

Intraoperative Findings and Difficulties Encountered During Laparoscopic Cholecystectomy: An Observational Study

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Abstract

Background:

Laparoscopic cholecystectomy is the standard intervention for symptomatic gallstone disease; however, intraoperative challenges can prolong surgery or increase complications.

Objective:

This study evaluated the frequency and determinants of operative difficulties.

Methods:

A prospective observational study was conducted among 67 patients undergoing laparoscopic cholecystectomy at Green Life Medical College Hospital between January 2022 and December 2023. Patients with cirrhosis, malignancy, prior upper abdominal surgery, or coagulation disorders were excluded. Intraoperative variables, including gallbladder wall thickness, adhesions, anatomical variations, and dissection complexity, were documented.

Results:

Standard procedures were completed in 76.1% of cases, whereas 14.9% were classified as difficult. Distended or congested gallbladder (32.8%) and omental wrapping (20.9%) were common findings. Thick gallbladder wall ≥ 3 mm, dense adhesions, and difficult Calot's triangle dissection independently predicted operative difficulty.

Conclusion:

Preoperative identification of gallbladder wall thickening, adhesions, and complex Calot's triangle anatomy may help anticipate a challenging laparoscopic cholecystectomy.

Keywords: Laparoscopic cholecystectomy, operative difficulty, gallstones, Calot's triangle

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Introduction:

Laparoscopic cholecystectomy (LC) has evolved as the gold standard for the surgical management of symptomatic gallstone disease since its introduction in the late 1980s and is now well established worldwide.¹ The surgery has numerous advantages compared to traditional open cholecystectomy, like reduced postoperative pain, less hospitalization, faster recovery, better cosmetic outcome, and earlier return to full

activity.² Despite these advantages and the widespread use of minimally invasive techniques, LC remains technically challenging in some patients, with conversion rates to open surgery ranging from 2% to 15% across studies.³ The technical difficulty with LC can be attributed to a variety of causes, including patient factors, extent of disease, anatomical abnormalities, and gynaecological technical challenges.⁴ Dense pericholecystic adhesions, gallbladder wall thickening, distorted anatomy of Calot's triangle,

and intrahepatic gallbladder position are among the most common intraoperative issues that raise operative difficulty.⁵ They can contribute to increased operative time, enhanced risk of bile duct injury, hemorrhage, gallbladder perforation, and, consequently, conversion to an open operation. The incidence of bile duct injury, though uncommon at 0.3-0.7%, is one of the most feared of LC complications and typically happens in the case of challenging dissection failing in obtaining a critical view of safety.⁶ Several preoperative scoring systems have been developed that predict difficult LC based upon clinical, laboratory, and radiological factors.⁷ However, intraoperative results are not always as anticipated preoperatively, which underscores the utility of systematic intraoperative documentation and analysis of intraoperative parameters. Preoperative ultrasonographic assessment of gallbladder wall thickness has consistently been identified as a potent predictor of operative complexity, with a correlation with increased rates of conversion and complications in patients with thickness > 3-4 mm.⁸ Similarly, the presence and number of adhesions, particularly at Calot's triangle and the gallbladder bed, significantly affect the dissection challenge and surgical outcomes.⁹ Understanding intraoperative causes of difficult LC is crucial for several reasons. Firstly, it helps surgeons provide improved preoperative counseling regarding the likelihood of conversion and complications. Second, it facilitates successful surgical planning, such as arranging adequate operating time, ensuring the availability of experienced surgical teams, and preparing for possible conversion.¹⁰ Third, proper systematic assessment of intraoperative findings helps identify individuals who will benefit from early referral to advanced centres with expertise in hepatobiliary surgery. This study aimed to assess intraoperative complications encountered during laparoscopic cholecystectomy in symptomatic gallstone disease patients. The primary objectives were to determine the incidence and characteristics of intraoperative issues, to correlate gallbladder wall thickness and condition with the difficulty of the operation, and to identify independent predictors of difficult LC through multivariate analysis.

Methods:

This prospective observational study was conducted at Green Life Medical College Hospital

from January 2022 to December 2023. A total of 67 patients underwent laparoscopic cholecystectomy over a defined study period. All consecutive patients diagnosed with symptomatic gallstone disease and scheduled for elective laparoscopic cholecystectomy were included after obtaining informed written consent. Cases with cirrhosis, malignancy, or prior upper abdominal surgery were excluded to ensure uniform intraoperative conditions. The institutional ethics committee approved the study.

