious (6,7).

Stone number's predictive value shown comparatively high specificity and moderate sensitivity. Although gallstones may be reliably detected by ultrasonography, overlapping shadows or numerous little calculi can occasionally make it difficult to precisely quantify the quantity of stones (8,12).

Another therapeutically significant characteristic measured during preoperative imaging is common bile duct diameter. Biliary blockage or choledocholithiasis may be indicated by dilatation of the common bile duct. Increased common bile duct width was linked to greater operational difficulties in a number of patients in the current investigation (10).

These results demonstrate how crucial it is becoming to include radiological data into surgical decision-making. From the standpoint of clinical informatics, prediction algorithms that assess surgical risk may be able to include structured imaging information. Surgeons may be able to foresee technical difficulties and enhance surgical planning with the use of such models (9).

The methodical comparison of ultrasonographic results with intraoperative observations and the application of structured imaging parameters are two of this study's strong points. But it's also important to recognize some limitations. The sample size was comparatively small, and the retrospective approach restricts causal inference. Additionally, operator expertise may have an impact on how ultrasonography is interpreted. The predictive

usefulness of ultrasonographic variables may be further clarified by future research using prospective methods and bigger sample sizes. Predictive accuracy in surgical surgery may also be improved by integrating machine learning models with radiological characteristics (9,11).

CONCLUSION

Preoperative ultrasonography remains a highly effective diagnostic tool for cholelithiasis and provides valuable information regarding potential operative difficulty. There is a helpful association between intraoperative observations and parameters including the thickness of the gallbladder wall, the presence of pericholecystic fluid, and the diameter of the common bile duct. Surgical planning and risk assessment can be aided by including organized ultrasonographic data into preoperative evaluation. In the long run, these prediction methods might lead to better surgical results and increased patient safety during laparoscopic cholecystectomy.

Acknowledgments

The authors acknowledge the Department of General Surgery and the radiology department at MGM Medical College and Hospital for their support in data collection.

Funding

No funding sources.

Conflict of Interest

None declared.

Ethical Approval

The study was approved by the Institutional Ethics Committee of MGM Medical College, Navi Mumbai..

Approval No: DHR-EC/2025/04/31

Date: 03 April 2025

REFERENCES

1. Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: cholelithiasis and cancer. Gut Liver. 2012 Apr;6(2):172-87. doi: 10.5009/gnl.2012.6.2.172. Epub 2012 Apr 17. PMID: 22570746; PMCID: PMC3343155.

2. Portincasa P, Moschetta A, Palasciano G. Cholesterol gallstone disease. Lancet. 2006 Jul 15;368(9531):230-9. doi: 10.1016/S0140-6736(06)69044-2. PMID: 16844493.

3. Schirmer BD, Edge SB, Dix J, Hyser MJ, Hanks JB, Jones RS. Laparoscopic cholecystectomy: treatment of choice for symptomatic cholelithiasis. Ann Surg. 1991;213(6):665–676.

4. Shea JA, Healey MJ, Berlin JA, Clarke JR, Malet PF, Staroscik RN, et al. Mortality and complications associated with laparoscopic cholecystectomy. Ann Surg. 1996;224(5):609–620.

5. Strasberg SM. The critical view of safety in laparoscopic cholecystectomy. J Am Coll Surg. 1995;180(1):101–125.

6. Randhawa JS, Pujahari AK. Preoperative prediction of difficult laparoscopic cholecystectomy. World J Surg. 2009;33(11):2586–2591.

7. Gupta N, Ranjan G, Arora MP, Goswami B, Chaudhary P, Kapur A, et al. Validation of a scoring system to predict difficult laparoscopic cholecystectomy. Int J Surg. 2013;11(9):1002–1006.

8. Lee NW, Collins J, Britt R. Evaluation of ultrasonography in the diagnosis of gallbladder disease. Radiology. 1980;134(3):639–642.

9. Vivek MA, Augustine AJ, Rao R. A comprehensive predictive scoring method for difficult laparoscopic cholecystectomy. J Minim Access Surg. 2014;10(2):62–67.

10. Indar AA, Beckingham IJ. Acute cholecystitis. BMJ. 2002;325(7365):639–643.

11. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019;25(1):44–56.

12. Nidoni R, Udachan TV, Sasnur P, Baloorkar R. Predicting difficult laparoscopic cholecystectomy based on preoperative parameters. Int Surg J. 2015;2(3):9–12.