Original Article

Clinico-Radiological Score for Predicting the Difficulty of Laparoscopic Cholecystectomy in Acute Calculous Cholecystitis

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Abstract

Background: Acute calculous cholecystitis is a common surgical condition for which early laparoscopic cholecystectomy is the standard treatment. However, operative difficulty varies widely and is often unpredictable, leading to increased complications and technical challenges. Accurate preoperative prediction of operative difficulty is essential for surgical planning, patient counseling, and optimizing outcomes. This study aimed to develop a clinico-radiological scoring system using preoperative parameters to predict operative difficulty in patients with acute calculous cholecystitis. **Material and Methods:** This retrospective observational study included adult patients with acute calculous cholecystitis who underwent laparoscopic cholecystectomy at a tertiary care center between February 2022 and August 2023. Clinical, laboratory, and ultrasonographic parameters were collected from medical records. Operative difficulty was categorized as easy or difficult based on intraoperative findings documented in operative notes. Univariate analysis was performed using independent t-tests and chi-square tests, followed by multivariate linear regression analysis to identify independent predictors. A preoperative clinico-radiological scoring system was constructed based on regression coefficients and statistical significance. Correlation between the preoperative score and operative difficulty was assessed using Spearman's rank correlation coefficient. **Results:** A total of 183 patients were included, of whom 77 (42.1%) underwent difficult laparoscopic cholecystectomy. Elevated C-reactive protein levels and neutrophil-to-lymphocyte ratio were significantly associated with operative difficulty on univariate analysis. Clinical factors such as positive Murphy's sign and prior endoscopic retrograde cholangiopancreatography showed strong associations. Radiological predictors included increased gallbladder wall thickness, multiple gallstones, stone impaction at the gallbladder neck, and presence of pericholecystic fluid. Multivariate linear regression analysis identified Murphy's sign, prior endoscopic retrograde cholangiopancreatography, elevated C-reactive protein levels, gallbladder wall thickness, and stone impaction at the gallbladder neck as independent predictors ($R^2 = 0.863$). The derived scoring system ranged from 0 to 13 and demonstrated strong correlation with operative difficulty (Spearman's $\rho = 0.796$, $p < 0.001$). A score ≥ 7 was significantly associated with difficult laparoscopic cholecystectomy ($p < 0.001$). **Conclusion:** The proposed clinico-radiological scoring system, based on routine preoperative clinical, laboratory, and ultrasonographic parameters, is a reliable tool for predicting operative difficulty in laparoscopic cholecystectomy for acute calculous cholecystitis. This scoring system may assist surgeons in preoperative risk stratification, surgical planning, and patient counseling, thereby improving operative preparedness and outcomes.

Keywords: Acute calculous cholecystitis, c-reactive protein, difficult laparoscopic cholecystectomy, gallbladder wall thickness, laparoscopic cholecystectomy, preoperative scoring system, stone impaction, ultrasonography.

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Introduction

Acute calculous cholecystitis is a common surgical condition resulting from obstruction of the cystic duct by gallstones, leading to gallbladder inflammation and secondary infection.[1] Early laparoscopic cholecystectomy remains the standard treatment; however, operative difficulty varies widely depending on the severity of inflammation, local anatomical distortion, and patient-related factors.[2] Despite advances in laparoscopic techniques and instrumentation, difficult laparoscopic cholecystectomy continues to pose significant intraoperative challenges and is associated with increased complication rates and longer operative duration.[3] Preoperative identification of patients at risk for difficult laparoscopic cholecystectomy is essential for optimal surgical planning, appropriate allocation of surgical expertise, and informed patient counseling.[4] Clinical presentation, laboratory markers of inflammation, and radiological findings, particularly those identified on preoperative ultrasonography, which is the most widely used

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first-line imaging modality in acute calculous cholecystitis, have been shown to correlate with operative difficulty. Parameters such as elevated inflammatory markers, increased gallbladder wall thickness, impacted gallstones, and the presence of pericholecystic fluid are frequently associated with increased surgical complexity.[5-7]

Several scoring systems have been proposed to predict operative difficulty; however, many rely on limited parameters or incorporate intraoperative findings, thereby limiting their utility in preoperative risk stratification.[8,9] There remains a need for a comprehensive, practical, and reliable scoring system that integrates routinely available clinical, laboratory, and radiological variables to accurately predict operative difficulty before surgery. The present study aims to develop a clinico-radiological scoring system based on preoperative parameters to predict operative difficulty in laparoscopic cholecystectomy for acute calculous cholecystitis.

