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Original Article

Prevalence and Predictors of Difficult Laparoscopic Cholecystectomy in a Tertiary Care Hospital: A Cross-Sectional Study

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A B S T R A C T

Background: For the treatment of symptomatic gallstone disease, laparoscopic cholecystectomy (LC) is considered to be ideal. Nonetheless, a small group of cases cannot be easily overcome because of a number of patient- and disease-related factors. Proper forecasting of these challenging cases is very imperative towards planning surgery, reducing complications and maximizing results particularly in the resource poor settings.

Objective: To identify the prevalence and predictors of hard laparoscopic cholecystectomy in a tertiary care hospital at Pakistan.

Methodology: It is a three-month cross sectional observational study that involved 150 adult patients who had laparoscopic cholecystectomy. The patients with gallbladder malignancy, severe coagulopathy, primary open cholecystectomy, or any incomplete intraoperative information were excluded. Information was gathered in a prospective manner through a structured exercise that is a questionnaire. Operative criteria used to define the difficulty LC were that operative time exceeded 90 minutes, that the surgery was converted to an open surgery, significant hemorrhage (>100 mL), extreme adhesions, poor visibility of Calot triple anatomy, or subtotal cholecystectomy. Univariate and multivariate logistic regression in SPSS was used as a statistical analysis.

Results: The rate of tough LC was 28 percent. The independent predictors were the gallbladder wall greater than 4 mm thick (OR 3.1; 95% CI: 1.530 6.22; p=0.002), previous history of acute cholecystitis (OR 2.7; 95% CI: 1.310 5.88; p= 0.006), BMI greater than 30 kg/m 2 (OR 2.2; 95% CI: 1.049 In 12.7 percent of patients, postoperative events were related to complications; the wound infection and bile leak are most often identified.

Conclusion: Difficult LC was present in above quarter of the cases. Wall thickness of the gallbladder greater than 4 mm, a history of prior acute cholecystitis, obesity and harsh adhesions were powerful independent predictors. With the identification of such risk factors antecedent to surgery, it is possible to prepare surgery and educate the patient to better perioperative outcomes.

Keywords: Laparoscopic cholecystectomy, difficult cholecystectomy, predictors, gallbladder wall thickness, adhesions, BMI, surgical risk stratification

Introduction

Laparoscopic cholecystectomy (LC) has become the gold standard for treating symptomatic gallstone disease due to its minimally invasive nature, shorter recovery time, and reduced postoperative complications compared to open cholecystectomy[1–3]. However, despite its widespread adoption and technological advancements, LC can present considerable intraoperative challenges, leading to conversion to open surgery, increased operative time, or complications[4–6]. Identifying predictors of difficult LC is essential for surgical planning, patient counseling, and minimizing morbidity. Factors associated with difficult LC include acute cholecystitis, male gender, obesity, previous abdominal surgery, and a thickened gallbladder wall as visualized on ultrasonography[7–9].

Inflammatory processes such as empyema or gangrenous cholecystitis may obscure anatomical landmarks, increasing the risk of bile duct injury[10].

Preoperative imaging and biochemical markers like leukocytosis or elevated C-reactive protein (CRP) have also been proposed as potential predictors of surgical difficulty[11,12]. In resource-limited settings like many tertiary care hospitals in South Asia, the ability to anticipate a difficult LC is even more critical to prevent complications and reduce the rate of conversion to

open procedures[13]. Surgeons must be equipped with reliable preoperative assessment tools and clinical predictors to optimize surgical outcomes and allocate experienced personnel for anticipated complex cases[14]. This study aims to identify and evaluate the predictors of difficult laparoscopic cholecystectomy in a tertiary care hospital, to aid in the refinement of preoperative risk assessment and enhance surgical safety and efficiency.

