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Case Series

Preoperative Ultrasonographic Gallbladder Wall Thickness, Operative Difficulty and Postoperative Recovery after Laparoscopic Cholecystectomy: A Hospital-Based Case Series

Irappa S. Lamani[1], Sridhara Venkappa Badiger[2], Akash Talikoti[3]

[1]Senior Resident, Department of General Surgery, S Nijalingappa Medical College, Bagalkot, Karnataka, India

[2]Assistant Professor, Department of Orthopaedics, K H Patil Institute of Medical Sciences Gadag, Karnataka, India

[3]Senior Resident, Department of Paediatrics, S Nijalingappa Medical College, Bagalkot, Karnataka, India

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Corresponding Author: Dr. Akash Talikoti

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Abstract:

Background: Operative time and length of hospital stay are practical measures of how difficult a laparoscopic cholecystectomy (LC) is and how quickly patients recover. We examined whether gallbladder wall thickness (GWT) on preoperative ultrasonography (USG) predicts gallbladder dissection time, postoperative hospital stay and surgical site infection (SSI).

Methods: This hospital-based case series included 44 patients with acute cholecystitis who underwent LC at HSK Hospital, Bagalkot, between August 2022 and February 2024. GWT was grouped as <4.0 mm (Group I, n = 12), 4.0–4.9 mm (Group II, n = 27) and ≥5.0 mm (Group III, n = 5). Gallbladder dissection time, postoperative hospital stay and SSI on days 3, 7 and 30 were recorded.

Results: Mean dissection time was 68.1 ± 19.1 minutes. It increased from 53.8 ± 13.3 minutes in Group I to 71.7 ± 15.8 minutes in Group II and 83.0 ± 29.1 minutes in Group III ($p = 0.009$). GWT correlated moderately with dissection time (Spearman $\rho = 0.54$; $p < 0.001$); each 1 mm increase was associated with about 20 minutes of additional dissection ($R^2 = 0.39$). Dissection lasting 75 minutes or more occurred in 8.3%, 51.9% and 80.0% of the three groups ($p = 0.006$). Mean postoperative stay was 4.8 ± 1.6 days and rose from 4.3 to 4.7 to 6.2 days across the groups; the trend was weak (0.9 days per mm, $R^2 = 0.12$, $p = 0.022$) and group differences were not significant ($p = 0.166$). No patient developed SSI.

Conclusion: Preoperative GWT is a useful predictor of a prolonged gallbladder dissection and shows a modest association with longer postoperative stay. It can help surgeons schedule operating time and counsel patients about recovery.

Keywords: Laparoscopic cholecystectomy; Gallbladder wall thickness; Operative time; Length of stay; Surgical site infection; Ultrasonography.

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Introduction

Laparoscopic cholecystectomy (LC) is the standard treatment for symptomatic gallstone disease and acute cholecystitis. Its advantages over open cholecystectomy—less pain, earlier mobilisation, shorter hospital stay and better cosmesis—are well established [1]. These advantages are not uniform, however. A large population-based study of 8909 cholecystectomies in the United Kingdom and Ireland found that longer operations were associated with more complications and readmissions, showing that operative difficulty carries consequences beyond the theatre [2].

Operating time and postoperative length of stay are therefore practical, measurable markers of difficulty and recovery. For hospitals in India, where theatre time and beds are limited and many patients travel long distances, being able to predict a long operation or a prolonged admission has direct value. It allows better list scheduling, the allocation of a senior surgeon to difficult cases, and realistic counselling of patients and families about time off work and expected discharge.

Acute cholecystitis is the commonest reason for a difficult LC. The Tokyo Guidelines 2018 recognise gallbladder wall thickening on imaging as part of the diagnosis and severity assessment of acute cholecystitis [3]. Ultrasonography (USG) measures wall thickness accurately and cheaply, and a value

above 3 mm is generally taken as abnormal [4]. Thickening reflects oedema, inflammation and, in recurrent disease, fibrosis. Each of these makes the gallbladder harder to grasp, retract and separate from the liver bed, and makes the planes of Calot's triangle harder to define. A longer dissection is the expected result.