Materials and Methods

Study Design and Setting: This retrospective observational study was conducted at a tertiary care center, KMCH Institute of Health Sciences and Research, Coimbatore, India.

Objectives: The primary objective of this study was to develop a clinico-radiological scoring system to predict operative difficulty in laparoscopic cholecystectomy for acute calculous cholecystitis. The secondary objectives were to identify independent preoperative predictors of operative difficulty and to evaluate the predictive performance of the derived scoring system.

Study Population: Medical records of adult patients diagnosed with acute calculous cholecystitis who underwent laparoscopic cholecystectomy between February 2022 and August 2023 were reviewed. The diagnosis of acute calculous cholecystitis was based on clinical presentation, laboratory findings, and ultrasonographic features consistent with standard diagnostic criteria.[1]

Inclusion and Exclusion Criteria

Patients aged eighteen years and above diagnosed with acute calculous cholecystitis and managed with laparoscopic cholecystectomy were included in the study. Patients with acute acalculous cholecystitis, those who underwent interval cholecystectomy, patients managed conservatively, patients below eighteen years of age, and patients with severe systemic comorbidities were excluded. All included patients underwent early laparoscopic cholecystectomy during the same hospital admission, typically within 48 hours of admission, after initial clinical stabilization. Emergency laparoscopic cholecystectomy was not routinely performed at our institution.

Sample Size: All eligible patients meeting the inclusion criteria during the study period were included. A total of 183 patients constituted the final study population, exceeding the calculated minimum sample size of 181 based on a previously reported prevalence of difficult laparoscopic cholecystectomy.[10,11]

Data Collection: Data were collected retrospectively from the hospital Medical Records Department (MRD), including electronic patient records, operative notes, laboratory reports, and ultrasonography findings. Operative notes documented immediately after surgery were used to assess intraoperative findings and operative difficulty. Variables recorded included demographic details, clinical presentation, laboratory parameters, radiological findings, intraoperative observations, and postoperative outcomes.

Clinical variables included abdominal pain, vomiting, fever, abdominal guarding, Murphy's sign, abdominal distension, and history of endoscopic retrograde cholangiopancreatography or prior abdominal surgery. History of endoscopic retrograde cholangiopancreatography was defined as any prior ERCP performed before laparoscopic cholecystectomy, irrespective of whether biliary stenting was performed.

Laboratory parameters included white blood cell count, neutrophil-to-lymphocyte ratio, C-reactive protein, hemoglobin, platelet count, electrolytes, liver function tests, and coagulation profile.

Radiological evaluation was performed using transabdominal ultrasonography for all patients prior to surgery. Ultrasonography findings were obtained from formal radiology reports documented in the Medical Records Department. The assessed variables included gallbladder wall thickness, number of gallstones, presence of impacted stone at the gallbladder neck, pericholecystic fluid, and perihepatic fluid. Gallbladder wall thickness was measured at the most thickened portion of the gallbladder wall. All ultrasonographic examinations were performed by experienced radiologists as part of routine clinical evaluation. These parameters have been previously reported to be associated with operative difficulty.[12-14]

Intraoperative findings included duration of surgery, difficulty in Calot's triangle dissection, presence of omental adhesions, intraoperative bleeding, and need for surgical drain placement. Postoperative complications were recorded separately.

Surgical Technique: All laparoscopic cholecystectomies were performed by a single experienced surgical team using a standardized operative technique. This ensured consistency in operative approach and intraoperative difficulty assessment. The operating surgeon also documented intraoperative findings and operative difficulty immediately after each procedure.

