



Evaluation of Clinicopathological and Radiological Parameters in Predicting the Difficulty of Laparoscopic Cholecystectomy

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ABSTRACT:

Background: Difficult laparoscopic cholecystectomy carries prolonged operative time, conversion, and morbidity; preoperative identification of high-risk patients aids planning and counselling.

Aims/Objectives: To determine the clinical, pathological, and radiological parameters that predict difficult laparoscopic cholecystectomy and to identify independent predictors.

Methodology: This prospective observational study enrolled 100 patients undergoing elective laparoscopic cholecystectomy for symptomatic cholelithiasis. Preoperative clinical, biochemical, and ultrasonographic parameters were recorded and correlated with an operationally defined difficult procedure. Associations were assessed using the chi-square test, Fisher exact test, and independent t-test, followed by multivariable logistic regression.

Results: A difficult procedure occurred in 26 (26.0%) patients. Significant predictors were gallbladder wall thickening greater than 3 millimetres (13/26, 50.0% versus 8/74, 10.8%; odds ratio 7.82; $p < 0.001$), positive Murphy sign (11/26, 42.3% versus 2/74, 2.7%; $p < 0.001$), prior hospitalisation (12/26, 46.2% versus 4/74, 5.4%; $p < 0.001$), two or more previous attacks (16/26, 61.5% versus 16/74, 21.6%; $p < 0.001$), raised alkaline phosphatase (10/26, 38.5%; $p = 0.002$), and leucocytosis (11/26, 42.3%; $p = 0.009$). Wall thickening remained an independent predictor (adjusted odds ratio 4.62; $p = 0.021$). Conversion to open surgery was required in 2 (2.0%) patients.

Conclusions: Gallbladder wall thickening, inflammatory clinical signs, and recurrent biliary disease reliably predict operative difficulty and permit preoperative risk stratification.

Key-words: Gallstones; Cholecystitis; Operative time; Conversion to open surgery; Ultrasonography; Risk assessment

INTRODUCTION:

Laparoscopic cholecystectomy is the accepted standard of care for symptomatic gallstone disease, offering less pain, shorter hospitalisation, and quicker recovery than the open approach. Nevertheless, the procedure is technically variable, and a proportion of cases prove unexpectedly difficult owing

to dense adhesions, obscuration of Calot's triangle, and distorted biliary anatomy. Such difficulty translates into prolonged operative time, a greater need for bail-out manoeuvres, conversion to open surgery, and a higher risk of bile duct injury and postoperative morbidity.¹



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Because operative difficulty is a principal determinant of intra-operative and postoperative outcomes, its preoperative anticipation is clinically valuable. Reliable prediction allows the operating list to be planned rationally, an experienced surgeon to be allocated to high-risk cases, the patient to be counselled realistically about the possibility of conversion, and the team to be prepared for a demanding dissection. To this end, several objective grading systems and preoperative risk scores have been developed and validated, including the CholeS operative difficulty grading scale and its associated preoperative risk score.^{2,3}

A wide range of predictors has been proposed, spanning demographic variables, clinical history, inflammatory and hepatobiliary biochemistry, and ultrasonographic morphology; however, systematic appraisal has shown that the reported models are heterogeneous and inconsistently validated across populations.⁴ More recently, radiologically based and machine-learning nomograms have refined preoperative stratification, yet their generalisability to routine practice in resource-limited settings remains uncertain.^{5,6} These inconsistencies justify continued primary evaluation of locally applicable predictors that combine readily available clinical, laboratory, and sonographic information.^{7,8}

Aim and Objectives:

The present study was therefore undertaken to determine, in patients undergoing elective laparoscopic cholecystectomy for symptomatic cholelithiasis at a tertiary care teaching hospital, which preoperative clinicopathological and radiological parameters are associated with a difficult procedure, to quantify the strength of these associations, and to identify factors that independently predict operative difficulty so that a practical framework for preoperative risk stratification can be proposed.