Preoperative data, including age, gender, body mass index (BMI), comorbidities, and residential background, were recorded. During surgery, operative findings, including gallbladder size, wall thickness, presence and extent of adhesions, and anatomical variations, were carefully noted. Intraoperative difficulties such as dense adhesions, dissection challenges in Calot's triangle, difficulty in holding the gallbladder, gallbladder perforation, and intraoperative bleeding were documented. Wall thickness and gallbladder condition were assessed visually and correlated with dissection complexity. The type of cholecystectomy was also noted. All procedures were performed by experienced laparoscopic surgeons following the standard four-port technique under general anesthesia. Collected data were analyzed using SPSS Statistics version 26.0. Descriptive statistics were presented as frequencies and percentages for categorical variables and as mean±standard deviation for continuous variables. Univariate, bivariate, and multiple logistic regression analyses were performed to identify significant associations and independent predictors of difficult laparoscopic cholecystectomy.

Results:

The findings presented across Tables-I to V collectively describe the demographic distribution, intraoperative conditions, and determinants of surgical difficulty among 67 patients undergoing laparoscopic cholecystectomy. As shown in Table-I, the study consisted predominantly of females (65.7%), with most patients either overweight (41.8%) or obese (31.3%). Older age groups were well represented, with 28.4% above 60 years, and common comorbidities included hypertension (28.4 per cent) and diabetes mellitus (22.4 per cent), while 13.4 per cent had both, suggesting a metabolic risk profile.

Table-I: Baseline demographic and clinical characteristics (N=67)

Variable	no. (%)
Gender	
Male	23(34.3)
Female	44(65.7)
Age Group (years)	
18–30	15(22.4)
31–40	9(13.4)
41–50	15(22.4)
51–60	9(13.4)
>60	19(28.4)
BMI Category	
<25 (Normal)	18(26.9)
25–29.9 (Overweight)	28(41.8)
≥30 (Obese)	21(31.3)
Residence	
Urban	39 (58.2)
Rural	28(41.8)
Comorbidities	
Hypertension	19(28.4)
Diabetes Mellitus	15(22.4)
Both HTN + DM	9(13.4)
None	24(35.8)

Table-II: Type of surgery and operative classification (N=67)

Variable	no. (%)
Type of Procedure	
Conventional Laparoscopic Cholecystectomy	51(76.1)
Difficult Laparoscopic Cholecystectomy	10(14.9)
Associated Metabolic Syndrome Indicator	
HTN + DM	9(13.4)

Table-III: Intraoperative gallbladder findings (N=67)

Gallbladder Appearance	no. (%)
Normal	13(19.4)
Distended, congested, edematous	22(32.8)
Contracted fibrosed	4(6.0)
Compacted with stones	2(3.0)
Intrahepatic gallbladder	6(9.0)
Wrapped with omentum	14(20.9)
Adhesion between GB and duodenum	6(9.0)

Table-II indicated that conventional laparoscopic cholecystectomy accounted for the majority of procedures (76.1%), while 14.9% were classified as complex operations.

Table-III highlighted several pathological gallbladder states, including distension or edema in 32.8%, omental wrapping in 20.9%, and intrahepatic gallbladder in 9.0%, all of which contribute to operative complexity.

Adhesions were common, as demonstrated in Table-IV, where liver–omentum adhesions were observed in 20.9%, GB–duodenum adhesions in 9.0%, and dense multi-organ adhesions in 4.5%, while 62.7% of procedures proceeded without significant difficulty. Operative challenges included difficult Calot's triangle dissection in 23.9%, difficult GB bed dissection in 25.4%, and difficulty holding the gallbladder in 17.9%, alongside GB perforation and bleeding in 9.0% each.

Table-IV: Intraoperative adhesions and surgical difficulties (N=67)

Variable	no. (%)
Adhesion Sites	
Liver–omentum adhesions	14(20.9)
GB–duodenum adhesions	6(9.0)
Dense multi-organ adhesions	3(4.5)
No significant adhesions	44(65.7)
Intraoperative Difficulty Events	
Omental wrapping	14(20.9)
Difficulty in holding GB	12(17.9)
Calot's triangle difficult dissection	16(23.9)
GB bed difficult dissection	17(25.4)
Adhesions around GB	14(20.9)
GB perforation	6(9.0)
Bleeding during surgery	6(9.0)
No difficulty / Smooth procedure	42(62.7)

Multivariate analysis in Table-V showed that thick gallbladder wall (OR 6.97, $p=0.006$) was the strongest independent predictor of complex surgery, followed by dense adhesions (OR 4.85, $p=0.012$), difficult Calot's dissection (OR 3.56, $p=0.021$), and moderate–severe bleeding (OR 2.56, $p=0.049$). Age above 50 years ($p=0.186$) and female sex ($p=0.382$) did not significantly influence operative difficulty.