Outcome Measures: The primary outcome was operative difficulty of laparoscopic cholecystectomy, categorized as easy or difficult based on intraoperative findings documented in operative notes, consistent with principles described in previously validated operative difficulty grading systems.[4,5]

Cases were classified as easy laparoscopic cholecystectomy (n=106) when the procedure was completed without significant technical difficulty, characterized by clear Calot's triangle anatomy, minimal adhesions, and smooth dissection as documented in operative notes. Cases were classified as difficult laparoscopic cholecystectomy (n=77) when operative notes documented one or more of the following intraoperative findings: dense adhesions around the gallbladder or Calot's triangle, distorted anatomy requiring additional dissection, difficult Calot's triangle dissection, or intraoperative bleeding requiring hemostasis and prolonged dissection. Operative duration was analyzed as a supportive intraoperative correlate of difficulty and was not used as the sole defining criterion for classification.

Difficulty classification was based on contemporaneous operative documentation recorded immediately after surgery by the operating surgeon.

Secondary outcomes included intraoperative complications and postoperative morbidity.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 20.0 for Windows (IBM Corp., Armonk, NY). Continuous variables were expressed as mean with standard deviation, and categorical variables were expressed as frequencies and percentages. Independent t-test was used for comparison of continuous variables, and chi-square test was used for comparison of categorical variables between easy and difficult laparoscopic cholecystectomy groups.

Variables with a p-value less than 0.05 on univariate analysis were entered into a multivariate linear regression model to identify independent predictors of operative difficulty. Operative difficulty classification based on intraoperative findings was used as the dependent variable and was coded as a binary variable (easy = 0, difficult = 1) for regression analysis. Preoperative clinical, laboratory, and radiological variables that were significant on univariate analysis were included as independent predictor variables in the multivariate linear regression model.

Based on the regression coefficients and statistical strength of association, a clinico-radiological scoring system was constructed by assigning appropriate weightage to each independent predictor variable. Variables that remained statistically significant on multivariate analysis were assigned higher scores, whereas variables significant only on univariate analysis were retained in the scoring system with lower weightage due to their clinical relevance. The magnitude of regression coefficients and statistical significance were considered while assigning the final score for each variable.

The cumulative preoperative score for each patient was calculated by summing individual component scores, yielding a total score ranging from 0 to 13. Correlation analysis using Spearman's rank correlation coefficient was performed to assess the relationship between the derived preoperative score and operative difficulty. The ability of the score to predict difficult laparoscopic cholecystectomy was further evaluated using cutoff-based analysis. Receiver operating characteristic (ROC) curve analysis was performed to determine optimal cutoff values for continuous variables. Cutoff points were selected based on the maximum Youden index. The predictive performance of the scoring system was further evaluated by analyzing its association with operative difficulty using appropriate statistical tests. The optimal cutoff score for predicting difficult laparoscopic cholecystectomy was determined based on score performance and predictive accuracy analysis. A p-value less than 0.05 was considered statistically significant.

Results

Demographic Variables: A total of 183 adult patients with acute calculous cholecystitis who underwent laparoscopic cholecystectomy were included in the study. Based on predefined intraoperative difficulty criteria documented in operative notes, 106 patients (57.9%) underwent an easy laparoscopic cholecystectomy, while 77 patients (42.1%) experienced a difficult laparoscopic cholecystectomy. The mean age of the study population was comparable between the easy and difficult laparoscopic cholecystectomy groups and did not show a statistically significant association with operative difficulty. Similarly, sex distribution did not significantly differ between the two groups. The baseline demographic characteristics, including age and sex distribution, are summarized in [Table 1].

Table 1: Demographic characteristics of patients undergoing easy and difficult laparoscopic cholecystectomy. Abbreviations: LC, laparoscopic cholecystectomy.