Several studies have tested this link. Ghazanfar et al. found that patients with a difficult LC had thicker walls and markedly longer operations, about 91 versus 57 minutes [5]. In a prospective study of 1089 patients, Kokoroskos et al. showed that wall thickness correlated positively with operative time, intraoperative events and hospital stay [6]. Raman et al. reported that hospital stay lengthened as the degree of thickening increased [7]. Indian studies from Mysuru and Jodhpur reported longer operative times and hospital stays with increasing thickness, using similar grading systems [8,9]. Nidoni et al., working in north Karnataka, included wall thickness above 3 mm among the predictors of a difficult LC [10].

Most of these studies, however, report operative time for the whole procedure, which includes port placement, closure and delays unrelated to the gallbladder itself. Gallbladder dissection time—from the start of dissection at Calot's triangle to complete separation from the liver bed—is a more direct measure of the difficulty attributable to the gallbladder. Few studies have reported it.

Data on postoperative surgical site infection (SSI) in relation to wall thickness are also sparse, and most series combine elective and emergency cases.

We therefore studied patients with acute cholecystitis undergoing LC at a tertiary teaching hospital in Bagalkot, Karnataka. Our aim was to determine whether preoperative ultrasonographic gallbladder wall thickness is associated with gallbladder dissection time, the length of postoperative hospital stay and the occurrence of SSI within 30 days of surgery.

Materials and Methods

Study Design and Setting: This prospective, hospital-based case series was conducted in the Department of General Surgery, S. Nijalingappa Medical College and HSK Hospital and Research Centre, Bagalkot, Karnataka, between 1 August 2022 and 29 February 2024. The Institutional Ethics Committee on Human Subjects Research granted approval on 16 July 2022 (File No. SNMC/IECHSR/2021-22/A-54/1.1). All participants gave written informed consent in English or Kannada.

Participants: We enrolled consecutive patients aged 18–65 years with a diagnosis of acute cholecystitis, an available abdominal ultrasound report, and a plan for LC. Patients in whom wall thickness could not be measured, and those with choledocholithiasis, suspected gallbladder malignancy or a bleeding disorder, were excluded.

Sample Size: The sample size was calculated with OpenEpi version 2.3.1. Based on a complication proportion of 83.3% in moderately thickened gallbladders reported by Sharath Chandra and Bose [8], with 12% absolute precision and 95% confidence, at least 36 patients were required. This was rounded to 40, and 44 patients were enrolled.

Ultrasonography and Grouping: Abdominal USG was performed in the radiology department during the preoperative work-up, and gallbladder wall thickness (GWT) was recorded in millimetres from the report. Patients were divided into Group I (<4.0 mm, mild thickening), Group II (4.0–4.9 mm, moderate) and Group III (≥5.0 mm, severe).

Operative Procedure: LC was performed under general anaesthesia with a standard four-port technique and carbon dioxide pneumoperitoneum at 12–15 mmHg. Calot's triangle was dissected to obtain the critical view of safety [11] before the cystic duct and artery were clipped and divided. The gallbladder was then separated from the liver bed with electrocautery and extracted in a retrieval bag. Standard antibiotic prophylaxis was given at induction.

Outcome Measures: Outcomes were recorded prospectively in a structured proforma.

- Gallbladder dissection time (minutes): the time from the start of dissection at Calot's triangle to complete detachment of the gallbladder from the liver bed. A dissection of 75 minutes or more, roughly the upper quartile of the observed distribution, was defined as prolonged.
- Postoperative hospital stay (days): the number of days from surgery to discharge. A stay of more than 5 days was defined as prolonged. Patients were discharged when they were tolerating a normal diet, mobile, afebrile and had adequate oral pain control.
- SSI: assessed by wound inspection on postoperative days 3 and 7 and at the 30-day follow-up visit, using Centers for Disease Control and Prevention criteria (purulent discharge, local signs of infection or a positive wound culture).

Intraoperative complications (major haemorrhage, bile leak, biliary or other injury and conversion) were also recorded so that their contribution to dissection time could be examined.

Statistical Analysis: Data were entered in Microsoft Excel and analysed with SPSS version 19.0 and Python (SciPy). Continuous variables are expressed as mean ± standard deviation (SD) and median (range); categorical variables as number

(percentage). Dissection time and hospital stay were compared across the three groups with the Kruskal–Wallis test, with one-way ANOVA as a sensitivity analysis. The association between GWT as a continuous variable and each outcome was assessed with Spearman's rank correlation and simple linear regression.

