Original Article

Laparoscopic Cholecystectomy a gold standard treatment for symptomatic Gall stone diseases

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Abstract

Background: Laparoscopic cholecystectomy is the gold standard for surgical treatment of symptomatic gallstone disease. But, a thickened gall bladder (GB) wall on the pre-operative ultrasonography might predict the difficulty of the operation, conversion to open surgery, post-operative complications, and longer hospital stay. This study was conducted to assess the correlation of the thickness of the GB wall in the preoperative period with the surgical outcomes in patients undergoing laparoscopic cholecystectomy. **Material and Methods:** This is a prospective observational study, incorporating 54 consecutive patients undergoing elective laparoscopic cholecystectomy from August 2022 to August 2024. Pre-op ultrasonography was used to assess GB wall thickness (grade I: 1-2mm, grade II: >2-3mm, grade III: >3-4mm, grade IV: >4mm). The type of cholecystitis, conversion to open cholecystectomy, postoperative complications and length of hospital stay were assessed. **Results:** Of the 54 patients, female patients were more predominant (64.81%) and 74.07% of the patients had calculous cholecystitis. The most prevalent were Grade II (35.19%) and Grade III (33.33%) GB wall thickness. Six patients (11.11%) had to be converted to open cholecystectomy, the rate being the highest in Grade IV patients (50%). The mean GB wall thickness was significantly higher in patients requiring conversion compared with those who completed laparoscopic surgery (4.47±0.21 mm vs. 2.96±0.12 mm; p<0.0001). 18.52% of the patients developed postoperative complications, most of them being bile leak (12.96%) and surgical site infection (11.11%) with the highest incidence in Grade IV. The postoperative hospital stay was significantly longer with the higher GB wall thickness (p=0.0004), and converted cases had significantly longer hospital stay compared to the laparoscopic cases (5.33±0.49 vs. 3.65±0.13 days, p=0.0001). **Conclusion:** Preop USGW is a simple and reliable predictor of the difficulty of surgery during LC. Grade III and Grade IV wall thickness has been shown to be statistically significant risk factors for conversion to open surgery, postoperative complications and longer hospital stay. Regular evaluation of GB wall thickness can help in pre-operative risk stratification, surgical planning and counseling.

Keywords: Gallbladder wall thickness; Laparoscopic cholecystectomy; Ultrasonography; Conversion to open cholecystectomy; Postoperative complications.

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Introduction

Laparoscopic cholecystectomy is the gold-standard procedure for management of symptomatic gallstone disease.[1] Laparoscopic cholecystectomy (Laparoscopic cholecystectomy) has now replaced Open cholecystectomy (open cholecystectomy) for the treatment of gallbladder diseases.[2] Postoperative recovery time and length of hospitalization have decreased significantly since routine cholecystectomy changed from an open to a laparoscopic procedure, as have the time taken to return to normal activity, postoperative narcotic requirements, and overall cost.[3]

However, certain conditions disqualify laparoscopic cholecystectomy and lead surgeons to perform conventional open cholecystectomy. This includes pericholecystic adhesions and adhesions between the common bile duct, the cystic duct, and the cystic artery. These conditions may significantly prolong laparoscopic time and may cause bleeding or gallbladder rupture.[3] Therefore, patients for open cholecystectomy should be identified before they go to the laparoscopic surgery.

Gallbladder wall thickening is an indicator of cholecystitis in patients presenting with symptoms of gallstone disease.[4] Previous studies have shown increased postoperative complications, increased rates of conversion to an open procedure, and longer lengths of stay in thick-walled gallbladder patients.[5] Reported studies have only evaluated gallbladder wall as being thick or not thick, without looking at the degree of thickness.

We hypothesize that, more severe the wall thickening, the greater the chance of conversions and complications, and longer post-operative hospital stay. With this background, our study aims to evaluate the impact of gallbladder wall thickness, assessed by

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ultrasound preoperatively, on the outcome of laparoscopic cholecystectomy and to evaluate any intra or postoperative complications in relation to them, in the setting of current practice at our institute.

Materials and Methods

The study was a prospective observational study carried out in the Department of General Surgery in our institution from August 2022 to August 2024. Fifty-four consecutive patients who were scheduled to undergo elective laparoscopic cholecystectomy were studied. A detailed clinical evaluation was performed for all the patients using a pre-designed proforma which included demographic, clinical history features and physical examination findings. All patients underwent routine preoperative laboratory tests—such as complete blood count, liver function tests and abdominal ultrasonography (USG). For comparison, nine individuals without any history of gallbladder disease underwent abdominal ultrasonography, and the thickness of their normal gallbladders was compared with the thickness of gallbladders in patients with symptoms of gallbladder disease who had normal gallbladder wall thickness (≤2 mm).