Methodology

This cross-sectional observational study was conducted to assess the prevalence and predictors of difficult laparoscopic cholecystectomy in patients undergoing surgery for gallstone-related diseases. The study was carried out in a tertiary care hospital Islamabad over a period of three months. All patients aged 18 years and above undergoing either elective or emergency laparoscopic cholecystectomy for symptomatic gallstone disease, acute cholecystitis, gallstone pancreatitis, or biliary colic during the study period were included after obtaining informed written consent. Patients with preoperative diagnosis of gallbladder malignancy, severe coagulopathy despite correction, those undergoing primary open cholecystectomy, and those with missing or incomplete intraoperative data were excluded. The sample size was calculated using Cochran's formula based on an anticipated prevalence of difficult laparoscopic cholecystectomy of 17.4 %, with a 95% confidence interval, 5% margin of error total population in three months undergoing this surgery is 380, yielding a minimum sample size of 150. Data were collected prospectively using a structured questionnaire filled by the operating surgeon or surgical resident, capturing detailed information regarding patient demographics, clinical history, laboratory investigations, radiological findings, intraoperative factors, and postoperative outcomes. The definition of difficult laparoscopic cholecystectomy was based on objective intraoperative criteria, including prolonged operative time beyond 90 minutes, conversion to open surgery, excessive bleeding over 100 mL, severe adhesions necessitating extensive dissection, difficulty in identifying Calot's triangle, intraoperative bile duct or vascular injury, and subtotal cholecystectomy performed due to unclear anatomy.

Data collected included variables such as age, gender, BMI, comorbidities, history of acute cholecystitis, biliary colic, gallstone pancreatitis, previous abdominal surgery, prior ERCP, preoperative laboratory parameters including total leukocyte count and liver function tests, as well as radiological findings such as gallbladder wall thickness, pericholecystic fluid, impacted stones, and CBD dilatation. Intraoperative findings detailed adhesion severity, ease of Calot's triangle dissection, bile spillage, perforation, blood loss, need for conversion to open surgery, intraoperative injuries, and performance of subtotal cholecystectomy. Postoperative outcomes recorded included complications such as bile leak, wound infection, prolonged hospital stay, and total duration of hospitalization. Data were analyzed using SPSS version [XX] with descriptive statistics presented as means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Inferential statistics included chi-square tests for categorical comparisons between difficult and non-difficult cases, independent t-tests or Mann-Whitney U tests for continuous variables, and multivariate logistic regression to identify independent predictors of difficult laparoscopic cholecystectomy. Statistical significance was considered at a p-value of less than 0.05. Ethical approval for the study was obtained from the Institutional Review Board of [Hospital Name], and confidentiality was maintained through the use of anonymous identifiers. The study adhered to ethical standards with no additional risk imposed on participants as it was purely observational in nature.

Results

A total of 150 patients undergoing laparoscopic cholecystectomy were included in the final analysis. The mean age of the patients was 45.6 ± 12.3 years, with a range between 19 and 76 years. Out of the total, 102 patients (68%) were female and 48 patients (32%) were male. The mean BMI was 28.2 ± 4.1 kg/m².

Comorbidities were present in 82 patients (54.7%), with hypertension being the most common, observed in 42 patients (28%), followed by diabetes mellitus in 31 patients (20.7%) and chronic liver disease in 9 patients (6%). A history of previous acute cholecystitis was documented in 56 patients (37.3%), biliary colic in 102 patients (68%), gallstone pancreatitis in 18 patients (12%), and previous abdominal surgery in 31 patients (20.7%). Prior ERCP had been performed in 12 patients (8%). Regarding preoperative laboratory investigations, the mean total leukocyte count was 10.5 ± 3.2 $\times 10^9$/L, while liver function tests showed mild abnormalities in 29 patients (19.3%). Radiological findings revealed gallbladder wall thickening greater than 4 mm in 46 patients (30.7%), pericholecystic fluid in 21 patients (14%), impacted gallstones at the neck in 35 patients (23.3%), and common bile duct dilatation in 19 patients (12.7%). Intraoperatively, adhesions were present in 82 patients (54.7%), categorized as mild in 33 patients (22%), moderate in 29 patients (19.3%), and severe in 20 patients (13.3%). Difficulty in Calot's triangle dissection was reported as easy in 72 cases (48%), moderate in 46 cases (30.7%), and difficult in 32 cases (21.3%). Bile spillage occurred in 42 patients (28%), gallbladder perforation in 30 patients (20%), and bleeding exceeding 100 mL in 18 cases (12%). The mean

operative time was 76.4 ± 21.8 minutes, with prolonged operative time greater than 90 minutes documented in 38 patients (25.3%). Conversion to open surgery occurred in 11 patients (7.3%), predominantly due to dense adhesions in six cases and unclear anatomy at Calot's triangle in five cases. Subtotal cholecystectomy was performed in seven cases (4.7%). Intraoperative injury was observed in three patients (2%), all of which were minor bile leaks managed intraoperatively; no vascular injuries were reported.