MATERIALS AND METHODS:

Study design and setting:

This hospital-based prospective observational study was conducted in the Department of General Surgery of a tertiary care teaching hospital over an eighteen-month period from January 2025 to June 2026. Consecutive patients fulfilling the eligibility criteria were enrolled after written informed consent, and their preoperative parameters were correlated with the intra-operative course of laparoscopic cholecystectomy.

Study population and eligibility:

One hundred adults aged eighteen years or older undergoing elective laparoscopic cholecystectomy for symptomatic cholelithiasis were studied. Eligible patients included those with symptomatic gallstones or acute cholecystitis, those with mild-to-moderate gallstone pancreatitis graded by the 2012

Revised Atlanta classification, and those with cholecystitis following endoscopic retrograde cholangiopancreatography. Patients with a severe comorbid burden precluding safe general anaesthesia (American Society of Anesthesiologists physical status III to V), those declining the laparoscopic approach, and those with a concurrent common bile duct stone were excluded.

Sample size:

The sample size was estimated using the standard formula for a single proportion in observational studies. Assuming an anticipated prevalence of difficult laparoscopic cholecystectomy of 24% from earlier work, at a 95% confidence level with an absolute precision of 8.5%, a minimum of 97 patients was required; 100 patients were enrolled.

Measurements and data collection:

A structured proforma was used to record demographic details, presenting symptoms and signs, biliary history, and comorbidities. Preoperative investigations comprised a complete blood count and liver function tests; the total leukocyte count, serum total bilirubin, aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase were recorded, with elevation defined a priori as a total leukocyte count above 12,000 cells per cubic millimetre, aspartate aminotransferase above 40 units per litre, alanine aminotransferase above 45 units per litre, alkaline phosphatase above 270 units per litre, and total bilirubin above 2.0 milligrams per decilitre. Abdominal ultrasonography documented gallbladder wall thickness, gallbladder morphology, pericholecystic fluid, the number, size, and site of calculi, common bile duct diameter, and hepatic status. Intra-operative variables comprised the appearance of Calot's triangle, the severity of adhesions, operative time, intra-operative complications, and the need for bail-out or conversion; postoperative outcomes included complications, hospital stay, and histopathology.

Grading and operational definition of difficult laparoscopic cholecystectomy:

Intra-operative severity was assessed at the initial laparoscopic view using established descriptive grading of Calot's triangle (normal, partially obscured, or completely frozen) and a five-tier adhesion grade, consistent with contemporary intra-operative grading scales.^{9,10} For analysis, a procedure was operationally defined as difficult if any one of the following was present: operative time exceeding 60 minutes; conversion to open surgery; a bail-out subtotal cholecystectomy; gallbladder-fossa bleeding requiring intra-operative control; a completely frozen Calot's triangle; or severe-to-extreme adhesions (grade 4 or 5). This composite, anchored on operative time, intra-operative findings, and conversion, follows the criteria used in comparable predictive studies.¹¹

Surgical procedure:

All operations were performed under general anaesthesia using a standard four-port technique, with dissection directed at achieving the critical view of safety. Where safe dissection of Calot's triangle was not feasible, a reconstituting subtotal cholecystectomy or conversion to open surgery was undertaken as a deliberate safety measure. Drain placement was at the discretion of the operating surgeon.

Statistical analysis:

Data were entered in a spreadsheet and analysed with standard statistical software. Continuous variables were summarised as mean plus or minus standard deviation and categorical variables as frequencies with percentages, expressed as n (%). Associations between preoperative parameters and operative difficulty were tested with the chi-square test or the Fisher exact test for categorical variables, as appropriate to expected cell counts, and with the independent-samples t-test for continuous variables; odds ratios with 95% confidence intervals were computed. Variables significant on univariate analysis were entered into a multivariable logistic regression model to identify independent predictors. A two-sided p value below 0.05 was considered statistically significant.

