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PRE-OPERATIVE PREDICTORS OF DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY USING CLINICAL, HAEMATOLOGICAL AND RADIOLOGICAL PARAMETERS

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the gold-standard treatment for gallbladder disease, but inflammation, adhesions, or anatomical variation can make the procedure technically difficult, prolonging operative time and occasionally necessitating conversion to open surgery. **Objective:** To determine pre-operative clinical, haematological, and radiological predictors of difficult LC and to evaluate their association with conversion to open cholecystectomy. **Methods:** This observational descriptive study was conducted over 18 months in the Department of General Surgery, Kanachur Institute of Medical Sciences, Mangalore, after Institutional Ethics Committee approval. Fifty-seven adults aged 18–70 years undergoing elective or emergency LC were enrolled. Pre-operative clinical (age, sex, BMI, prior abdominal surgery), haematological (total leucocyte count [TLC], monocyte-to-lymphocyte ratio [MLR]), and ultrasonographic (gallbladder status, wall thickness, stone number, impacted stone, pericholecystic fluid) parameters were recorded and correlated with intra-operative difficulty grade and conversion, using the chi-square test (significance at $p<0.05$). **Results:** Of 57 patients, 96.5% completed LC successfully and 3.5% required conversion. Overall difficulty was graded easy in 49.1%, difficult in 26.3%, and very difficult in 24.6%. Higher BMI (28.43±3.16 kg/m² in very difficult vs. 25.50±3.01 kg/m² in easy cases; $p<0.001$), prior acute cholecystitis ($p=0.017$), prior jaundice ($p=0.038$), and previous abdominal surgery ($p=0.049$) were significant clinical predictors of difficulty. Raised total leucocyte count ($p=0.020$) and increased MLR ($p=0.005$) were significant haematological predictors. Sonographic gallbladder distension ($p=0.002$) and wall thickness >3 mm ($p=0.040$) were significant radiological predictors. No predictor reached significance for conversion, likely owing to the small number of conversion events. **Conclusion:** Readily available pre-operative clinical, haematological, and ultrasonographic parameters can meaningfully predict operative difficulty in LC, supporting better surgical planning, resource allocation, and patient counselling, even though conversion itself remained infrequent in this cohort.

KEYWORDS : Laparoscopic Cholecystectomy, Difficult Laparoscopic Cholecystectomy, Gallbladder Disease, Pre-Operative Predictors, Ultrasonography.

1. INTRODUCTION

Gallbladder disease remains one of the most prevalent gastrointestinal disorders, with rising age-specific incidence reported in recent cohorts (Girme, Gupta, & Shah, 2024) and substantial regional variation in disease burden within India (Besra et al.; Kumar et al., 2024). Laparoscopic cholecystectomy (LC) has become the gold-standard treatment for gallbladder disease because of its minimally invasive nature, shorter hospital stay, and faster recovery compared with open surgery.

Despite these advantages, LC remains technically demanding in a meaningful proportion of cases, and reported conversion rates to open surgery vary widely across populations (Chin, Mallika Arachchige, Orbell-Smith, & Wysocki, 2023). Several pre-operative factors—clinical history, body habitus, inflammatory blood markers, and sonographic gallbladder characteristics—have been proposed as predictors of a technically difficult procedure (Magnano San Lio et al., 2022; Ramírez-Giraldo et al., 2022). Anticipating difficulty before surgery allows the operating team to plan staffing and counselling appropriately, and may reduce intra-operative complications (Sugrue et al., 2019).

While individual predictors—such as gallbladder wall thickening, raised white cell count, or monocyte-to-lymphocyte ratio (MLR)—have each been studied, comprehensive evaluation combining clinical, haematological, and radiological domains within a single Indian cohort remains limited (Durak, Alkurt, & Tutan, 2021; Avci et al., 2024). This study was undertaken to identify pre-operative predictors of difficult LC across these three domains and their relationship with conversion to open cholecystectomy.

2. MATERIALS AND METHODS

Study Design and Setting: This observational descriptive study was conducted in the Department of General Surgery, Kanachur Institute of Medical Sciences, Deralakatte, Mangalore, over 18 months, following Institutional Ethics Committee approval.

Population: Consecutive adults aged 18–70 years presenting with acute or chronic cholecystitis (with or without cholelithiasis) and planned for elective or emergency LC were screened. Patients with indications for common bile duct exploration, obstructive jaundice, suspected gallbladder carcinoma, or absolute contraindications to laparoscopy were excluded. Written informed consent was obtained from all participants.

Sample Size: The minimum sample size of 57 was calculated using the prevalence formula ($Z\alpha=1.96$, expected proportion $P=0.18$ for gallbladder wall thickening predicting difficult LC, precision $d=0.10$).

Variables: Pre-operative predictors were captured under three domains: (i) clinical—age, sex, body mass index (BMI), prior abdominal surgery; (ii) haematological—complete blood count, total leucocyte count (TLC), and MLR; (iii) radiological (ultrasonography)—gallbladder status, wall thickness (<3 mm vs. >3 mm), stone number, impacted stone, and pericholecystic fluid. Intra-operative parameters recorded included ease of peritoneal access, operative duration, difficulty of gallbladder dissection and extraction, duct/artery injury, and conversion to open surgery. An overall difficulty grade (easy/difficult/very difficult) was assigned for each case.

Statistical Analysis: Data were entered in Microsoft Excel and analysed using SPSS version 27. Categorical variables

were expressed as frequencies/percentages and continuous variables as mean ± standard deviation. Associations between pre-operative predictors and intra-operative difficulty/conversion were tested using the chi-square test; a two-sided $p<0.05$ was considered significant.

