



Research Article

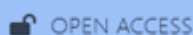
Preoperative C-Reactive Protein as a Predictor of Difficult Laparoscopic Cholecystectomy: A Prospective Observational Analysis

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the gold standard for the treatment of symptomatic cholelithiasis. However, a subset of patients experience difficult laparoscopic cholecystectomy (DLC), which increases operative time, risk of complications, and likelihood of conversion to open surgery. Identifying clinical, sonological, and intraoperative predictors is essential for improving surgical outcomes.

Aim: To evaluate the clinical, sonological, and intraoperative predictors of difficult laparoscopic cholecystectomy in patients with cholelithiasis.

Methods: A prospective observational study was conducted on 148 patients undergoing LC at RNT Medical College and MB Hospital, Udaipur, from February 2024 to July 2025. Detailed clinical history, laboratory parameters including serum C-reactive protein (CRP), and ultrasonography findings were recorded. Intraoperative parameters such as gallbladder appearance, adhesions, bile/stone spillage, and duct/artery injury were assessed. Difficult LC was defined as operative time >60 minutes, significant bleeding, dense adhesions, difficult dissection of Calot's triangle, or conversion to open surgery.

Results: The mean age of patients was 45.5 years, with female predominance (75%). The most common symptom was abdominal pain (60%). Elevated CRP was significantly associated with operative difficulty, with mean CRP values rising from simple LC (22 mg/dl) to difficult LC (46 mg/dl) and converted cases (83 mg/dl). On ultrasonography, pericholecystic collection (31.7%), gallbladder wall thickening (24.3%), and impacted stones (10.1%) were common predictors. Intraoperatively, abnormal gallbladder appearance (43.9%) and pericholecystic adhesions (25%) were the main challenges. Difficult LC accounted for 21.6% of cases, while 4.7% required conversion to open surgery.

Conclusion: Serum CRP levels, ultrasonographic findings (gallbladder wall thickening, pericholecystic collection, impacted stones), and intraoperative parameters (adhesions, abnormal gallbladder appearance) are reliable predictors of difficult laparoscopic cholecystectomy. Incorporating these predictors into preoperative assessment may enhance risk stratification, surgical planning, and patient safety.

Keywords: Laparoscopic cholecystectomy, Difficult cholecystectomy, Cholelithiasis, C-reactive protein (CRP).

INTRODUCTION

Cholelithiasis is one of the most prevalent biliary tract diseases worldwide and remains a common indication for surgical intervention. Laparoscopic cholecystectomy (LC), first introduced in the late 1980s, has now become the gold standard for treating symptomatic gallstone disease due to its minimally invasive nature, shorter hospital stay, faster recovery, and

reduced postoperative pain compared with open surgery [1,2]. Despite these advantages, a subset of patients present with “difficult laparoscopic cholecystectomy” (DLC), which is associated with increased operative time, higher conversion rates to open cholecystectomy, and increased risk of complications [3,4].

Predicting the difficulty of LC preoperatively or early intraoperatively is crucial for surgical planning, patient counseling, and reducing morbidity. Several factors have been implicated in increasing operative difficulty, including demographic variables (age, male sex, obesity), clinical presentation (recurrent attacks of cholecystitis, prior hospitalizations), sonological features (gallbladder wall thickening, pericholecystic collection, impacted stones), and intraoperative findings (dense adhesions, altered Calot’s anatomy) [5–7]. Ultrasonography (USG), being cost-effective and widely available, provides valuable insights into gallbladder pathology, while intraoperative findings remain the definitive determinant of surgical complexity [8].

Conversion to open cholecystectomy, though less common today, is still required in difficult cases to ensure patient safety. Reported conversion rates vary from 2% to 15%, depending on patient characteristics and institutional experience [9]. Recognizing predictors of difficulty in LC not only allows better preparedness for the surgical team but also helps in timely decision-making regarding conversion, thereby reducing operative complications such as bile duct injury. The present study was designed to identify and evaluate the clinical, sonological, and Intraoperative predictors of difficult laparoscopic cholecystectomy in patients undergoing surgery for cholelithiasis. By analyzing these predictors systematically, the study aims to improve preoperative risk stratification and optimize surgical outcomes.