Patients who had a diagnosis of cholecystitis and/or cholelithiasis on ultrasonography and had at least one episode of upper abdominal pain and were deemed suitable for elective laparoscopic cholecystectomy were included in the study. Patients who were reported to have a history or investigations indicative of common bile duct (CBD) stones, gall bladder polyps or gall bladder carcinoma were excluded. All the participants signed a written informed consent form before entering the study, and the study protocol was approved by the Institutional Ethics Committee.

The thickness of the gall bladder wall was classified according to the result of the abdominal ultrasonography as Grade I (1-2 mm), Grade II (>2-3 mm), Grade III (>3-4 mm), or Grade IV (>4 mm). The patients were divided into these grades and their clinical and surgical results were prospectively documented. These variables were evaluated: type of cholecystitis (calculous or acalculous), acute or chronic inflammation, conversion from Laparoscopic to Open cholecystectomy, Intraoperative and Postoperative complications, Post-operative length of stay and Gallbladder wall thickness based on gender and surgical outcome.

Data were analysed using GraphPad Prism for Windows. Continuous variables were presented as mean ± standard error of the mean (SEM) while categorical variables were presented as frequencies and percentages. The Student's t-test was used to compare two independent groups and one-way analysis of variance (ANOVA) was used for more than two groups with Tukey's multiple comparison test as post hoc comparison. The Chi-square test was used in testing the associations between categorical variables. A p-value <0.05 was considered statistically significant.

Results

A total of 54 patients who underwent laparoscopic cholecystectomy were studied. The study population had a higher number of females (35, 64.81%) compared to males (19, 35.19%). The most common age group was 31–40 years (27.78%), followed by 41–50 years (25.93%) and 51–60 years (22.22%). Co-morbidities were seen in most patients (90.74%) with none, hypertension (7.41%) and diabetes mellitus (1.85%). [Table 1]

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population (N=54)

Variable	Category	n (%)
Age group (years)	≤30	4 (7.41)
	31–40	15 (27.78)
	41–50	14 (25.93)
	51–60	12 (22.22)
	≥60	9 (16.67)
Gender	Female	35 (64.81)
	Male	19 (35.19)
Co-morbidities	None	49 (90.74)
	Hypertension	4 (7.41)
	Diabetes mellitus	1 (1.85)

In this study, the number of patients with calculous cholecystitis (74.07%) was higher than the number of patients with acalculous cholecystitis (25.93%). In general, chronic cholecystitis was the most common (42, 77.78%) and acute cholecystitis was seen in 12 (22.22%) patients. Grade II (35.19%) was the most common grade, followed by Grade III (33.33%), Grade I (16.67%) and Grade IV (14.81%) on the basis of gall bladder wall thickness. [Table 2]

Table 2: Distribution of Cholecystitis and Gallbladder Wall Thickness Grade

Variable		n (%)
Type of cholecystitis	Acalculous	14 (25.93)
	Calculous	40 (74.07)
Disease type	Acute	12 (22.22)
	Chronic	42 (77.78)
GB wall thickness grade	Grade I (1–2 mm)	9 (16.67)
	Grade II (>2–3 mm)	19 (35.19)
	Grade III (>3–4 mm)	18 (33.33)
	Grade IV (>4 mm)	8 (14.81)

The comparison of the gallbladder wall thickness grade with the type of cholecystitis revealed that acalculous cholecystitis was more common with wall thickness grade IV (35.71%) and calculous cholecystitis was more common with wall thickness grade II (40.00%) and III (35.00%). Both acalculous and calculous cholecystitis had the least grade I wall thickness. [Table 3]

Table 3: Association Between Gallbladder Wall Thickness Grade and Type of Cholecystitis

GB wall grade	Acalculous n (%)	Calculous n (%)
Grade I	2 (14.29)	7 (17.50)
Grade II	3 (21.43)	16 (40.00)
Grade III	4 (28.57)	14 (35.00)
Grade IV	5 (35.71)	3 (7.50)
Total	14 (100)	40 (100)

Evaluation of acute and chronic cholecystitis by the different grades of gallbladder wall thickness showed that the acute acalculous cholecystitis was limited to Grades I and II, with one patient in each. Chronic acalculous cholecystitis was the most common in grade IV. Calculous cholecystitis was more common in the chronic form in all grades with the highest in Grade II and III (11 patients) and acute calculous cholecystitis was more common in Grade II (5 patients). [Table 4]

Table 4: Distribution of Acute and Chronic Cholecystitis According to Gallbladder Wall Thickness Grade

Grade	Acalculous Acute	Acalculous Chronic	Calculous Acute	Calculous Chronic
I	1	1	2	5
II	1	2	5	11
III	0	4	3	11
IV	0	5	0	3