RESULTS:

One hundred patients were studied. The mean age was 37.9 ± 12.0 years (range 20–81 years), and the disease predominantly affected young to middle-aged adults, with 40 (40.0%) patients aged 31–45 years and 34 (34.0%) aged 18–30 years. There was a marked female preponderance, with 82 (82.0%) women and 18 (18.0%) men. The mean body mass index was 22.5 ± 3.2 kilograms per square metre, and most patients had a normal body mass index (72, 72.0%). Right hypochondrial pain was universal (100, 100.0%), whereas vomiting was present in 26 (26.0%) and a positive Murphy sign in 13 (13.0%). A recurrent course was common, with two or more previous attacks in 32 (32.0%) patients and prior hospitalisation for biliary disease in 16 (16.0%); a history of endoscopic retrograde cholangiopancreatography and of pancreatitis was each present in 4 (4.0%). Comorbidity was infrequent, comprising diabetes mellitus and hypertension in 8 (8.0%) patients each, hypothyroidism in 5 (5.0%), and chronic obstructive pulmonary disease in 4 (4.0%). The baseline profile is summarised in Table 1.

Preoperative biochemistry showed a mean total leukocyte count of $9,090.9 \pm 3,279.9$ cells per cubic millimetre, with leucocytosis above 12,000 in 22 (22.0%) patients. The mean aspartate aminotransferase was 39.3 ± 22.5 units per litre (elevated in 20, 20.0%), the mean alanine aminotransferase 39.3 ± 29.7 units per litre (elevated in 17, 17.0%), the mean alkaline phosphatase 226.6 ± 74.2 units per litre (elevated in 17, 17.0%), and the mean total bilirubin 0.7 ± 0.5 milligrams

per decilitre (elevated in 4, 4.0%). On ultrasonography, the gallbladder wall exceeded 3 millimetres in 21 (21.0%) patients; the gallbladder was contracted in 57 (57.0%), partially contracted in 21 (21.0%), distended in 13 (13.0%), and normal in 9 (9.0%). Pericholecystic fluid was present in 7 (7.0%) and an impacted neck or Hartmann-pouch stone in 13 (13.0%). Multiple calculi were seen in 78 (78.0%) patients, the common bile duct exceeded 6 millimetres in 14 (14.0%), a post-procedure biliary stent was present in 4 (4.0%), and the liver was sonographically normal in 82 (82.0%). These findings are detailed in Table 2.

At operation, Calot's triangle was normal in 54 (54.0%) patients, partially obscured in 42 (42.0%), and completely frozen in 4 (4.0%). Adhesions were graded I–II in 72 (72.0%) patients, III in 22 (22.0%), and IV–V in 6 (6.0%). The mean operative time was 49.8 ± 36.0 minutes, and 21 (21.0%) procedures exceeded 60 minutes. A subtotal (bail-out) cholecystectomy was required in 4 (4.0%) patients and conversion to open surgery in 2 (2.0%). Intra-operative stone or bile spillage occurred in 15 (15.0%) patients and gallbladder-fossa bleeding in 9 (9.0%); there were no major vascular, bile duct, or visceral injuries. A drain was placed in 89 (89.0%) patients. Postoperatively, surgical site infection occurred in 7 (7.0%), fever in 8 (8.0%), and readmission in 4 (4.0%), with no mortality. The mean hospital stay was 3.2 ± 0.8 days. Histopathology showed chronic cholecystitis with cholelithiasis in 84 (84.0%) patients, acute calculous cholecystitis in 13 (13.0%), chronic cholecystitis with cholesterosis in 2 (2.0%), and xanthogranulomatous cholecystitis in 1 (1.0%). The intra-operative and postoperative findings are presented in Table 3.