Table I: Baseline Demographics and Clinical Characteristics of Patients (n=150)	
Variable	n (%) or Mean ± SD
Age (years)	45.6 ± 12.3
Gender (Male/Female)	48 (32%) / 102 (68%)
BMI (kg/m²)	28.2 ± 4.1
Comorbidities	
- Hypertension	42 (28%)
- Diabetes Mellitus	31 (20.7%)
- Chronic Liver Disease	9 (6%)
History of Acute Cholecystitis	56 (37.3%)
History of Biliary Colic	102 (68%)
History of Gallstone Pancreatitis	18 (12%)
Previous Abdominal Surgery	31 (20.7%)
Prior ERCP	12 (8%)

According to the operational definition, difficult laparoscopic cholecystectomy was identified in 42 patients (28%). This included patients with prolonged operative time, conversion to open surgery, severe adhesions, or other intraoperative complications as defined. Postoperatively, the mean hospital stay was 2.9 ± 1.4 days. Prolonged hospital stay beyond three days was observed in 34 patients (22.7%). Postoperative complications occurred in 19 patients (12.7%), which included wound infection in nine patients (6%), bile leak in four patients (2.7%), and other minor complications in six patients (4%). On univariate analysis, difficult laparoscopic cholecystectomy was significantly associated with age greater than 50 years (p=0.02), BMI over 30 kg/m² (p=0.03), history of acute cholecystitis (p=0.01), previous abdominal surgery (p=0.04), gallbladder wall thickness greater than 4 mm (p=0.003), and the presence of severe adhesions (p<0.001). Multivariate logistic regression analysis identified gallbladder wall thickness greater than 4 mm, history of acute cholecystitis, severe adhesions, and BMI over 30 kg/m² as independent predictors of difficult laparoscopic cholecystectomy. Gallbladder wall thickness greater than 4 mm had an odds ratio of 3.1 with a 95% confidence interval of 1.5 to 6.2 (p=0.002). History of acute cholecystitis had an odds ratio of 2.7 with a 95% confidence interval of 1.3 to 5.8 (p=0.006). Severe adhesions had an odds ratio of 4.5 with a 95% confidence interval of 2.0 to 10.1 (p<0.001). BMI over 30 kg/m² had an odds ratio of 2.2 with a 95% confidence interval of 1.05 to 4.6 (p=0.038). These predictors remained statistically significant after adjusting for other confounding variables such as age and gender.

Table II: Intraoperative and Postoperative Findings	
Variable	n (%) or Mean ± SD
Operative Time (minutes)	76.4 ± 21.8
Adhesions	
- Mild	33 (22%)
- Moderate	29 (19.3%)
- Severe	20 (13.3%)
Difficulty in Calot's Triangle	
- Easy	72 (48%)
- Moderate	46 (30.7%)
- Difficult	32 (21.3%)
Bile Spillage	42 (28%)
Gallbladder Perforation	30 (20%)
Blood Loss >100 mL	18 (12%)
Conversion to Open Surgery	11 (7.3%)
Subtotal Cholecystectomy	7 (4.7%)
Intraoperative Injury	3 (2%)
Difficult LC (as defined)	42 (28%)
Postoperative Complications	19 (12.7%)
- Wound Infection	9 (6%)
- Bile Leak	4 (2.7%)
Hospital Stay (days)	2.9 ± 1.4

