

A Prospective Study of Preoperative Predictors and Scoring Systems to Predict Difficult Laparoscopic Cholecystectomy, with Comparison of the RSCLO Score and a New Institutional Score

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Abstract

Introduction: Difficult laparoscopic cholecystectomy (LC) increases operative time, conversion and biliary injury. Preoperative prediction aids planning. This study identified preoperative predictors of difficult LC and compared the Randhawa-Pujahari (RSCLO) score with a new institutional (Berhampur) score.

Methods: In this prospective observational analytical study, 260 adults undergoing elective LC for gallstone disease were assessed with clinical, laboratory and ultrasonographic parameters, and both scoring systems were applied preoperatively. Intraoperative difficulty was defined by predefined criteria. Associations were tested by chi-square or Fisher exact test; $p < 0.05$ was significant, and the diagnostic performance of the two scores was compared.

Results: Difficult LC occurred in 57 patients (21.9 percent). Advancing age ($p = 0.02$), male sex ($p = 0.02$), obesity ($p = 0.03$), raised total leukocyte count ($p < 0.001$), deranged liver function ($p < 0.001$), higher ASA grade ($p < 0.001$), previous acute cholecystitis ($p = 0.04$), pericholecystic collection ($p < 0.001$), impacted neck stone ($p < 0.001$), gallbladder wall thickening ($p < 0.001$) and lesser surgeon experience ($p = 0.02$) were significant predictors. The Berhampur score showed higher sensitivity (80.7 versus 75.4 percent) and a lower false-negative rate (19.3 versus 24.6 percent) than RSCLO, with slightly lower specificity (85.2 versus 90.1 percent).

Conclusion: Difficult LC can be reliably anticipated from routine preoperative parameters. The new Berhampur score improved sensitivity and missed fewer difficult cases than RSCLO, supporting its role in preoperative risk stratification, though multicenter validation is needed.

Keywords: Cholecystectomy, Laparoscopic; Gallstones; Cholecystitis; Risk Assessment; Preoperative Care; Predictive Value of Tests.

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Introduction

Laparoscopic cholecystectomy (LC) is the standard treatment for symptomatic gallstone disease and one of the commonest operations in general surgery [1, 2]. Gallstones are highly prevalent, and in India the burden is substantial, particularly in the northern and eastern states [3, 4, 5].

Although most cholecystectomies are straightforward, a proportion prove technically difficult, with dense adhesions, a frozen Calot triangle, obscured anatomy or a contracted, thick-walled gallbladder. Such difficulty prolongs operating time and raises the risk of bile-duct and vascular injury and of conversion to open surgery [6, 7]. Anticipating these cases before operation is

therefore valuable: it allows appropriate scheduling, allocation of an experienced surgeon, informed consent and readiness for bailout strategies such as subtotal cholecystectomy [6, 8]. A number of preoperative scoring systems have been proposed to quantify this risk, combining demographic, clinical, laboratory and ultrasonographic variables [7, 9, 10].

Among the most widely used in Indian practice is the Randhawa-Pujahari (RSCLO) score [6], but reported sensitivities vary and a clinically relevant proportion of difficult cases is missed, which is precisely the group in which forewarning matters most [11, 12]. The critical view of safety remains

the cornerstone of safe dissection, yet its attainment can be hindered by the very anatomical distortion that preoperative scores seek to predict [13]. Reliable, locally validated prediction is thus of practical importance, especially in high-volume public hospitals. Against this background the present study was undertaken with two aims: to identify the preoperative clinical, laboratory, ultrasonographic and surgeon-related factors associated with difficult LC, and to compare the predictive performance of the established RSCLO score with a new institutional (Berhampur) score developed for this population.

Materials and Methods

Design and Setting: This prospective observational analytical study was conducted in the Department of General Surgery of MKCG Medical College and Hospital, Berhampur, a tertiary care teaching hospital in Southern Odisha, India, over 24 months from November 2023 to October 2025, after Institutional Ethics Committee approval.

Participants: Consecutive adults admitted with cholelithiasis and planned for elective LC who consented and were willing to follow up were included. Patients undergoing emergency cholecystectomy, those with suspected or confirmed gallbladder malignancy, concomitant common bile-duct stones requiring primary open surgery, previous biliary tract surgery, or unfit for general anaesthesia were excluded. A total of 260 patients were enrolled by consecutive sampling; the target size was based on the reported incidence of difficult LC with allowance for dropouts and subgroup analysis.