MATERIALS AND METHODS

Study Design and Setting:

This was a prospective cross-sectional observational study conducted in the Department of General Surgery, RNT Medical College and MB Hospital, Udaipur, Rajasthan. The study was carried out after obtaining approval from the Institutional Ethical Committee and written informed consent from all participants.

Study Population and Duration:

All consecutive patients admitted with a diagnosis of cholelithiasis and scheduled for laparoscopic cholecystectomy between **February 2024 and July 2025** were considered for inclusion.

Sample Size:

A sample size of **148 patients** was calculated using the formula for estimating a single proportion:

Assumption: variable must be categorical.

Formula: $n = (Z_{1-\alpha/2})^2 (100-P) P/d^2$

Where $(Z_{1-\alpha/2}) = 1.96$ (2 tailed and 5% α error)

P= proportion of difficult Laparoscopic Cholecystectomy having CRP value $>22\text{mg/L} = 78\%$

(In previous study by Kaushik B et al. Int. Surg J 2018) d= Relative precision 10% of 78%

Inclusion Criteria

- All patients clinically, serologically, and radiologically diagnosed with calculus cholecystitis (cholelithiasis).
- Patients willing to undergo laparoscopic cholecystectomy.

Exclusion Criteria

- Acute cholangitis.
- Acute appendicitis.
- Acute pancreatitis.
- Other systemic inflammatory conditions (e.g., inflammatory bowel disease).

Data Collection:

A detailed clinical history and physical examination were performed for all patients. Demographic data (age, sex), symptoms (pain abdomen, vomiting, dyspepsia, nausea), and previous hospitalizations were recorded. Preoperative blood samples were taken for routine laboratory tests, including liver function tests and serum C-reactive protein (CRP) levels. Radiological evaluation was done using ultrasonography (USG) and, when indicated, magnetic resonance cholangiopancreatography (MRCP).

Sonological Parameters Assessed

- Gallbladder wall thickness (>4 mm considered significant).
- Presence of pericholecystic fluid collection.
- Impacted gallstones at the neck or cystic duct.

Surgical Procedure and Intraoperative Assessment

All laparoscopic cholecystectomies were performed by consultants with at least three years of laparoscopic experience,

or by residents under direct supervision. Operative findings including gallbladder appearance (distended, inflamed, contracted), presence of adhesions, bile/stone spillage, and duct/artery injury were documented.

Definition of Difficult Laparoscopic Cholecystectomy

- Operative time >60 minutes, and/or
- Significant bleeding, dense adhesions, difficult dissection of Calot's triangle, or need for conversion to open cholecystectomy.

Data Recording:

Preoperative risk scoring was done using standardized criteria based on clinical and sonological findings. Patients were categorized into easy, difficult, or very difficult LC groups.

Statistical Analysis:

Data were entered in Microsoft Excel 2010 and analyzed using SPSS version 16. Results were expressed as mean \pm standard deviation (SD) for continuous variables and as percentages for categorical variables. The chi-square test was applied for categorical data, and Student's t-test for continuous data. A p-value <0.05 was considered statistically significant.

RESULT

Demographic profile of study population

A total of 148 patients with cholelithiasis were included. The mean age was 45.5 years, with most patients in the 41–50 year age group (27.7%). Females predominated, accounting for 75% of cases (female-to-male ratio = 3:1).

Table 1: Demographic profile of study population (n = 148)

Variable	Category	No. of Patients	Percentage (%)
Age (years)	<30	24	16.21
	31–40	34	22.97
	41–50	41	27.7
	51–60	23	15.54
	>60	26	17.56
Gender	Female	111	75
	Male	37	25

The most common presenting complaint was **abdominal pain (60%)**, followed by vomiting (36%) and dyspepsia (31%). Shown in fig 1.