Proportions with prolonged dissection or stay were compared using the Fisher–Freeman–Halton exact test (Monte Carlo, 20 000 permutations).

Dissection time and hospital stay in patients with and without intraoperative complications were compared with the Mann–Whitney U test. A two-sided $p < 0.05$ was considered significant.

Results

Forty-four patients were analysed. Gallbladder dissection time rose clearly with wall thickness, whereas postoperative stay rose only modestly, and no SSI occurred.

Table 1: Baseline characteristics by gallbladder wall thickness group

Variable	Group I (<4.0 mm), n = 12	Group II (4.0–4.9 mm), n = 27	Group III (≥5.0 mm), n = 5	Total, n = 44	p value
Age, years, mean ± SD	42.6 ± 14.7	41.4 ± 8.4	51.0 ± 11.4	42.8 ± 10.9	0.288[a]
Female, n (%)	7 (58.3)	9 (33.3)	4 (80.0)	20 (45.5)	0.103[b]
GWT, mm, mean ± SD	3.33 ± 0.25	4.13 ± 0.22	5.20 ± 0.45	4.03 ± 0.60	—

[a] Kruskal–Wallis test. [b] Fisher–Freeman–Halton exact test.

The mean age was 42.8 years, and 24 patients (54.5%) were men. The three groups were comparable in age and sex, so these factors are unlikely to explain the differences in outcome below.

Table 2: Gallbladder dissection time by gallbladder wall thickness group

Measure	Group I (<4.0 mm), n = 12	Group II (4.0–4.9 mm), n = 27	Group III (≥5.0 mm), n = 5	Total, n = 44	p value
Dissection time, min, mean ± SD	53.8 ± 13.3	71.7 ± 15.8	83.0 ± 29.1	68.1 ± 19.1	0.009[a]
Median (range), min	60 (30–75)	75 (45–90)	90 (40–120)	62.5 (30–120)	
Prolonged dissection ≥75 min, n (%)	1 (8.3)	14 (51.9)	4 (80.0)	19 (43.2)	0.006[b]

[a] Kruskal–Wallis test (one-way ANOVA p = 0.003). [b] Fisher–Freeman–Halton exact test.

Mean dissection time increased by about 18 minutes from Group I to Group II and by a further 11 minutes I Group III. A prolonged dissection was rare with a wall under 4 mm (8.3%) but occurred in half of Group II and four of five patients in Group III. The longest dissection (120 minutes) was in the patient with a 6 mm wall who required conversion.

Table 3: Postoperative hospital stay and surgical site infection by gallbladder wall thickness group

Measure	Group I (<4.0 mm), n = 12	Group II (4.0–4.9 mm), n = 27	Group III (≥5.0 mm), n = 5	Total, n = 44	p value
Hospital stay, days, mean ± SD	4.25 ± 1.60	4.74 ± 1.35	6.20 ± 2.39	4.77 ± 1.61	0.166[a]
Median (range), days	4 (2–8)	5 (3–7)	6 (3–9)	4.5 (2–9)	
Prolonged stay >5 days, n (%)	2 (16.7)	9 (33.3)	3 (60.0)	14 (31.8)	0.225[b]
SSI on day 3, 7 or 30, n (%)	0 (0)	0 (0)	0 (0)	0 (0)	—

[a] Kruskal–Wallis test (one-way ANOVA p = 0.071). [b] Fisher–Freeman–Halton exact test.

Mean stay was about two days longer in Group III than in Group I, and the proportion with a prolonged stay rose from 16.7% to 60.0%. These group differences did not reach significance. No patient developed SSI at any follow-up point.

Table 4: Gallbladder wall thickness (continuous, per 1 mm) and outcomes

Outcome	Spearman ρ	p value	Regression slope per 1 mm (R^2)	p value
Dissection time, min	0.54	<0.001	+19.9 min (0.39)	<0.001
Postoperative stay, days	0.24	0.119	+0.9 days (0.12)	0.022

Wall thickness explained about 39% of the variation in dissection time. Its association with hospital stay was weak: the linear trend was significant, but the rank correlation was not, so the stay finding should be read with caution. Dissection time and hospital stay were not correlated with each other ($\rho = -0.16$, $p = 0.31$).