A difficult laparoscopic cholecystectomy occurred in 26 (26.0%) of the 100 patients, and the difficult group had a substantially longer operative time (98.3 ± 40.8 versus 32.7 ± 7.6 minutes; $t = 8.14$; $p < 0.001$) and hospital stay (3.8 ± 0.8 versus 3.0 ± 0.7 days; $t = 4.72$; $p < 0.001$) than the easy group. On univariate analysis (Table 4), the strongest clinical predictors were a positive Murphy sign (11/26, 42.3% versus 2/74, 2.7%; odds ratio 21.52, 95% confidence interval 4.93–93.92; $p < 0.001$), acute cholecystitis on histopathology (11/26, 42.3% versus 2/74, 2.7%; odds ratio 21.52; $p < 0.001$), prior hospitalisation (12/26, 46.2% versus 4/74, 5.4%; odds ratio 13.51, 95% confidence interval 4.00–45.60; $p < 0.001$), two or more previous attacks (16/26, 61.5% versus 16/74, 21.6%; $\chi^2 = 12.31$; odds ratio 5.57; $p < 0.001$), vomiting (13/26, 50.0% versus 13/74, 17.6%; $\chi^2 = 8.90$; odds ratio 4.56; $p = 0.003$), and diabetes mellitus (5/26, 19.2% versus 3/74, 4.1%; odds ratio 5.23; $p = 0.027$).

Among laboratory parameters, leucocytosis (11/26, 42.3% versus 11/74, 14.9%; $\chi^2 = 6.92$; odds ratio 4.10; $p = 0.009$),

raised alkaline phosphatase (10/26, 38.5% versus 7/74, 9.5%; odds ratio 5.73; $p = 0.002$), and raised alanine aminotransferase (8/26, 30.8% versus 9/74, 12.2%; odds ratio 3.17; $p = 0.038$) were significantly associated with difficulty, whereas raised aspartate aminotransferase ($p = 0.190$) and hyperbilirubinaemia ($p = 0.053$) were not; the mean total leukocyte count ($10,520 \pm 3,450$ versus $8,589 \pm 3,087$; $t = 2.52$; $p = 0.016$) and alkaline phosphatase (263.7 ± 82.8 versus 213.6 ± 66.7 ; $t = 2.79$; $p = 0.008$) were higher in the difficult group. Among radiological parameters, gallbladder wall thickening greater than 3 millimetres was the strongest sonographic predictor (13/26, 50.0% versus 8/74, 10.8%; $\chi^2 = 15.53$; odds ratio 7.82, 95% confidence interval 2.77–22.11; $p < 0.001$), followed by a distended gallbladder (11/26, 42.3% versus 2/74, 2.7%; odds ratio 21.52; $p < 0.001$) and an impacted neck stone (7/26, 26.9% versus 6/74, 8.1%; odds ratio 4.05; $p = 0.036$). Pericholecystic fluid showed a non-significant trend (4/26, 15.4% versus 3/74, 4.1%; $p = 0.073$). Age above 50

years, male sex, body mass index of 25 or above, hypertension, common bile duct diameter above 6 millimetres, and mean age and body mass index were not associated with difficulty (all $p > 0.05$).

On multivariable logistic regression incorporating the significant univariate predictors (Table 5), gallbladder wall thickening greater than 3 millimetres remained an independent predictor of difficulty (adjusted odds ratio 4.62, 95% confidence interval 1.26–16.90; $p = 0.021$), while a positive Murphy sign showed a strong but non-significant trend (adjusted odds ratio 22.66; $p = 0.068$). The remaining variables—two or more previous attacks, prior hospitalisation, impacted neck stone, leucocytosis, and raised alkaline phosphatase—were no longer independently significant after adjustment, consistent with their shared underlying inflammatory basis.