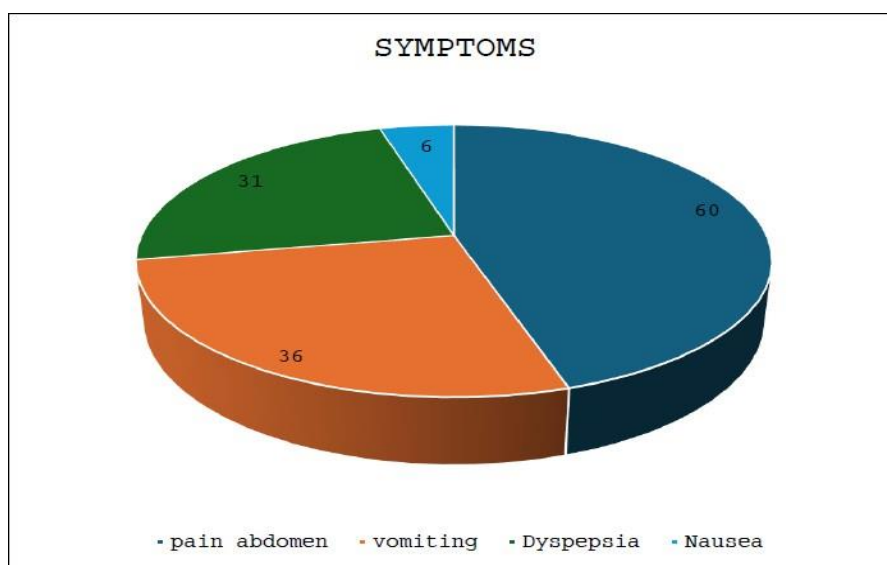


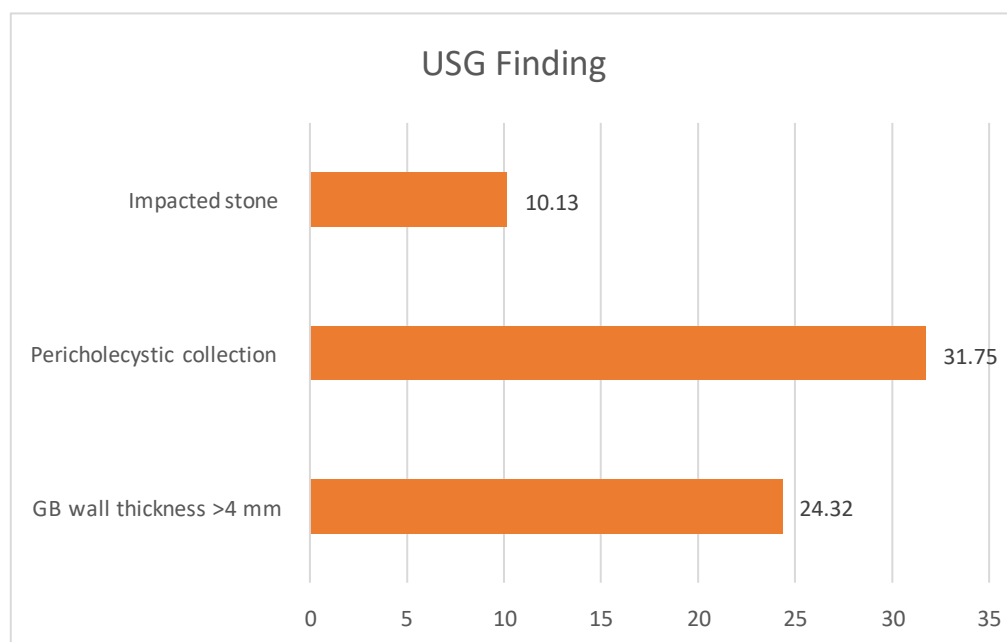
Fig1: Symptoms of patients with cholelithiasis

Serum CRP levels varied widely. More than half of patients (53.37%) had CRP <22 mg/dl, while 43.24% had CRP 22–83 mg/dl, and only 3.37% had CRP >83 mg/dl which is represent in table 2.