Variable	Total (n=183)	Easy LC (n=106)	Difficult LC (n=77)
Age range (years)			
21-30	23 (12.6%)	14 (13.2%)	9 (11.7%)
31-40	28 (15.3%)	17 (16.0%)	11 (14.3%)
41-50	42 (23.0%)	24 (22.6%)	18 (23.4%)
51-60	40 (21.9%)	22 (20.8%)	18 (23.4%)
61-70	35 (19.1%)	22 (20.8%)	13 (16.9%)
71-80	14 (7.7%)	6 (5.7%)	8 (10.4%)
81-90	1 (0.5%)	1 (0.9%)	0 (0.0%)
Sex			
Male	81 (44.3%)	47 (44.3%)	34 (44.2%)
Female	102 (55.7%)	59 (55.7%)	43 (55.8%)
Total	183 (100%)	106 (100%)	77 (100%)

Laboratory Parameters Associated with Operative Difficulty: Among the laboratory parameters analyzed, C-reactive protein and neutrophil-to-lymphocyte ratio were the only variables that demonstrated a statistically significant association with operative difficulty. Patients who underwent difficult laparoscopic cholecystectomy had significantly higher mean C-reactive protein levels compared to those who underwent easy laparoscopic cholecystectomy ($p<0.001$), and the mean neutrophil-to-lymphocyte ratio was also significantly higher in the difficult surgery group ($p=0.026$). Comparison of these significant laboratory parameters between the two groups is shown in Table 2. Other laboratory parameters, including total leukocyte count, hemoglobin, platelet count, electrolytes, and liver function test parameters (serum bilirubin, AST, ALT, and alkaline phosphatase), as well as coagulation profile, did not show a statistically significant association with operative difficulty.

Table 2: Comparison of significant laboratory parameters between easy and difficult laparoscopic cholecystectomy. Abbreviations: LC, laparoscopic cholecystectomy; CRP, C-reactive protein; NLR, neutrophil-to-lymphocyte ratio.

Marker	Easy LC (n=106) Mean ± SD	Difficult LC (n=77) Mean ± SD	t-value	p-value
C-reactive protein (mg/dL)	9.17 ± 2.01	53.70 ± 66.61	-6.82	<0.001
Neutrophil-to-lymphocyte ratio	3.16 ± 2.70	4.42 ± 4.76	-2.26	0.026

Clinical Parameters Associated with Operative Difficulty: Among the clinical parameters assessed, Murphy's sign and history of endoscopic retrograde cholangiopancreatography were significantly associated with operative difficulty. A significantly higher proportion of patients in the difficult laparoscopic cholecystectomy group had a positive Murphy's sign and prior history of endoscopic retrograde cholangiopancreatography compared to the easy laparoscopic cholecystectomy group (p<0.001 for both), as shown in Table 3. Other clinical parameters, including abdominal pain, vomiting, fever, abdominal guarding, abdominal distension, and prior abdominal surgery, did not show a statistically significant association with operative difficulty.

Table 3: Clinical parameters associated with operative difficulty. Abbreviations: LC, laparoscopic cholecystectomy; ERCP, endoscopic retrograde cholangiopancreatography

Clinical parameter	Category	Easy LC (n=106), n (%)	Difficult LC (n=77), n (%)	χ^2 value	p-value
Murphy's sign	Positive	46 (43.4%)	69 (89.6%)	67.09	<0.001
	Negative	60 (56.6%)	8 (10.4%)	67.09	<0.001
History of ERCP	Yes	8 (7.5%)	62 (80.5%)	98.42	<0.001
	No	98 (92.5%)	15 (19.5%)	98.42	<0.001

Radiological Parameters Identified on Preoperative Ultrasonography: Radiological parameters identified on preoperative ultrasonography and significantly associated with difficult laparoscopic cholecystectomy included increased gallbladder wall thickness, presence of multiple gallstones, stone impaction at the gallbladder neck, and presence of pericholecystic fluid, as shown in [Table 4]. Perihepatic fluid did not show a statistically significant association with operative difficulty.

Table 4: Comparison of radiological parameters between easy and difficult laparoscopic cholecystectomy. Abbreviations: LC, laparoscopic cholecystectomy; GB, gallbladder.

