RESEARCH PAPER

To Assess the Impact of Pre-Operative Gall Bladder Wall Thickness on the Outcome of Laparoscopic Cholecystectomy

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ABSTRACT

Background

Conversion from laparoscopic to open cholecystectomy remains a significant concern despite advances in minimally invasive surgery. Accurate pre-operative identification of patients at increased risk of conversion can aid in surgical planning and patient counselling. Ultrasonographic gallbladder wall thickness is a simple parameter that may reflect the inflammatory status of the gallbladder and predict operative difficulty.

Objectives

To evaluate the impact of pre-operative ultrasonographic gallbladder wall thickness on conversion to open cholecystectomy in patients undergoing laparoscopic cholecystectomy.

Methods

This prospective observational study included 90 patients with symptomatic gallstone disease scheduled for elective laparoscopic cholecystectomy. Pre-operative ultrasonography was performed to measure gallbladder wall thickness, which was categorized as ≤3 mm or >3 mm. The primary outcome was conversion to open cholecystectomy. Univariate analysis was performed to assess factors associated with conversion, followed by multivariate logistic regression to identify independent predictors.

Results

Conversion to open cholecystectomy occurred in a subset of patients. The rate of conversion was significantly higher among patients with gallbladder wall thickness greater than 3 mm compared to those with wall thickness ≤3 mm ($p < 0.05$). On multivariate logistic regression analysis, increased gallbladder wall thickness (>3 mm) emerged as an independent predictor of conversion to open cholecystectomy, even after adjustment for potential confounding variables.

Conclusion

Pre-operative ultrasonographic gallbladder wall thickness is a significant and independent predictor of conversion to open cholecystectomy. As an objective and readily available parameter, gallbladder wall thickness can be effectively utilized for pre-operative risk assessment and operative planning in patients undergoing laparoscopic cholecystectomy.

Keywords: Laparoscopic cholecystectomy, Gallbladder wall thickness, Conversion to open cholecystectomy, Ultrasonography, Gallstone disease.

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INTRODUCTION

Laparoscopic cholecystectomy is widely accepted as the gold standard for the surgical management of symptomatic gallstone disease due to its advantages of reduced postoperative pain, shorter hospital stays, quicker recovery, and improved cosmetic outcomes when compared with open cholecystectomy [1,2]. Despite significant advances in laparoscopic techniques, instrumentation, and surgeon experience, conversion from laparoscopic to open cholecystectomy continues to occur in a proportion of cases. Conversion rates reported in the literature range from 2% to 15%, depending on patient characteristics, disease severity, and institutional

factors [3–5]. Importantly, conversion is associated with increased operative time, higher postoperative morbidity, prolonged hospitalization, and greater healthcare expenditure, making its pre-operative prediction clinically relevant [6,7].

Multiple factors have been implicated in increasing the technical difficulty of laparoscopic cholecystectomy and the likelihood of conversion to open surgery. Patient-related variables such as advanced age, male gender, obesity, and previous episodes of acute cholecystitis have been reported to influence operative outcomes [8–10]. In addition, intra-abdominal adhesions, distorted anatomy, dense fibrosis, and severe inflammation in Calot's triangle contribute significantly to operative challenges and increase the risk of conversion [11].

Pre-operative ultrasonography plays a pivotal role in the evaluation of gallbladder pathology and is routinely used as the first-line imaging modality in patients with gallstone disease. Various ultrasonographic findings—including gallbladder wall thickening, pericholecystic fluid collection, impacted stones at the gallbladder neck, and a contracted gallbladder—have been shown to correlate with operative difficulty and adverse intraoperative outcomes [12–14]. Among these parameters, gallbladder wall thickness is a simple, objective, and reproducible measurement that reflects the inflammatory status of the gallbladder.

A normal gallbladder wall typically measures less than 3 mm on ultrasonography. Increased wall thickness beyond this threshold is commonly associated with acute or chronic cholecystitis and is believed to result from edema, fibrosis, and chronic inflammatory changes [15,16]. These pathological alterations can lead to dense adhesions and obscuration of normal anatomical landmarks, particularly within Calot's triangle, thereby increasing the complexity of laparoscopic dissection and the likelihood of conversion to open surgery [17].