Table 2: CRP values among study population

CRP (mg/dl)	No. of Patients	Percentage (%)
<22	79	53.37
22–83	64	43.24
>83	5	3.37

On ultrasonography, **pericholecystic collection** was the most frequent finding (31.75%), followed by gallbladder wall thickening >4 mm (24.32%) and impacted stones (10.13%). Shown in fig 2.

**Fig2: USG findings among study population**

Operative Findings and Outcomes:

Intraoperative assessment showed that **abnormal gallbladder appearance** was the most common finding (65 cases), followed by **pericholecystic adhesions** (37 cases). Bile/stone spillage and duct/artery injury were rare (3 cases each).

Table 3: Intraoperative findings

Finding	No. of Cases	Percentage (%)
GB appearance abnormal	65	43.92
Pericholecystic adhesions	37	25
Bile/stone spillage	3	2.02
Duct/artery injury	3	2.02

Regarding **gallbladder appearance**, 56.08% were normal and distended, 25% were distended and inflamed, and 18.91% were contracted. Which is shown in table 4.

Table 4: Gallbladder appearance intraoperatively

Appearance	No. of Patients	Percentage (%)
Normal & distended	83	56.08
Distended & inflamed	37	25
Contracted	28	18.91

The **mean operative time** increased with the difficulty of surgery. Simple LC averaged 30.68 minutes, difficult LC 54.7 minutes, and conversion to open 84.28 minutes.

Table 5: Duration of surgery

Type of Surgery	Mean (minutes)	SD
Simple cholecystectomy (n=109)	30.68	7.7
Difficult cholecystectomy (n=32)	54.7	14.6

Conversion to open (n=7)	84.28	14.2
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Preoperative scoring classified 76.35% of cases as easy, 22.9% as difficult, and only 0.013% as very difficult.

Table 6: Preoperative scoring

Category	No. of Patients	Percentage (%)
Easy	113	76.35
Difficult	34	22.9
Very difficult	2	0.013

Overall, **73.64%** of patients underwent simple cholecystectomy, **21.63%** had difficult cholecystectomy, and **4.73%** required conversion to open surgery. Shown in fig 3

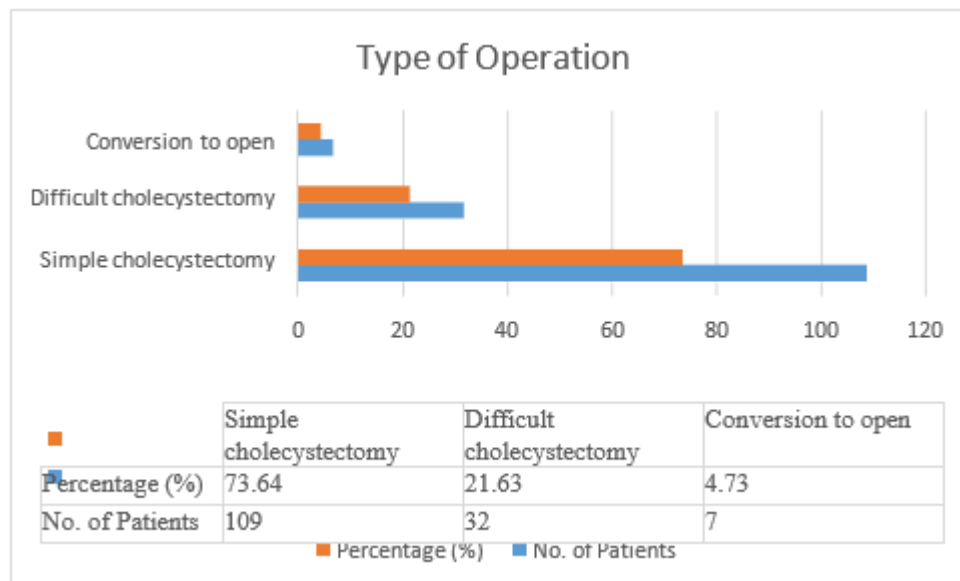


Fig 3: Type of operation

DISCUSSION

Laparoscopic cholecystectomy (LC) has become the gold standard treatment for symptomatic cholelithiasis, but a significant subset of patients continue to pose intraoperative challenges, often necessitating conversion to open surgery. In our study, 21.6% of patients underwent difficult LC and 4.7% required conversion to open, findings consistent with earlier reports that place conversion rates between 2% and 15% worldwide [11,12]. Identifying predictors of difficult LC remains essential for operative planning, improving patient safety, and reducing morbidity.