Assessment: All patients underwent standardized preoperative evaluation comprising history, examination, laboratory tests and ultrasonography. Recorded variables were age, sex, body mass index (BMI), duration of symptoms, previous attacks of acute cholecystitis, previous upper-abdominal surgery, history of endoscopic retrograde cholangiopancreatography (ERCP), palpable gallbladder, comorbidity and American Society of Anesthesiologists (ASA) grade; total leukocyte count (TLC) and liver function tests (LFT: bilirubin, aspartate and alanine aminotransferases and alkaline phosphatase); and ultrasonographic gallbladder wall thickness, pericholecystic fluid or oedema, impacted neck or Hartmann-pouch stone, stone number and gallbladder contraction. Both the RSCLO score and the new Berhampur score were calculated preoperatively and each patient classified as predicted easy or difficult.

Operative procedure and outcome: All patients underwent standard four-port LC under general anaesthesia by surgeons of varying laparoscopic experience, following the principle of the critical

view of safety. Intraoperative difficulty was judged from operating time, dense adhesions, a frozen Calot triangle, difficult dissection, bile or stone spillage, need for additional ports and conversion. LC was classified as difficult when one or more of the following were present: operating time exceeding 90 minutes, conversion to open surgery, significant intraoperative complication, severe adhesions or distorted biliary anatomy. Immediate complications, hospital stay and mortality were recorded.

Statistical Analysis: Data were analyzed in IBM SPSS version 17.0. Categorical variables were summarized as frequencies and percentages and continuous variables as means. Associations between preoperative variables and operative difficulty were tested with the chi-square test, and the Fisher exact test where appropriate; a two-tailed $p < 0.05$ was considered significant. The sensitivity, specificity and false-negative rate of the two scores were computed against the intraoperative reference, and the internal consistency of the new score was assessed with the Cronbach alpha coefficient.

Ethics: The protocol was approved by the Institutional Ethics Committee and conducted per ICMR guidelines and the Declaration of Helsinki; written informed consent was obtained and data anonymized. [AUTHOR TO SUPPLY: ethics approval number and date.]

Results

Cohort and difficulty: Of 260 patients undergoing elective LC, 57 (21.9 percent) had a difficult procedure and 203 (78.1 percent) did not (Table 1). The mean age was 45 years; 191 patients (73.5 percent) were women and 69 (26.5 percent) men, and 182 (70.0 percent) were urban residents. Obesity was common (128, 49.2 percent), with a further 85 (32.7 percent) overweight. Raised TLC and deranged LFT were each present in 78 patients (30.0 percent); most were ASA grade I (180, 69.2 percent). Six of the 57 difficult cases (10.5 percent) were converted to open surgery, the remaining 51 being completed laparoscopically.

Predictors of difficulty: On univariate analysis, difficulty rose with advancing age, being highest in patients aged 60 years or more ($p = 0.02$), and was commoner in men than women (37.7 versus 16.2 percent, $p = 0.02$) and in obese patients (70.2 percent of difficult cases, $p = 0.03$) (Table 2). Raised TLC (present in 80.7 percent of difficult versus 12.8 percent of non-difficult cases, $p < 0.001$) and deranged LFT ($p < 0.001$) were strong laboratory predictors, as was higher ASA grade ($p < 0.001$). A previous attack of acute cholecystitis increased difficulty (27.1 versus 11.1 percent, $p = 0.04$). Among ultrasonographic findings, pericholecystic collection (difficult in 75.8 percent of those

affected, $p < 0.001$), impacted neck stone (59.1 percent, $p < 0.001$) and increasing gallbladder wall thickness (difficult in 83.3 percent with marked thickening, $p < 0.001$) showed the strongest associations. Lesser surgeon experience was also associated with difficulty (30.0 versus 17.8 percent, $p = 0.02$). A palpable gallbladder (2.0 percent), previous abdominal surgery (28.1 percent) and prior ERCP (1.9 percent) were infrequent and not significantly associated with difficulty.

Performance of the scoring systems: Both scores were significantly associated with operative difficulty (Table 3). The RSCLO score (cut-off 6 or

more) correctly identified 43 of 57 difficult cases, giving a sensitivity of 75.4 percent and specificity of 90.1 percent, with 14 difficult cases (24.6 percent) misclassified as easy.

The Berhampur score (cut-off 5 or more) correctly identified 46 of 57 difficult cases, a sensitivity of 80.7 percent and specificity of 85.2 percent, with only 11 missed (19.3 percent). Head to head, the new score detected more difficult cases (46 versus 43) and missed fewer (11 versus 14) at the cost of slightly lower specificity (Table 3, Figure 1). The internal consistency of the new score was moderate (Cronbach alpha 0.60).

Table 1: Baseline characteristics of patients undergoing elective laparoscopic cholecystectomy (n = 260).