Tables & Graphs:

Table 1. Baseline demographic, clinical, and comorbid characteristics (N = 100)

Variable	Category	n (%)
Age group, years	18–30	34 (34.0)
	31–45	40 (40.0)
	46–60	22 (22.0)
	61–75	3 (3.0)
	>75	1 (1.0)
Sex	Female	82 (82.0)
	Male	18 (18.0)
Body mass index, kg/m ²	<18.5	9 (9.0)
	18.5–24.9	72 (72.0)
	25.0–29.9	17 (17.0)
	≥30.0	2 (2.0)
Symptoms and signs	Right hypochondrial pain	100 (100.0)
	Vomiting	26 (26.0)
	Murphy sign / tenderness	13 (13.0)
Previous history	≥2 previous attacks	32 (32.0)
	Prior hospitalisation	16 (16.0)
	Previous ERCP	4 (4.0)
	Pancreatitis	4 (4.0)
	Abdominal surgery	4 (4.0)
Comorbidities	Diabetes mellitus	8 (8.0)
	Hypertension	8 (8.0)
	Hypothyroidism	5 (5.0)
	COPD	4 (4.0)

ERCP, endoscopic retrograde cholangiopancreatography; COPD, chronic obstructive pulmonary disease. Values are n (%).

Table 2. Preoperative laboratory and ultrasonographic parameters (N = 100)

Parameter	Category / cut-off	n (%)
Elevated leukocyte count*	TLC >12,000/mm ³	22 (22.0)
Elevated aspartate aminotransferase*	AST >40 U/L	20 (20.0)
Elevated alanine aminotransferase*	ALT >45 U/L	17 (17.0)
Elevated alkaline phosphatase*	ALP >270 U/L	17 (17.0)
Elevated total bilirubin*	>2.0 mg/dL	4 (4.0)
Gallbladder wall thickness	>3 mm	21 (21.0)
Gallbladder morphology	Contracted	57 (57.0)
	Partially contracted	21 (21.0)
	Distended	13 (13.0)
	Normal	9 (9.0)
Pericholecystic fluid	Present	7 (7.0)
Stone site	Neck / Hartmann pouch	13 (13.0)
Calculi	Multiple	78 (78.0)
Common bile duct	>6 mm	14 (14.0)
Biliary stent (post-ERCP)	Present	4 (4.0)
Liver	Normal	82 (82.0)

*Elevation defined by the cut-offs shown. TLC, total leukocyte count; AST, aspartate aminotransferase; ALT, alanine aminotransferase; ALP, alkaline phosphatase; ERCP, endoscopic retrograde cholangiopancreatography. Values are n (%).

Table 3. Intra-operative and postoperative outcomes (N = 100)

Parameter	Category	n (%)
Calot's triangle	Normal	54 (54.0)
	Partially obscured	42 (42.0)
	Completely frozen	4 (4.0)
Adhesion grade	I–II	72 (72.0)
	III	22 (22.0)
	IV–V	6 (6.0)
Operative time	>60 min	21 (21.0)
Conversion to open	Yes	2 (2.0)
Subtotal (bail-out)	Yes	4 (4.0)
Stone / bile spillage	Yes	15 (15.0)
Gallbladder-fossa bleeding	Yes	9 (9.0)
Drain placed	Yes	89 (89.0)
Surgical site infection	Yes	7 (7.0)
Fever	Yes	8 (8.0)
Readmission	Yes	4 (4.0)

Mean operative time 49.8 ± 36.0 minutes; mean hospital stay 3.2 ± 0.8 days. Values are n (%).

Table 4. Univariate association of preoperative parameters with difficult laparoscopic cholecystectomy