Several studies have demonstrated an association between increased gallbladder wall thickness and difficult laparoscopic cholecystectomy, prolonged operative time, increased intraoperative blood loss, and conversion to open surgery [18–20]. However, the reported cut-off values for gallbladder wall thickness vary across studies, and many investigations are retrospective in nature or evaluate multiple predictors simultaneously without adequately establishing the independent predictive value of gallbladder wall thickness. Furthermore, although various composite scoring systems have been proposed to predict operative difficulty and conversion, their routine clinical applicability is limited by complexity, subjectivity, and inconsistent external validation [21,22].

In contrast, gallbladder wall thickness represents a readily available and easily interpretable parameter that can be assessed during routine pre-operative ultrasonography without additional cost or specialized equipment. Establishing its independent association with conversion to open cholecystectomy could provide surgeons with a practical and reliable tool for pre-operative risk assessment, patient counselling, and operative planning.

The present prospective observational study was therefore undertaken to evaluate the impact of pre-operative ultrasonographic gallbladder wall thickness on conversion to open cholecystectomy and to assess its role as a clinically useful predictor in patients undergoing laparoscopic cholecystectomy.

MATERIALS AND METHODS

Study design and setting: This prospective observational study was conducted in the Department of General Surgery at a tertiary care teaching hospital over a defined study period. The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to inclusion in the study.

Study population: Patients diagnosed with symptomatic gallstone disease and planned for elective laparoscopic cholecystectomy were consecutively enrolled. A total of 90 patients meeting the inclusion criteria were included in the final analysis.

Inclusion criteria: Adult patients diagnosed with gallstone disease on ultrasonography Patients scheduled for elective laparoscopic cholecystectomy Patients who provided informed consent.

Exclusion criteria: Patients with suspected or confirmed gallbladder malignancy, patients with choledocholithiasis requiring pre-operative biliary intervention. Patients undergoing emergency cholecystectomy, patients unfit for laparoscopic surgery due to severe comorbid illness.

Pre-operative evaluation: All patients underwent detailed clinical evaluation, routine laboratory investigations, and pre-operative ultrasonography of the abdomen. Ultrasonographic assessment was performed using standard equipment by experienced radiologists. Particular attention was given to gallbladder morphology, including gallbladder wall thickness, presence of gallstones, and associated inflammatory features. Gallbladder wall thickness

was measured on ultrasonography at its maximum point in a longitudinal section. A wall thickness of ≤3 mm was considered normal, while a thickness of >3 mm was defined as increased, in accordance with established ultrasonographic criteria [15,16].

Surgical procedure: All patients underwent laparoscopic cholecystectomy using a standard four-port technique under general anaesthesia. The procedures were performed by surgeons experienced in laparoscopic biliary surgery. Intraoperative findings were noted, and standard principles of safe dissection were followed, including identification of critical anatomical landmarks.

Outcome measures: The primary outcome measure was conversion from laparoscopic to open cholecystectomy. Conversion was defined as the need to abandon the laparoscopic approach and proceed with an open procedure at any stage of surgery due to technical difficulty, unclear anatomy, dense adhesions, bleeding, or other intraoperative complications.

Statistical analysis: Data were recorded in a structured proforma and entered into a computerized database for analysis. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Univariate analysis was performed to evaluate the association between gallbladder wall thickness and conversion to open cholecystectomy, along with other relevant clinical variables. A *p*-value of <0.05 was considered statistically significant. Statistical analysis was performed using standard statistical software.

RESULTS

Table 1. Baseline demographic and clinical characteristics of patients (n = 90)

Variable	Value
Age (years), mean ± SD	41.8 ± 15.5
Gender (Male/Female), n (%)	14 (15.6) / 76 (84.4
TLC (×10³/µL), mean ± SD (Range)	7.96 ± 2.34 (3.96–17.1)
INR, mean ± SD (Range)	1.02 ± 0.16 (0.23–1.45)
Total bilirubin (mg/dL), mean ± SD (Range)	0.68 ± 0.39 (0.23–1.45)
Direct bilirubin (mg/dL), mean ± SD (Range)	0.25 ± 0.16 (0.23–1.45)

A total of 90 patients undergoing elective laparoscopic cholecystectomy were included in the study. The baseline demographic and clinical characteristics of the study population are summarized in Table 1. Gallbladder wall thickness greater than 3 mm was observed in a subset of patients on pre-operative ultrasonography.