There was no significant difference (p=0.87) between the mean gallbladder wall thickness of females (3.14±0.14 mm) and males (3.10±0.25 mm). However, the patients who needed conversion to open cholecystectomy had a significantly higher mean gallbladder wall thickness compared with those who underwent laparoscopic surgery (4.47±0.21 mm vs. 2.96±0.12 mm, p<0.0001). [Table 5]

Table 5: Gallbladder Wall Thickness According to Gender and Surgical Procedure

Variable	Female	Male	Laparoscopic	Converted to Open
n	35	19	48	6
Minimum (mm)	1.50	1.60	1.50	3.90
Maximum (mm)	4.80	5.20	5.00	5.20
Mean ± SEM	3.14±0.14	3.10±0.25	2.96±0.12	4.47±0.21
P value	0.87		<0.0001	

In total, 6 patients (11.11%) had to be converted from laparoscopic to open cholecystectomy. None of the patients with Grade I or Grade II gallbladder wall thickness required conversion. The conversion rate was higher with higher gallbladder wall thickness, with the conversion rate of Grade III being 11.11% and Grade IV being 50.00%. [Table 6]

Table 6: Conversion to Open Cholecystectomy According to Gallbladder Wall Thickness Grade

Grade	Converted (n)	Total	Conversion (%)
Grade I	0	9	0
Grade II	0	19	0
Grade III	2	18	11.11
Grade IV	4	8	50.00
Total	6	54	11.11

10 patients (18.52%) had postoperative complications and 44 patients (81.48%) had an uncomplicated postoperative course. Grade IV gallbladder wall thickness had the highest number of complications (5 patients), Grade II (2 patients) and Grade III (2 patients). One patient in Grade I had postoperative complications, indicating that the higher the wall thickness grade, the more complications. [Table 7]

Table 7: Postoperative Complications According to Gallbladder Wall Thickness Grade

Grade	Patients with complications n (%)
Grade I	1 (1.85)
Grade II	2 (3.70)
Grade III	2 (3.70)
Grade IV	5 (9.26)
Total complications	10 (18.52)
No complications	44 (81.48)

The most common postoperative complication was bile leak (12.96%, 7 patients) followed by surgical site infection (11.11%, 6 patients). There was no record of any hemorrhage, or common bile duct injury, in the present study. [Table 8]

Table 8: Type of Postoperative Complications

Complication	n (%)
Bile leak	7 (12.96)
Surgical site infection	6 (11.11)
Hemorrhage	0
CBD injury	0

There was a progressive increase in the duration of postoperative hospital stay with increasing gallbladder wall thickness grade. The mean duration of hospitalization was 3.12±0.12 days for Grade I, 3.35±0.12 days for Grade II, 3.69±0.15 days for Grade III, and 4.67±0.33 days for Grade IV. The overall difference among the groups was statistically significant (ANOVA, p=0.0004). A post hoc analysis revealed a significantly longer hospital stay in Grade IV compared with Grades I, II and III. [Table 9]

Table 9: Postoperative Hospital Stay According to Gallbladder Wall Thickness Grade

Grade	n	Minimum	Maximum	Mean ± SEM (days)
Grade I	8	3	4	3.12±0.12
Grade II	17	3	4	3.35±0.12
Grade III	16	3	5	3.69±0.15
Grade IV	3	4	5	4.67±0.33

Patients who underwent successful laparoscopic cholecystectomy had a significantly shorter postoperative hospital stay than those converted to open cholecystectomy (3.65±0.13 vs. 5.33±0.49 days; p=0.0001). Also, the converted group had a higher mean gall bladder wall thickness than the laparoscopy group (4.47±0.21mm vs. 2.96±0.12mm; p<0.0001), suggesting a correlation between increased gall bladder wall thickness, conversion to open surgery and longer hospital stay. [Table 10]

Table 10: Surgical Outcomes

Variable	Laparoscopic	Converted to Open
Patients	48	6
Mean hospital stay (days)	3.65±0.13	5.33±0.49
Mean GB wall thickness (mm)	2.96±0.12	4.47±0.21
P value	0.0001	<0.0001

Discussion

Laparoscopic cholecystectomy is considered as the gold standard in the treatment of both calculous and acalculous cholecystitis due to its reduced postoperative morbidity, shorter hospital stay and quicker recovery when compared to open surgery. In the present study, 54 patients who had undergone laparoscopic cholecystectomy were evaluated to assess the value of the thickness of the gallbladder (GB) wall measured by ultrasonography as a predictor of the difficulty of the operation and postoperative outcome. The female gender predominated (64.81%) as gallstone disease is known to be more prevalent in the female gender due to the effect of hormones especially the cholesterol supersaturation and gall bladder hypomotility in pregnancy.[6] Although the majority of difficult cholecystectomies reported in previous studies have been male, the present study did not show any difference between the thickness of the GB wall in males and females (p=0.87). The mean age of the study population was 47.5 years, with the highest frequency being found in the fourth decade, which corroborates the increase in gallstone disease with age. No associated co-morbidities were present in most of the patients and both hypertension and diabetes mellitus were uncommon and did not appear to be associated with surgical conversion in the present study.