Characteristic	n (%)
Mean age (years)	45
Age 20-39 / 40-59 / ≥ 60 years	117 (45.0) / 83 (31.9) / 60 (23.1)
Male / Female	69 (26.5) / 191 (73.5)
Urban / Rural residence	182 (70.0) / 78 (30.0)
BMI: normal / overweight / obese	47 (18.1) / 85 (32.7) / 128 (49.2)
Raised total leukocyte count	78 (30.0)
Deranged liver function test	78 (30.0)
ASA grade I / II / III	180 (69.2) / 65 (25.0) / 15 (5.8)
Previous acute cholecystitis	170 (65.4)
Pericholecystic collection (USG)	66 (25.4)
Impacted stone at gallbladder neck (USG)	44 (16.9)
GB wall: ≤ 3 / > 3 / ≥ 4 mm	172 (66.2) / 52 (20.0) / 36 (13.8)
Palpable gallbladder	5 (1.9)
Previous upper-abdominal surgery	73 (28.1)
Previous ERCP	5 (1.9)
Operated by experienced surgeon	180 (69.2)
Difficult laparoscopic cholecystectomy	57 (21.9)
Conversion to open (of difficult cases)	6 (10.5)

BMI body mass index; ASA American Society of Anesthesiologists; USG ultrasonography; GB gallbladder; ERCP endoscopic retrograde cholangiopancreatography.

Table 2: Association of preoperative predictors with difficult laparoscopic cholecystectomy (univariate analysis).

Predictor	Difficult, n (%)	Non-difficult, n (%)	p
Age ≥ 60 years	26 (45.6)	34 (16.7)	0.02
Male sex	26 (37.7 of men)	43 (62.3 of men)	0.02
Obese (BMI ≥ 25)	40 (70.2)	88 (43.3)	0.03
Raised total leukocyte count	52 (91.2)	26 (12.8)	< 0.001
Deranged liver function test	31 (54.4)	47 (23.2)	< 0.001
ASA grade II-III	33 (57.9)	47 (23.2)	< 0.001
Previous acute cholecystitis	46 (80.7)	124 (61.1)	0.04
Pericholecystic collection	50 (87.7)	16 (7.9)	< 0.001
Impacted neck stone	26 (45.6)	18 (8.9)	< 0.001
Marked GB wall thickening (≥ 4 mm)	30 (52.6)	6 (3.0)	< 0.001
Less-experienced surgeon	24 (42.1)	56 (27.6)	0.02
Palpable gallbladder	-	-	NS
Previous abdominal surgery	-	-	NS
Previous ERCP	-	-	NS

Chi-square or Fisher exact test. Percentages are of the difficult (n=57) or non-difficult (n=203) group unless stated as of men. NS not significant; GB gallbladder; ERCP endoscopic retrograde cholangiopancreatography.

Table 3: Predictive performance of the RSCLO score and the new Berhampur score for difficult laparoscopic cholecystectomy (n = 260).

Parameter	RSCLO score (cut-off ≥ 6)	Berhampur score (cut-off ≥ 5)
True positives / difficult	43 / 57	46 / 57
False negatives	14	11
True negatives / easy	183 / 203	173 / 203
False positives	20	30
Sensitivity (%)	75.4	80.7
Specificity (%)	90.1	85.2
False-negative rate (%)	24.6	19.3

Reference standard: intraoperative assessment of difficulty. Internal consistency of the Berhampur score: Cronbach alpha 0.60.

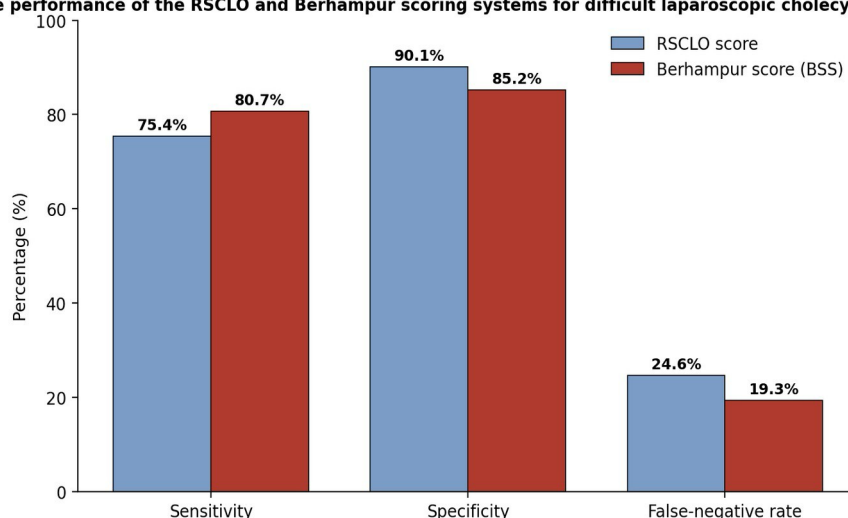
Predictive performance of the RSCLO and Berhampur scoring systems for difficult laparoscopic cholecystectomy (n = 260)

Figure 1: Sensitivity, specificity and false-negative rate of the RSCLO and Berhampur scoring systems for difficult laparoscopic cholecystectomy (n = 260). The Berhampur score shows higher sensitivity and a lower false-negative rate; RSCLO shows higher specificity.