Predictor	Difficult (n=26), n (%)	Easy (n=74), n (%)	Test statistic	OR (95% CI)	p
Age >50 years	5 (19.2)	9 (12.2)	Fisher	1.76 (0.55–5.61)	0.511
Male sex	4 (15.4)	14 (18.9)	Fisher	0.83 (0.26–2.67)	0.776
BMI ≥ 25 kg/m ²	6 (23.1)	13 (17.6)	Fisher	1.44 (0.50–4.17)	0.567
Murphy sign	11 (42.3)	2 (2.7)	Fisher	21.52 (4.93–93.92)	<0.001
Vomiting	13 (50.0)	13 (17.6)	$\chi^2 = 8.90$	4.56 (1.75–11.86)	0.003
Acute cholecystitis†	11 (42.3)	2 (2.7)	Fisher	21.52 (4.93–93.92)	<0.001
≥ 2 previous attacks	16 (61.5)	16 (21.6)	$\chi^2 = 12.31$	5.57 (2.16–14.37)	<0.001
Prior hospitalisation	12 (46.2)	4 (5.4)	Fisher	13.51 (4.00–45.60)	<0.001
Previous ERCP	3 (11.5)	1 (1.4)	Fisher	7.30 (1.02–52.24)	0.053
Diabetes mellitus	5 (19.2)	3 (4.1)	Fisher	5.23 (1.26–21.71)	0.027
Leukocytosis >12,000	11 (42.3)	11 (14.9)	$\chi^2 = 6.92$	4.10 (1.53–11.01)	0.009
ALT >45 U/L	8 (30.8)	9 (12.2)	Fisher	3.17 (1.10–9.14)	0.038
ALP >270 U/L	10 (38.5)	7 (9.5)	Fisher	5.73 (1.94–16.88)	0.002
GB wall >3 mm	13 (50.0)	8 (10.8)	$\chi^2 = 15.53$	7.82 (2.77–22.11)	<0.001
Distended GB (USG)	11 (42.3)	2 (2.7)	Fisher	21.52 (4.93–93.92)	<0.001
Impacted neck stone	7 (26.9)	6 (8.1)	Fisher	4.05 (1.26–12.99)	0.036
Pericholecystic fluid	4 (15.4)	3 (4.1)	Fisher	4.09 (0.93–17.86)	0.073
CBD >6 mm	4 (15.4)	10 (13.5)	Fisher	1.23 (0.37–4.10)	0.754

† Acute cholecystitis on histopathological examination. χ^2 , chi-square statistic with continuity correction; Fisher, Fisher exact test; OR, odds ratio; CI, confidence interval; BMI, body mass index; ERCP, endoscopic retrograde cholangiopancreatography; ALT, alanine aminotransferase; ALP, alkaline phosphatase; GB, gallbladder; USG, ultrasonography; CBD, common bile duct. Bold p values are significant ($p < 0.05$).

Table 5. Multivariable logistic regression for independent predictors of difficult laparoscopic cholecystectomy

Predictor	Adjusted OR (95% CI)	p
Gallbladder wall >3 mm	4.62 (1.26–16.90)	0.021
Murphy sign	22.66 (0.80–645.8)	0.068
≥ 2 previous attacks	1.85 (0.49–6.90)	0.362
Prior hospitalisation	1.71 (0.19–15.40)	0.631
Leukocytosis >12,000	0.41 (0.04–3.91)	0.437
ALP >270 U/L	0.77 (0.12–4.92)	0.783

OR, odds ratio; CI, confidence interval; ALP, alkaline phosphatase. Bold p value is significant ($p < 0.05$).

DISCUSSION:

In this prospective series of 100 patients undergoing elective laparoscopic cholecystectomy for symptomatic cholelithiasis, a difficult procedure occurred in 26.0% of cases, a proportion consistent with the 20–25% commonly reported in the literature. The principal findings were that markers of active or recurrent gallbladder inflammation—a positive Murphy sign, acute cholecystitis, two or more previous attacks, prior hospitalisation, leucocytosis, and a raised alkaline phosphatase—together with gallbladder wall thickening on ultrasonography, were strongly associated with operative

difficulty, whereas demographic factors carried little predictive weight.