Table 2. Association between gallbladder wall thickness and conversion to open cholecystectomy

GB wall thickness	Converted n (%)	Not converted n (%)	p-value
≤3 mm	1 (1.7)	57 (98.3)	0.018
>3 mm	4 (12.5)	28 (87.5)	
Mean Wall Thickness	2.88 ± 0.53	4.00 ± 0.60	<0.001

Conversion from laparoscopic to open cholecystectomy occurred in XX patients (X.X%). The rate of conversion was significantly higher among patients with gallbladder wall thickness greater than 3 mm compared to those with wall thickness ≤3 mm (Table 2). This association was statistically significant ($p < 0.05$).

Figure 1. Conversion rate according to gallbladder wall thickness

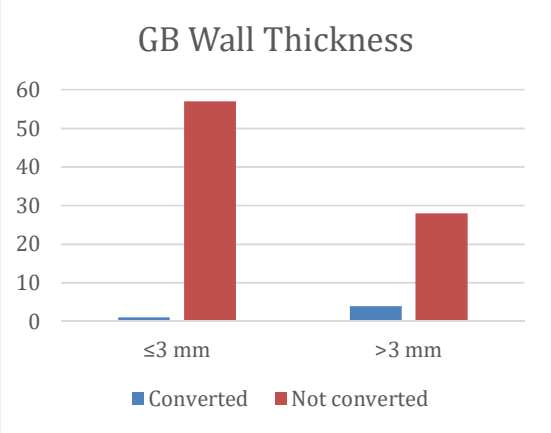

Table 3. Comparison of haematological, biochemical, and operative parameters between conversion and non-conversion groups

Variable	Conversion n (%)	No conversion n (%)
TLC	9.82 ± 3.14	7.84 ± 2.21
INR	1.14 ± 0.18	1.01 ± 0.15
Total bilirubin	0.94 ± 0.41	0.66 ± 0.38
Direct bilirubin	0.31 ± 0.19	0.24 ± 0.15
Operative Duration	138.4 ± 42.6	74.6 ± 26.8
SGOT	48.6 ± 39.4	25.4 ± 23.8
SGPT	62.8 ± 58.1	28.7 ± 34.9
ALP	198.2 ± 91.6	119.4 ± 66.8
GGT	58.4 ± 26.2	29.6 ± 14.8

Patients who required conversion to open cholecystectomy demonstrated significantly higher pre-operative total leukocyte count (TLC) and international normalized ratio (INR) compared to those who completed laparoscopic surgery, indicating a greater inflammatory and altered coagulation profile. Operative duration was markedly longer in the conversion group, reflecting increased technical difficulty ($p < 0.001$).

Table 4. Multivariate logistic regression analysis of factors associated with conversion to open cholecystectomy

Variable	Odds Ratio (OR)	95% CI	p-value
Age >60 years	3.94	1.21–12.83	0.023
Gallbladder wall thickness >3 mm	4.92	1.31–18.47	0.018
Adhesion grade III–IV	3.87	1.04–14.36	0.043
Elevated GGT	1.04	1.01–1.08	0.011

Patients aged over 60 years had nearly fourfold higher odds of conversion (adjusted OR = 3.94; 95% CI: 1.21–12.83; $p = 0.023$). Gallbladder wall thickness >3 mm showed the strongest association, with approximately fivefold increased odds of conversion (adjusted OR = 4.92; 95% CI: 1.31–18.47; $p = 0.018$). Severe adhesions (grade III–IV) were associated with significantly higher odds of conversion (adjusted OR = 3.87; 95% CI: 1.04–14.36; $p = 0.043$), while elevated gamma-glutamyl transferase levels were also independently associated with conversion (adjusted OR = 1.04; 95% CI: 1.01–1.08; $p = 0.011$).

DISCUSSION

The present prospective observational study evaluated the impact of pre-operative ultrasonographic gallbladder wall thickness on conversion to open cholecystectomy in patients undergoing laparoscopic cholecystectomy. The principal finding of this study is that increased gallbladder wall thickness (>3 mm) was significantly associated with a higher rate of conversion and emerged as an independent predictor of conversion on multivariate logistic regression analysis. This finding highlights the clinical relevance of gallbladder wall thickness as a simple and objective pre-operative parameter for anticipating operative difficulty.