Table III: Predictors of Difficult Laparoscopic Cholecystectomy (Univariate and Multivariate Analysis)			
Variable	Univariate p-value	Multivariate OR (95% CI)	Multivariate p-value
Age >50 years	0.02	—	—
BMI >30 kg/m²	0.03	2.2 (1.05–4.6)	0.038
History of Acute Cholecystitis	0.01	2.7 (1.3–5.8)	0.006
Previous Abdominal Surgery	0.04	—	—
Gallbladder Wall Thickness >4mm	0.003	3.1 (1.5–6.2)	0.002
Severe Adhesions	<0.001	4.5 (2.0–10.1)	<0.001

Discussion

In this study, we observed that difficult laparoscopic cholecystectomy (LC) was encountered in approximately 28% of cases, which aligns with the reported prevalence ranging between 15% and 35% in previously published literature on laparoscopic cholecystectomy outcomes in symptomatic gallstone

disease and acute cholecystitis populations[15] [16]. The predictors identified in our analysis, gallbladder wall thickness greater than 4 mm, prior history of acute cholecystitis, BMI above 30 kg/m², and severe adhesions, are consistent with previously established risk factors and reaffirm their significance in preoperative surgical planning[17] [18]. Our findings reinforce the clinical relevance of preoperative ultrasound findings, particularly gallbladder wall thickness, as a robust predictor of operative difficulty. Several studies have emphasized that a thickened gallbladder wall, often indicative of chronic inflammation, correlates with increased intraoperative complexity, risk of conversion to open surgery, and extended operative time[19] [20].

Additionally, patients with a history of acute cholecystitis were more likely to experience difficult dissection due to fibrotic adhesions and distorted anatomy, a finding corroborated by a recent meta-analysis[21]. Obesity has also been consistently linked to technical challenges in laparoscopic surgery. Our observation that patients with a BMI >30 kg/m² were more likely to have a difficult LC is supported by previous studies which have shown increased operative time, higher conversion rates, and greater complication risks in obese populations undergoing laparoscopic cholecystectomy[22] [23]. This association likely results from increased intra-abdominal fat, which compromises visualization and dissection, particularly in Calot's triangle.The presence of severe adhesions was another significant predictor identified in our study. Adhesions, whether from prior surgery or recurrent inflammation, are known to increase operative difficulty, conversion rates, and intraoperative complications, as demonstrated in multiple surgical series[24] [25]. In our cohort, adhesions not only contributed to prolonged operative time but were also the leading cause for conversion to open surgery. Intraoperative findings such as bile spillage and gallbladder perforation, although relatively frequent, did not independently predict difficult LC in multivariate analysis but were more commonly observed in those cases classified as difficult, echoing previous reports suggesting these are consequences rather than predictors of difficulty[26]. Our postoperative outcomes, including a 12.7% overall complication rate and 7.3% conversion rate, are comparable to internationally reported figures for similar surgical populations[27]. The wound infection and bile leak rates remained within expected ranges, further validating the reproducibility of our results with current surgical literature[28] [29]. This study contributes to the existing body of evidence by reaffirming key predictors in a local population and highlights the importance of preoperative risk stratification to aid in operative planning, surgeon preparedness, and patient counseling.

Conclusion

Difficult laparoscopic cholecystectomy was observed in 28% of cases in this study and was independently associated with gallbladder wall thickness >4 mm, history of acute cholecystitis, severe adhesions, and BMI >30 kg/m². These predictors can be identified preoperatively in most cases, allowing surgeons to anticipate technical challenges, allocate resources appropriately, and improve perioperative risk communication with patients.

Limitations: This was a single-center study conducted over a short duration, which may limit the generalizability of the findings. Surgeon experience and intraoperative decision-making could have introduced variability in defining surgical difficulty. Additionally, some predictors such as gallbladder wall thickness rely on operator-dependent ultrasound findings, which may lead to inter-observer bias.
Recommendations: Future studies should include larger, multi-center cohorts with standardized operative protocols to validate these predictors. Preoperative risk stratification tools incorporating clinical, radiological, and laboratory factors should be developed to assist surgeons. Training programs should emphasize strategies for managing high-risk laparoscopic cholecystectomy cases to minimize complications.

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