Radiological parameter	Category	Easy LC (n=106), n (%)	Difficult LC (n=77), n (%)	χ^2 value	p-value
Gallbladder wall thickness ≥4.4 mm	Yes	37 (34.9%)	41 (53.2%)	6.15	0.013
	No	69 (65.1%)	36 (46.8%)	6.15	0.013
Multiple gallstones	Yes	37 (34.9%)	66 (85.7%)	36.84	<0.001
	No	69 (65.1%)	11 (14.3%)	36.84	<0.001
Stone impaction at GB neck	Yes	16 (15.1%)	50 (64.9%)	46.39	<0.001
	No	90 (84.9%)	27 (35.1%)	46.39	<0.001
Pericholecystic fluid	Yes	36 (34.0%)	38 (49.4%)	4.41	0.036
	No	70 (66.0%)	39 (50.6%)	4.41	0.036

Intraoperative Findings in Easy and Difficult Laparoscopic Cholecystectomy: As expected, cases classified as difficult laparoscopic cholecystectomy demonstrated a significantly higher frequency of difficult Calot's triangle dissection and longer operative duration compared to easy cases ($p < 0.001$ for both), as shown in [Table 5]. Difficult Calot's triangle dissection was documented in 41 patients (53.2%) in the difficult laparoscopic cholecystectomy group, whereas none of the easy cases demonstrated difficult dissection. Similarly, operative duration exceeding 90 minutes was more frequent in the difficult laparoscopic cholecystectomy group (62.3%) compared to the easy group (1.9%). Operative duration was analyzed as an intraoperative indicator of technical complexity and was not used as the sole criterion for classification of operative difficulty. Other intraoperative parameters did not show statistically significant differences between the groups.

Table 5: Intraoperative findings in easy and difficult laparoscopic cholecystectomy. Abbreviations: LC, laparoscopic cholecystectomy.

Intraoperative factor	Category	Easy LC (n=106) n (%)	Difficult LC (n=77) n (%)	χ^2 value	p-value
Difficult Calot's dissection	Yes	0 (0.0%)	41 (53.2%)	77.52	<0.001
	No	106 (100%)	36 (46.8%)	77.52	<0.001
Operative duration >90 mins	Yes	2 (1.9%)	48 (62.3%)	75.89	<0.001
	No	104 (98.1%)	29 (37.7%)	75.89	<0.001

Postoperative Complications: Postoperative complications were observed more frequently in patients who underwent difficult laparoscopic cholecystectomy compared to those with easy surgery (p<0.001). The spectrum of complications observed included bile leak, postoperative ileus, hemorrhage requiring transfusion, pleural effusion, pneumonia, myocardial infarction, and sepsis, as summarized in [Table 6]. Postoperative complications occurred in 60 patients

(77.9%) in the difficult laparoscopic cholecystectomy group compared to 17 patients (16.0%) in the easy group. This reflects the greater technical complexity and operative challenges encountered in difficult laparoscopic cholecystectomy.

Table 6: Comparison of postoperative complications between easy and difficult laparoscopic cholecystectomy. Abbreviations: LC, laparoscopic cholecystectomy.

Postoperative complications	Category	Easy LC (n=106) n (%)	Difficult LC (n=77) n (%)	χ^2 value	p-value
Any postoperative complication	Yes	17 (16.0%)	60 (77.9%)	38.64	<0.001
	No	89 (84.0%)	17 (22.1%)	38.64	<0.001

Multivariate Linear Regression Analysis: Multivariate linear regression analysis was performed to identify independent predictors of operative difficulty. Variables that were statistically significant on univariate analysis were entered into the multivariate linear regression model to identify independent preoperative predictors of operative difficulty. The model demonstrated good explanatory performance (R^2 = 0.863). Murphy's sign, history of endoscopic retrograde cholangiopancreatography, elevated C-reactive protein levels, increased gallbladder wall thickness, and stone impaction at the gallbladder neck were identified as independent predictors of operative difficulty, as shown in [Table 7].