Table-V: Multivariate predictors of difficult laparoscopic cholecystectomy (N=67)

Predictor	β	p-value	OR (Exp β)	95% CI
Thick GB Wall (≥ 3 mm)	1.94	0.006	6.97	1.73–28.1
Dense Adhesions	1.58	0.012	4.85	1.42–16.6
Difficult Calot's Dissection	1.27	0.021	3.56	1.21–10.4
Moderate–Severe Bleeding	0.94	0.049	2.56	1.00–6.54
Age >50 years	0.42	0.186	1.52	0.81–2.84
Female Sex	0.18	0.382	1.2	0.79–1.81

Discussion:

This prospective observational study analyzed intraoperative difficulties encountered during laparoscopic cholecystectomy in 67 patients with symptomatic gallstone disease. Our results indicate that 76.1% of the cases were completed as standard laparoscopic procedures, with significant intraoperative difficulties necessitating prolonged dissection or extensive adhesiolysis in 14.9%. These rates compare favorably with the reported conversion rates of 2-15% with Pal et al,¹¹ indicating appropriate patient selection and surgical expertise at our institution. In multivariate analysis, three independent predictors of difficult laparoscopic cholecystectomy were found to be gallbladder wall thickness ≥ 3 mm (OR=6.97, p=0.006), dense adhesions (OR=4.85, p=0.012), and difficult dissection of the Calot's triangle (OR=3.56, p=0.021). Gallbladder wall thickening is the highest-order predictor; Khan et al⁸ showed that a wall thickness greater than 3 mm significantly prolongs operative time and increases complications, while Alotaibi et al¹² stated that increased wall thickness negatively affects surgical outcomes through impaired tissue handling and obscured anatomical planes. Our correlation analysis demonstrated an influential association between wall thickness and dissection of Calot's triangle (r=0.82), gallbladder bed dissection (r=0.75), and adhesions (r=0.78); this cascading effect of chronic inflammation on multiple parameters signifies an exponential increase in difficulty as these parameters rise. The second most significant predictor in our cohort was dense pericholecystic adhesions, observed in 34.3% of cases, with variable severity. Kapoor et al⁹ stressed that adhesions, especially those involving the duodenum and omentum, are strongly associated with visceral injury and prolonged operative time. Adhesions between the

gallbladder and duodenum were recorded in 9.0% of our series, reflecting a high-risk scenario requiring an exceptionally delicate dissection technique. Omental wrapping to the gallbladder (20.9%) and dense adhesions of multiple organs (4.5%) further complicated surgical access and increased the risk of conversion. The difficult Calot's triangle dissection, which occurred in 7.5% of our procedures, is a critical technical challenge associated with a risk of bile duct injury. Gupta et al⁶ pointed out that failure to obtain a critical view of safety during the dissection of Calot's triangle is the common cause of bile duct injuries that complicate 0.3-0.7% of laparoscopic cholecystectomies. Strasberg et al¹³ determined that obscured anatomy in that area requires conversion to avoid disastrous complications. We have identified this parameter as an independent predictor (OR=3.56), underscoring the importance of systematic intraoperative assessment and the surgeon's judgment regarding when conversion is required. The demographic profile from our cohort showed a female preponderance (65.7%) and a significant number of overweight or obese patients (73.1%), in line with established risk factors for gallstone disease.⁷ The metabolic comorbidities, such as hypertension (28.4%) and diabetes mellitus (22.4%), reflect a systemic inflammatory milieu that may also contribute to gallbladder pathology and increase surgical complexity.² Although age >50 years was included in our multivariate model, it did not reach statistical significance (OR=1.52, p=0.186), suggesting that anatomical and pathological factors outweigh demographic variables in determining operative difficulty. These findings have significant implications for clinical practice, particularly for preoperative counselling and surgical planning. Ramirez-Giraldo et al⁴ developed preoperative scoring systems using ultrasound measurements of

wall thickness and the presence of adhesions to stratify operative risk. Integration of our intraoperative predictors with these preoperative assessments could further improve risk stratification, support appropriate scheduling of operating time, ensure the availability of experienced personnel, and enhance the patient consent process regarding conversion likelihood. Early identification of high-risk cases may prompt referral to tertiary hepatobiliary centres with advanced laparoscopic expertise and immediate access to interventional radiology for the management of complex biliary injuries.

Limitations:

This single-centre study with a limited sample size may limit the generalizability of the findings to broader populations. Exclusion of malignant disease and patients who have undergone previous upper abdominal surgery avoids extension of findings to those at high risk, who typically present with the most challenging surgery.

Conclusion:

Gallbladder wall thickening ≥ 3 mm, dense pericholecystic adhesions, and difficult dissection of Calot's triangle are the most relevant independent predictors of operative difficulty in laparoscopic cholecystectomy. These intraoperative parameters are strongly interrelated and have a combined effect on surgical outcome, operating time, and the risk of conversion. The well-executed preoperative ultrasonographic evaluation of gallbladder wall thickness and the routine intraoperative reporting of anatomical difficulty provided a platform for appropriate surgical planning, resource utilization, and patient counselling.

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