The dominant role of gallbladder wall thickening accords closely with the wider evidence base. Wall thickening exceeding 3–4 millimetres reflects chronic inflammation and fibrosis that obscure tissue planes and distort Calot's triangle, and it has repeatedly emerged as one of the most consistent sonographic predictors of difficulty and conversion.¹² In the present cohort it was the only radiological variable that

remained independently predictive after multivariable adjustment (adjusted odds ratio 4.62), mirroring radiologically based nomograms in which wall thickness is a core component.^{5,17}

The strong associations observed for the Murphy sign, acute cholecystitis, and a distended, tense gallbladder are best interpreted as expressions of a single acute-inflammatory phenotype rather than as independent effects, which explains their identical effect estimates and their attenuation on multivariable analysis. A comparable pattern has been described in acute cholecystitis, in which a positive Murphy sign, diabetes, and delayed presentation were significantly more frequent among difficult procedures.¹³ Systemic and local inflammatory markers, including leucocytosis, likewise predict difficulty after gallbladder drainage and in machine-learning models, supporting the biological plausibility of the inflammatory associations found here.^{14,6}

Recurrent disease, captured as two or more previous attacks and prior hospitalisation, was among the most powerful clinical predictors, reflecting the cumulative fibrosis and adhesion formation that follow repeated inflammatory insults. This is consistent with preoperative scoring systems in which a history of hospitalisation or previous inflammation is a weighted determinant of difficulty and with cross-sectional and computed-tomography-based analyses of acute cholecystitis.^{11,15} The predictive contribution of raised alkaline phosphatase and leucocytosis, and the lack of contribution from bilirubin and common bile duct diameter, indicate that biochemical markers signal inflammatory activity rather than mechanical biliary obstruction, in keeping with prospective cohorts and validation studies.^{7,16}

By contrast, age, sex, and body mass index were not significantly associated with difficulty in this cohort. Although some studies identify older age, male sex, or obesity as risk factors, systematic appraisal has shown these demographic associations to be inconsistent across populations and weaker than inflammatory and sonographic markers.^{4,8} The female preponderance and generally normal body mass index of this South Asian cohort, together with the modest number of men, may have limited the power to detect demographic effects.

Operative safety was preserved despite the burden of inflammatory disease. Conversion to open surgery was required in only 2.0% of patients and a reconstituting subtotal cholecystectomy in 4.0%, with no bile duct, vascular, or visceral injury and no mortality. This reflects the deliberate use of bail-out subtotal cholecystectomy as a recognised safety strategy when the critical view of safety cannot be achieved, an approach endorsed by contemporary evidence.¹⁸ The intra-operative grading of Calot's triangle and adhesions used here

parallels validated intra-operative scales that correlate with operative time, conversion, and complications, reinforcing the value of anchoring the definition of difficulty on objective operative findings.^{9,10,19,20}

Taken together, these findings support a pragmatic model in which a small set of readily available parameters—gallbladder wall thickening on ultrasonography, clinical and biochemical evidence of active inflammation, and a recurrent disease course—identifies patients at high risk of a difficult procedure, allowing experienced surgeons to be allocated, patients to be counselled about the possibility of subtotal cholecystectomy or conversion, and operative resources to be planned.

CONCLUSION:

Difficult laparoscopic cholecystectomy was encountered in about one quarter of patients and was predicted chiefly by gallbladder wall thickening on ultrasonography and by clinical, biochemical, and historical markers of active or recurrent inflammation, with wall thickening the only independent predictor. Demographic factors had little predictive value. Routine preoperative assessment of these parameters can stratify risk, guide surgeon allocation and counselling, and support the timely use of bail-out strategies, thereby improving operative planning and patient safety.

DECLARATIONS:

Ethical Approval: The study was approved by the Institutional Review Board of M.L.B. Medical College (approval number 7978/IEC/PG-23-63/2026/SC-1, dated 26 December 2025), and written informed consent was obtained from every participant before enrolment. The study was conducted in accordance with the principles of the Declaration of Helsinki, and no patient-identifying information is reported.

Informed Consent: Informed consent was obtained from all participants prior to their inclusion in the study. Participants were informed that their data would be kept confidential and used solely for research purposes.

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