Discussion

In this cohort of 260 elective laparoscopic cholecystectomies, roughly one in five proved difficult, a proportion consistent with reported series [6, 9, 10]. The predictors that emerged are those repeatedly implicated in the literature, and their convergence here strengthens the case for structured preoperative risk assessment rather than reliance on any single variable.

Advancing age was associated with difficulty ($p=0.02$), plausibly through recurrent inflammation, fibrosis and dense adhesions in the Calot triangle, and this accords with earlier predictive work [6]. Male sex carried a higher risk ($p=0.02$), a finding attributed to delayed presentation and denser pericholecystic fibrosis, and echoed by grading and scoring studies [7, 6]. Obesity was strongly associated with difficulty ($p=0.03$): increased visceral fat and altered landmarks complicate access, retraction and dissection, as recognised in standard texts and prior series [2, 10]. Notably, a large series has argued that obesity per se need not increase morbidity when expertise is adequate, underscoring that its effect is partly modifiable [17]. Raised total leukocyte count and deranged

liver function were among the strongest laboratory predictors (both $p<0.001$), reflecting active inflammation, oedema and friable, obscured tissues, and both feature in established scoring systems [6, 10]. Higher ASA grade likewise predicted difficulty ($p<0.001$), consistent with the greater comorbidity and chronic inflammation of these patients [6]. A previous attack of acute cholecystitis increased risk ($p=0.04$) through the fibrosis and adhesions of repeated inflammation [7]. Ultrasonography contributed the most powerful single predictors. Pericholecystic collection, an impacted neck stone and gallbladder wall thickening each showed a strong association ($p<0.001$), with marked wall thickening the most striking, difficult in more than four-fifths of affected patients. These parameters form the backbone of most published scores [6, 7, 10], and their prominence here supports routine, structured reporting of these features before operation. Surgeon experience mattered ($p=0.02$): less experienced operators encountered more difficulty, and experienced surgeons more often completed anticipated difficult cases laparoscopically without conversion, reflecting the learning curve and familiarity with bailout manoeuvres such as

subtotal cholecystectomy [7, 15, 25]. By contrast, a palpable gallbladder, previous abdominal surgery and prior ERCP were uncommon and not significant predictors in this cohort; their limited prevalence, and the elective, adequately spaced nature of most procedures, likely explain the absence of association, in keeping with reports that prior surgery and remote ERCP need not preclude a safe laparoscopic approach [7, 21].

Both scores predicted difficulty significantly, but their profiles differed. The RSCLO score was highly specific (90.1 percent) yet missed almost a quarter of difficult cases, the very group in which pre-warning is most useful; similar false-negative limitations of predictive scores have been noted before [6, 22, 23]. The new Berhampur score raised sensitivity to 80.7 percent and cut the false-negative rate to 19.3 percent, detecting 46 of 57 difficult cases against 43 for RSCLO, at the cost of modestly lower specificity. In preoperative risk stratification this trade-off is generally acceptable, since under-calling difficulty carries greater clinical penalty than over-calling it [24]. The moderate Cronbach alpha (0.60) indicates acceptable but improvable internal consistency, and the score requires prospective external validation before wider adoption.

The findings carry practical weight. A combination of routine demographic, clinical, laboratory and ultrasonographic variables, distilled into a simple score, can flag the difficult gallbladder before the first incision, prompting senior involvement, longer scheduling, fuller consent and preparedness for conversion or subtotal cholecystectomy [13, 15]. In a resource-limited, high-volume setting such stratification is a low-cost route to safer operating.

This study has limitations. It was Single-Centre, which constrains generalizability; the sample, though adequate for the primary comparison, was modest for subgroup analysis; surgeon experience could not be fully standardized; and some intraoperative difficulty criteria are partly subjective despite predefined definitions.

Advanced imaging was not incorporated, and long-term outcomes, quality of life and cost were not assessed. Multicenter validation with objective difficulty grading, and possibly machine-learning models, is the logical next step [12, 24].

Conclusion

Difficult laparoscopic cholecystectomy can be reliably anticipated from routine preoperative parameters: advancing age, male sex, obesity, raised leukocyte count, deranged liver function, higher ASA grade, previous acute cholecystitis and, most powerfully, ultrasonographic gallbladder wall thickening, pericholecystic collection and impacted

neck stones, together with lesser surgeon experience. The new Berhampur score improved sensitivity and missed fewer difficult cases than the RSCLO score, at the cost of slightly lower specificity, making it a useful preoperative risk-stratification tool. Prospective multicentre validation is recommended before broad application.

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