Calculous cholecystitis accounted for almost three fourth (74.07%) and chronic cholecystitis was the most common pathological type in both calculous and acalculous cholecystitis. These results are very similar to those found by Majeski who noted calculous cholecystitis in 78.5% and acalculous cholecystitis in 21.5% of patients.[8] Thickening of the gallbladder wall is indicative of chronic inflammation, edema, fibrosis and repeated inflammatory insults, and laparoscopic dissection is technically difficult.[9,10] The average GB wall thickness for the present study was about 3.12 mm, with Grade II (>2 to 3 mm) and Grade III (>3 to 4 mm) being the most common grades. Mohammed et al. also showed that males had significantly thicker walls than females, while Aslam et al. showed that there was no significant difference between age and gender with regard to the wall thickness of the GB.[11,12] We also noted that the highest wall thickness (Grade IV >4 mm) was more often encountered in cases of acalculous chronic cholecystitis, while the other wall thickness grades (Grade II and III) were more often encountered in cases of chronic calculous cholecystitis. Majeski also found that over a third of the patients with acute and chronic calculous cholecystitis had a GB wall thickness greater than 3 mm, again supporting the connection between chronic inflammation and thickening of the GB wall.[8]

The main result of the present study was the significant relationship between increasing thickness of the GB wall and conversion to open cholecystectomy. The overall conversion rate was 11.11% and the mean GB wall thickness was significantly higher in converted patients than in the patients who underwent laparoscopic surgery (4.47±0.21 mm vs. 2.96±0.12 mm; p<0.0001). Moreover, there was no conversion in Grade I or Grade II patients; the conversion rate was 11.11% in Grade III patients and 50% in grade IV patients, which clearly showed that the higher the wall thickness, the more difficult the conversion. Previous investigators have used various cut-off values between 3 and 7 mm for a thick wall of the GB, but all found a higher risk of conversion the thicker the wall of the GB.[5,9,10,13] Majeski reported 10% conversion rate for patients with GB wall thickness >3 mm and several other studies have reported that GB wall thickness is one of the most valuable ultrasonographic findings that helps in predicting difficult laparoscopic cholecystectomy.[5,8] The common causes of conversion in the present study were dense adhesions, severe inflammation, bile leakage as a result of gallbladder perforation, and inability to dissect safely, which are similar to the causes of conversion reported by Karadeniz et al., who found gallbladder perforation and intraoperative bleeding to be the most common technical difficulties during laparoscopic cholecystectomy.[14]

There were postoperative complications in 18.52% patients, with bile leak and surgical site infection as the most common adverse events, while no patient had hemorrhage, bowel injury, retained bile duct stones or common bile duct injury. Significantly, these complications were progressive with increasing GB wall thickness; half of the Grade IV patients developed postoperative complications. Previous studies report complication rates that are similar to these (20% – 26%).[15,16] Moreover, the postoperative hospital stay was significantly longer as GB wall thickness increased (p=0.0004) and the longest hospital stay was observed in Grade IV patients. Preoperative GB wall thickness assessment was also clinically significant, as patients who underwent conversion to open surgery had significantly longer postoperative hospital stays than those who underwent laparoscopic cholecystectomy.

Based on these findings, GB wall thickness by ultrasonography may be a simple, inexpensive and readily available parameter that may help the surgeon to stratify the risk preoperatively, plan surgery, counsel patients, and anticipate the level of difficulty during surgery. However, there are some limitations in this study. The ultrasonographic measurement of GB wall thickness is operator dependent and can be different depending on the experience of the radiologist and the location of the measurement. Furthermore, the ultrasonographic examinations were done by different radiologists in the present study, which might have led to measurement variability. This relatively small sample size also restricts the ability to apply the results to other patients and larger, prospective, multicentric studies are needed to confirm the predictive value of GB wall thickness in laparoscopic cholecystectomy.

Conclusion

Laparoscopic cholecystectomy is the gold standard treatment worldwide for calculous and acalculous cholecystitis. We graded the gall bladder wall thickness (Grade I to Grade IV) and found that patients having grade III and grade IV thickness have increased conversions, complications and increased post op hospital stay. With increasing wall thickness the conversion to open rates are high. This information is important in preoperative risk assessment and in setting reasonable postoperative results. It can be used as a guide in obtaining informed consent. Thus, gallbladder wall thickness is one of the important guideline in the preoperative risk assessment for the surgeon and will help avoid complications and to convert to open if required. So the surgeon should keep in mind that a patient with Grade III or Grade IV thickness may require conversion from Laparoscopic to Open cholecystectomy.

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Conflicts of interest

There are no conflicts of interest.

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