Neutrophil-to-lymphocyte ratio, number of stones, and presence of pericholecystic fluid were not statistically significant on multivariate analysis. However, these variables were retained in the scoring system with lower weightage due to their statistical significance on univariate analysis and established clinical relevance reported in previous studies.

Table 7: Multivariate linear regression analysis of preoperative predictors of operative difficulty (R^2 = 0.863). Abbreviations: CRP, C-reactive protein; ERCP, endoscopic retrograde cholangiopancreatography; NLR, neutrophil-to-lymphocyte ratio; GB, gallbladder.

Predictor	B	Std. Error	Beta	t	p-value
Murphy's sign	-0.153	0.063	-0.125	-2.417	0.019
NLR > 4.01	-0.011	0.009	-0.069	-1.279	0.206
History of ERCP	-0.275	0.071	-0.273	-3.848	<0.001
CRP ≥ 23 mg/dL	0.001	0.001	0.116	2.012	0.048
Gallbladder wall thickness ≥ 4.4 mm	0.030	0.026	0.057	1.145	0.047
Multiple Gallstones	0.064	0.061	0.056	1.035	0.304
Pericholecystic fluid	0.017	0.051	0.017	0.340	0.735
Stone impaction at GB neck	-0.158	0.062	-0.154	-2.558	0.013

Preoperative Scoring System: A preoperative clinico-radiological scoring system was developed based on the strength of association of each preoperative variable with operative difficulty. Variables identified as independent predictors on multivariate linear regression analysis were assigned higher scores, while variables significant only on univariate analysis were included with lower scores based on their clinical relevance and relative statistical contribution. The magnitude of regression coefficients and statistical significance were considered while assigning the weightage for each variable. The final scoring system and assigned score ranges are shown in [Table 8].

Table 8: Preoperative clinico-radiological scoring system for predicting difficult laparoscopic cholecystectomy. Total preoperative score ranged from 0 to 13. Abbreviations: CRP, C-reactive protein; ERCP, endoscopic retrograde cholangiopancreatography; NLR, neutrophil-to-lymphocyte ratio.

Preoperative Variable	Score Range
History of ERCP	0-2
Murphy's sign	0-2
CRP (≥23 mg/dL)	0-2
NLR (>4.01)	0-1
Gallbladder wall thickness (≥4.4 mm)	0-2
Multiple gallstones	0-1
Pericholecystic fluid	0-1
Stone impaction at the gallbladder neck	0-2
Total score	0-13

Correlation and Predictive Performance: Correlation analysis was performed to evaluate the relationship between the cumulative preoperative score and operative difficulty classification. A strong positive correlation was observed between the preoperative score and operative difficulty (Spearman's $\rho = 0.796$, $p < 0.001$), as shown in [Table 9].

Table 9: Correlation between preoperative score and operative difficulty (n=183).

Variable Pair	Spearman's ρ	p-value
Preoperative score vs operative difficulty	0.796	<0.001

Patients were stratified based on the preoperative score to evaluate its ability to predict operative difficulty. A preoperative score of ≥7 was significantly associated with difficult laparoscopic cholecystectomy ($p < 0.001$), as shown in [Table 10]. This scoring system demonstrated strong predictive performance and showed a significant association with operative difficulty within the study population.

Table 10: Association between preoperative score category and operative difficulty. Statistical association assessed using Fisher's exact test due to zero cell counts. Abbreviations: LC, laparoscopic cholecystectomy.

Score Category	Easy LC n (%)	Difficult LC n (%)	Statistic	p-value
< 7	106 (100.0%)	10 (13.0%)	Fisher's exact test	<0.001
≥ 7	0 (0.0%)	67 (87.0%)	Fisher's exact test	<0.001

Discussion

Laparoscopic cholecystectomy remains the standard treatment for acute calculous cholecystitis; however, operative difficulty continues to be unpredictable despite advances in laparoscopic techniques and perioperative care.[1,2] Anticipating difficult laparoscopic cholecystectomy preoperatively is important for surgical planning, appropriate allocation of surgical expertise, and informed patient counselling.[5,7] The present study developed a clinico-radiological scoring system using routinely available preoperative parameters to predict operative difficulty in patients with acute calculous cholecystitis. This study demonstrates that a combination of clinical, laboratory, and radiological variables can predict operative difficulty with good accuracy.[10,14]