3. RESULTS

Of 57 patients, 37 (64.9%) were female and 20 (35.1%) male. The mean age was 47.72±12.62 years and mean BMI was 26.26±3.16 kg/m^2. Fifty-five patients (96.5%) completed LC successfully; only 2 (3.5%) required conversion to open surgery. Overall difficulty was graded easy in 28 cases (49.1%), difficult in 15 (26.3%), and very difficult in 14 (24.6%) (Table 1).

Table 1: Overall Difficulty Grade of Laparoscopic Cholecystectomy (n=57)

Overall difficulty grade	Frequency	Percentage (%)
Easy	28	49.1
Difficult	15	26.3
Very difficult	14	24.6
Total	57	100.0

Clinical Predictors: Gender showed no significant association with difficulty (p=0.656). A history of acute cholecystitis (78.6% of very difficult vs. 35.7% of easy cases; p=0.017), prior jaundice (28.6% vs. 10.7%; p=0.038), and previous abdominal surgery (64.3% vs. 28.6%; p=0.049) were significantly associated with greater difficulty. Mean BMI rose progressively across difficulty grades, while age, pulse rate, and blood pressure did not differ significantly between groups (Table 2).

Table 2: BMI and Age Across Overall Difficulty Grades

Parameter	Easy (Mean±SD)	Difficult (Mean±SD)	Very difficult (Mean±SD)	p
BMI (kg/m^2)	25.50±3.01	25.67±2.64	28.43±3.16	<0.001
Age (years)	49.21±12.71	46.13±13.40	46.43±12.17	0.686

Haematological Predictors: Raised total leucocyte count was present in 64.3% of very difficult cases versus 25.0% of easy cases (p=0.020). Increased MLR was seen in 64.3% of very difficult cases compared with 14.3% of easy cases (p=0.005). Haemoglobin and red cell counts showed no significant association with difficulty.

Radiological Predictors: A distended gallbladder on ultrasound was noted in 85.7% of very difficult cases versus 42.9% of easy cases (p=0.002). Gallbladder wall thickness >3 mm was present in 78.6% of very difficult versus 39.3% of easy cases (p=0.040). Pericholecystic fluid showed a rising but non-significant trend (50.0% in very difficult; p=0.079); stone number and impacted stone were not significant predictors (p=0.191 and p=0.364, respectively) (Table 3).

Table 3: Significant Haematological and Radiological Predictors of Difficulty

Predictor (significant subset)	Easy %	Difficult %	Very difficult %	p
Raised TLC	25.0	20.0	64.3	0.020
Increased MLR	14.3	20.0	64.3	0.005
GB distension (USG)	42.9	66.7	85.7	0.002
GB wall thickness >3mm	39.3	40.0	78.6	0.040

Intra-operative Correlates and Conversion: Operative duration exceeded 120 minutes in 71.4% of very difficult cases versus 7.1% of easy cases (p<0.001). Difficulty in gallbladder bed dissection and extraction both showed strong gradients across difficulty grades (p<0.001 each). No duct or artery injuries occurred in any patient. Conversion occurred only in the very difficult group (2/14, 14.3%) and did not reach statistical significance for any pre-operative variable (all p>0.05), likely reflecting the small number of conversion events.

4. DISCUSSION

This study found that readily available pre-operative variables—BMI, history of acute cholecystitis or jaundice, prior abdominal surgery, raised TLC, elevated MLR, gallbladder distension, and wall thickening—were significantly associated with intra-operative difficulty, consistent with prior reports (Bhandari, Khan, & Jha, 2021; Di Buono et al., 2021; Ramírez-Giraldo et al., 2022).

Prior inflammatory episodes plausibly cause dense adhesions and fibrosis around Calot's triangle, while prior surgery may limit peritoneal access through adhesions—mirrored here by the significant link between difficulty grade and access to the peritoneal cavity (p=0.002). Elevated BMI likely worsens exposure and retraction, consistent with its strong association with dissection and extraction difficulty (p<0.001 for each).

Elevated TLC and MLR likely serve as proxies for active inflammatory disease biology, which causes oedema and microvascular congestion that obscure anatomical planes (Durak, Alkurt, & Tutan, 2021; Avci et al., 2024). These markers are inexpensive and routinely available, making them attractive additions to preoperative risk stratification, though they should be interpreted alongside clinical and radiological findings rather than in isolation.

Ultrasonographic gallbladder distension and wall thickening reflect local inflammatory burden and altered organ mechanics that increase the technical demand of dissection, in keeping with prior work (Bhandari et al., 2021; Magnano San Lio et al., 2022). Notably, while these variables predicted difficulty robustly, none predicted conversion in this cohort—most plausibly because conversion is a rare, surgeon-judgment-dependent endpoint, and with only two conversion events, statistical power was limited (Sugrue et al., 2019). This suggests a practical hierarchy: pre-operative variables are best used to anticipate operative difficulty—informing scheduling and counselling—while reliable prediction of conversion itself would require larger, multicentric cohorts with standardized criteria.

5. CONCLUSION

In this cohort, higher BMI, prior acute cholecystitis, prior jaundice, and previous abdominal surgery were significant clinical predictors of difficult LC; raised TLC and MLR were significant haematological predictors; and gallbladder distension and wall thickness >3 mm were significant radiological predictors. Conversion to open surgery remained infrequent (3.5%) and was not significantly predicted by any single pre-operative variable. Integrating these inexpensive, routinely available clinical, haematological, and ultrasonographic parameters into pre-operative assessment can improve surgical planning, operating room preparedness, and patient counselling for anticipated difficult laparoscopic cholecystectomy.

Limitations: This was a single-centre study with a relatively small sample size and only two conversion events, limiting power to detect conversion-specific predictors; ultrasonographic assessment is also subject to operator variability, and the observational design precludes causal inference.

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