Table 5: Dissection time and hospital stay by occurrence of intraoperative complications

Measure	Complication, n = 10	No complication, n = 34	p value[c]
Dissection time, min, mean ± SD	86.0 ± 15.6	62.8 ± 16.9	0.001
Hospital stay, days, mean ± SD	4.7 ± 1.6	4.8 ± 1.6	0.853

[c] Mann–Whitney U test. Complications: major haemorrhage, bile leak, injury to other structures or conversion.

Patients who had an intraoperative complication needed on average 23 minutes longer for dissection, but their hospital stay was not longer.

Discussion

This study shows that preoperative ultrasonographic gallbladder wall thickness is a strong predictor of how long the gallbladder dissection will take during LC for acute cholecystitis. Each additional millimetre of wall thickness added about 20 minutes to the dissection, and four of five patients with a wall of 5 mm or more needed 75 minutes or longer. The association with postoperative hospital stay was in the same direction but weaker, and no SSI occurred.

Our dissection-time findings agree with previous work. Ghazanfar et al. reported operations lasting roughly 34 minutes longer in difficult cases, which had thicker walls [5]. Kokoroskos et al. found a positive correlation between wall thickness and operative time in over a thousand patients [6], and Indian series from Mysuru and Jodhpur reported longer operations in more thickened groups [8,9].

By measuring dissection time rather than total operative time, we isolated the part of the operation most directly affected by gallbladder inflammation, which may explain why wall thickness accounted for a substantial share (39%) of its variation. Patients with an intraoperative complication also had dissections about 23 minutes longer, reflecting the slower, more careful work that bleeding and a friable wall demand. A prolonged dissection is not merely an inconvenience: population data link longer operations to more complications and readmissions [2].

The relationship with hospital stay was modest. Mean stay rose from 4.3 days in Group I to 6.2 days in Group III, consistent with the stepwise increase reported by Raman et al. and Kokoroskos et al. [6,7]. In our data the linear trend was significant but group comparisons were not, probably because Group III contained only five patients. Length of stay in our setting is also influenced by factors other than surgical difficulty, including the severity of the presenting illness, the time taken for inflammation and pain to settle, social circumstances and travel distance. This may explain why stay did not correlate with dissection time and was not longer in patients with intraoperative complications. Our mean stay of 4.8 days is longer than the median of 3 days reported by Krishnamurthy et al. after early LC for gallbladder perforation [12]. Strategies such as preoperative percutaneous gallbladder drainage have been shown to shorten operative time and hospital stay in high-risk patients [13], and may be worth considering when severe thickening is found.

No SSI was recorded. Low wound infection rates are a recognised benefit of LC [1], and the use of a retrieval bag and prophylactic antibiotics probably contributed. With no events, our study cannot assess any link between wall thickness and SSI.

These results have practical value. A preoperative wall thickness of 4 mm or more, and especially 5 mm or more, should prompt the team to schedule a longer theatre slot, involve an experienced surgeon and prepare for possible difficulty [10,14]. Wall thickness alone is not a complete predictor; some authors found ultrasonographic scoring of limited value [15], and combining it with inflammatory markers may improve prediction [16]. Whatever the expected difficulty, the critical view of safety should not be compromised to save time [11].

The study has limitations. The sample was small, especially in the most thickened group, and it was a single-centre series without multivariable adjustment. Dissection times were recorded by the operating team without independent timing. USG was operator-dependent and the interval between scan and surgery varied. Discharge timing may have been influenced by non-clinical factors. Larger studies with standardised discharge criteria are needed to confirm the effect on hospital stay.

Conclusion

Preoperative ultrasonographic gallbladder wall thickness predicts a prolonged gallbladder dissection during LC for acute cholecystitis: each millimetre of thickening added about 20 minutes, and most patients with a wall of 4 mm or more needed 75 minutes or longer. Its association with postoperative hospital stay is modest, and SSI was not observed. Wall thickness on the routine preoperative scan is a simple, inexpensive tool for planning theatre time, assigning surgical expertise and counselling patients about their likely recovery.

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