Multivariate regression analysis identified Murphy's sign, prior endoscopic retrograde cholangiopancreatography, elevated C-reactive protein levels, increased gallbladder wall thickness, and stone impaction at the gallbladder neck as independent predictors of operative difficulty.[15,16] The derived scoring system demonstrated a strong correlation with operative difficulty (Spearman's $\rho = 0.796$) and good explanatory performance ($R^2 = 0.863$), indicating its usefulness in preoperative risk stratification.

Among clinical predictors, Murphy's sign was significantly associated with operative difficulty. A positive Murphy's sign reflects active gallbladder inflammation and localized peritoneal irritation, which may correspond to dense adhesions and distorted anatomy encountered during dissection of Calot's triangle.[3,10] Similarly, prior ERCP was strongly associated with operative difficulty, likely due to inflammatory changes, fibrosis, and altered anatomy resulting from previous biliary instrumentation.[4,6]

Laboratory markers also contributed significantly to prediction. Elevated C-reactive protein levels were independently associated with operative difficulty, reflecting the severity of inflammatory response and tissue edema.[15,16] The neutrophil-to-lymphocyte ratio was associated with operative difficulty on univariate analysis, supporting its role as an accessible marker of systemic inflammation and disease severity.[15]

Radiological parameters identified on preoperative ultrasonography played an important role in predicting operative difficulty. Increased gallbladder wall thickness, multiple gallstones, stone impaction at the gallbladder neck, and pericholecystic fluid were significantly associated with difficult surgery.[8,10,14] These findings are consistent with the pathological progression of acute cholecystitis, in which persistent obstruction and inflammation lead to edema, fibrosis, and anatomical distortion, thereby increasing surgical complexity.[1,13]

Intraoperative findings in the present study were consistent with operative difficulty classification. Difficult Calot's triangle dissection and prolonged operative duration were more frequently observed in cases categorized as difficult laparoscopic cholecystectomy. These findings reflect the increased technical complexity encountered in difficult cases and support the clinical relevance of preoperative prediction.

Several predictive models and scoring systems have previously been proposed to anticipate difficult laparoscopic cholecystectomy.[3,5,9,17] The present study builds on existing literature by incorporating objective inflammatory markers and ultrasonographic parameters specifically in patients with acute calculous cholecystitis. The derived scoring system demonstrated good internal performance and may serve as a practical tool using routinely available preoperative data.[16,17]

Certain limitations should be considered. This was a retrospective single-center study, which may limit generalizability. The scoring system was developed and internally evaluated within the same study population and therefore requires external validation in independent cohorts.[5,9] Additionally, operative difficulty classification was based on surgeon-documented intraoperative findings, which may introduce some subjectivity, although this was minimized by standardized documentation by a single experienced surgical team. Prospective validation in larger multicenter cohorts will help establish the generalizability and clinical utility of this scoring system.

Despite these limitations, the study has several strengths. It included an adequate sample size, comprehensive evaluation of clinical, laboratory, and radiological predictors, and objective statistical modeling using multivariate regression analysis. The derived scoring system is simple, practical, and based on routinely available parameters, making it feasible for application in routine surgical practice.

Conclusion

A clinico-radiological scoring system based on routinely available clinical, laboratory, and ultrasonographic parameters was developed to predict operative difficulty in laparoscopic cholecystectomy for acute calculous cholecystitis. Murphy's sign, prior endoscopic retrograde cholangiopancreatography, elevated C-reactive protein levels, increased gallbladder wall thickness, and stone impaction at the gallbladder neck were identified as key independent predictors and incorporated into this risk score.

The scoring system demonstrated good predictive performance within the study population and may assist surgeons in preoperative risk stratification, operative planning, allocation of surgical expertise, and patient counseling. However, external validation through multicenter prospective studies is required before routine clinical implementation.

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Conflicts of interest

There are no conflicts of interest.

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