In the present series, female patients predominated (75%), reflecting the well-documented higher prevalence of gallstone disease in women due to hormonal and metabolic influences [13]. However, the presence of male sex has often been associated with more severe inflammation and a higher likelihood of difficult LC in other studies [14]. Our findings showed no significant correlation between gender and operative difficulty, suggesting that inflammatory changes and gallbladder pathology may outweigh gender differences in predicting surgical complexity.

Age has also been reported as a risk factor for difficult LC, with older patients often presenting with chronic inflammation, fibrosis, and adhesions [15]. In our study, the mean age was 45.5 years, and the highest proportion of difficult cases occurred in the 41–50 year group. While age itself was not a statistically significant predictor, our data support previous observations that patients with a longer history of gallstone disease tend to demonstrate greater operative difficulty.

Serum CRP levels showed a strong correlation with operative outcomes in our study. The mean CRP was 22 mg/dl in simple cases, 46 mg/dl in difficult cases, and 83 mg/dl in those converted to open surgery, with statistical significance ($p < 0.0003$). These findings align with the work of Kaushik et al., who demonstrated significantly higher CRP levels in difficult and converted cases [16]. Similarly, Mok et al. reported that CRP values >200 mg/dl had strong predictive value for gangrenous cholecystitis and operative difficulty [17]. The role of CRP as a cost-effective and reliable biochemical marker is thus reinforced by our study.

Sonological findings were also important predictors. Gallbladder wall thickening (>4 mm) and pericholecystic collection were observed in 24.3% and 31.7% of cases, respectively, and were significantly associated with intraoperative difficulty. These results are comparable with studies by Randhawa et al. and Agrawal et al., who emphasized the predictive value of USG findings in preoperative scoring systems [18,19]. Impacted stones at the neck or cystic duct, present in 10.1% of our patients, also contributed to distorted anatomy and prolonged operative time, corroborating earlier observations that impacted stones complicate dissection of Calot's triangle [20].

Intraoperatively, the most common challenges encountered were abnormal gallbladder appearance and adhesions, both of which significantly prolonged operative time. In our cohort, difficult LC averaged 54.7 minutes, nearly double the mean operative time of simple cases (30.6 minutes). Similar trends have been described in previous studies, where adhesions and fibrosis were among the strongest intraoperative predictors of conversion [21]. The presence of bile/stone spillage and ductal/arterial injury was low in our study (2%), reflecting the importance of surgeon experience and careful dissection in minimizing complications.

Our findings reaffirm the multifactorial nature of difficult LC. No single parameter can reliably predict difficulty, but a combination of clinical features, sonological parameters, and CRP levels provides a practical risk stratification strategy. Importantly, preoperative scoring based on these parameters in our study correctly anticipated difficulty in over 22% of cases, reinforcing the utility of such systems in surgical practice.

CONCLUSION

Laparoscopic cholecystectomy remains the gold standard for treating symptomatic cholelithiasis, yet a considerable proportion of cases are difficult and may require conversion to open surgery. In this prospective study, serum CRP levels, ultrasonographic findings (gallbladder wall thickening, pericholecystic collection, impacted stones), and intraoperative features (adhesions, abnormal gallbladder appearance) were found to be reliable predictors of surgical difficulty.

Preoperative risk assessment using a combination of clinical, biochemical, and imaging parameters allows better surgical planning, timely anticipation of technical challenges, and safer operative outcomes. Early recognition of high-risk patients may help in reducing operative time, minimizing complications, and guiding appropriate decision-making regarding conversion.

Our findings support the integration of these predictors into routine preoperative evaluation to optimize patient care and improve surgical outcomes in laparoscopic cholecystectomy.

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