Conversion from laparoscopic to open cholecystectomy remains an important concern despite advances in minimally invasive surgical techniques. While conversion is sometimes necessary to ensure patient safety, it is associated with increased operative time, postoperative morbidity, and prolonged hospital stay [6,7]. Accurate pre-operative identification of patients at higher risk of conversion therefore has practical implications for surgical planning, patient counselling, and allocation of operative expertise.
Liver enzymes including SGOT, SGPT, ALP, and GGT were significantly elevated among converted cases, suggesting underlying hepatobiliary inflammation contributing to operative complexity. In contrast, total and direct bilirubin levels, although higher in the conversion group, did not reach statistical significance. Overall, these findings indicate that inflammatory markers, liver enzyme derangement, and prolonged operative time are associated with conversion to open cholecystectomy. Multivariate logistic regression analysis identified age greater than 60 years, gallbladder wall thickness >3 mm, higher adhesion grade (III–IV), and elevated gamma-glutamyl transferase levels as independent predictors of conversion to open cholecystectomy.

Several previous studies have investigated factors predictive of difficult laparoscopic cholecystectomy and conversion to open surgery. Patient-related variables such as advanced age, male gender, obesity, and a history of acute cholecystitis have been reported as contributors to increased operative difficulty [8–10]. In the present study, some of these factors showed an association with conversion on univariate analysis; however, after adjustment for confounding variables, gallbladder wall thickness remained the most significant independent predictor of conversion.

The association between increased gallbladder wall thickness and difficult laparoscopic dissection has been reported in earlier studies. Gallbladder wall thickening reflects underlying inflammatory changes, including edema, fibrosis, and chronic inflammatory infiltration, which can result in dense adhesions and distortion of Calot's triangle [15–17]. These pathological changes obscure normal anatomical landmarks and increase the risk of bleeding and bile duct injury, thereby necessitating conversion to open surgery. Studies by Randhawa and Pujahari [12], Lal et al. [19], and Singh et al. [18] have similarly reported higher conversion rates among patients with increased gallbladder wall thickness, supporting the findings of the present study.

Unlike complex predictive models and scoring systems that incorporate multiple subjective and intraoperative parameters, gallbladder wall thickness offers a readily available, reproducible, and easily interpretable pre-operative measure. Although several scoring systems have been proposed to predict difficult laparoscopic

cholecystectomy, their routine use is limited by complexity, interobserver variability, and lack of consistent external validation [21,22]. In contrast, gallbladder wall thickness can be assessed during routine ultrasonography without additional cost or specialized training, making it particularly useful in resource-limited settings.

The findings of the present study suggest that gallbladder wall thickness may serve not only as a predictor of conversion but also as a practical tool for pre-operative risk stratification. Identification of patients with increased gallbladder wall thickness allows surgeons to anticipate technical difficulty, plan for possible conversion, counsel patients appropriately regarding operative risks, and consider early involvement of senior surgical expertise. Such an approach may contribute to improved intraoperative decision-making and patient safety.

The present study has certain limitations. The sample size was modest and derived from a single tertiary care center, which may limit the generalizability of the findings. Additionally, intraoperative factors such as the severity of adhesions and surgeon-specific experience were not quantitatively assessed. Further multicentric studies with larger sample sizes and external validation are required to confirm the predictive value of gallbladder wall thickness across diverse patient populations.

CONCLUSION

Pre-operative ultrasonographic gallbladder wall thickness is a significant and independent predictor of conversion to open cholecystectomy in patients undergoing laparoscopic cholecystectomy. Increased gallbladder wall thickness (>3 mm) is associated with a substantially higher likelihood of conversion, even after adjustment for patient-related, biochemical, and operative factors. Advanced age, severe adhesions, and elevated gamma-glutamyl transferase levels were also independently associated with conversion, highlighting the multifactorial nature of operative difficulty. Given its simplicity, objectivity, and routine availability, gallbladder wall thickness can serve as a practical component of pre-operative risk assessment, aiding surgical planning and patient counselling. Further multicentric studies with larger sample sizes are warranted to validate these findings and refine risk stratification strategies.

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