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Validation of Pre and Per Operative Scoring System for Predicting Difficult Laparoscopic Cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the standard treatment for symptomatic gallbladder disease, but predicting intraoperative difficulty remains challenging. Preoperative and intraoperative scoring systems, such as the Nassar scale, aim to identify high-risk cases and improve surgical planning. The objective of this study is to validate preoperative and intraoperative scoring systems for predicting difficult laparoscopic cholecystectomy and to identify significant predictors associated with increased surgical complexity.

Methodology: This prospective observational study was conducted at Maharani Laxmi Bai Medical College, Jhansi, from May 2023 to June 2024, including 166 LC patients meeting inclusion criteria. Preoperative factors (age, gender, ASA grade, gallbladder wall thickness, CBD diameter, admission type) were documented. Intraoperative difficulty was graded using the Nassar scale. Statistical analyses included chi-square tests and multivariate logistic regression ($p<0.05$).

Results: Difficult LC occurred in 36.7% of cases. Significant predictors on univariate analysis included age >50 years, male gender, higher ASA grade, thick gallbladder wall, and emergency admission. Multivariate analysis identified male gender and emergency admission as independent predictors. Higher Nassar grades (3-4) strongly correlated with increased difficulty, operative time, blood loss, and postoperative interventions.

Conclusions: Validated scoring systems reliably predict difficult LC, aiding preoperative counselling, surgical preparedness, and resource allocation. Their routine use can improve safety and outcomes.

Keywords: Laparoscopic cholecystectomy, Predictive scoring system, Nassar scale, Surgical difficulty, Preoperative assessment

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INTRODUCTION

Laparoscopic cholecystectomy has emerged as the gold standard for treating symptomatic gallbladder diseases, offering advantages such as minimal invasiveness, reduced postoperative pain, and quicker recovery compared to traditional open procedures.[1] However, despite these benefits, the surgery can pose significant challenges due to patient-specific and intraoperative variables, which may complicate the operation and increase the risk of adverse outcomes.[2] Therefore, predicting the difficulty of laparoscopic cholecystectomy has become a crucial aspect of preoperative planning and patient management, aiming to improve surgical outcomes and safety.[3]

Preoperative and intraoperative scoring systems have been developed to identify patients at higher risk for complicated surgeries. These scoring systems are designed to evaluate various patient factors and procedural complexities that may increase surgical difficulty. Preoperative scoring systems rely on patient demographics, clinical history, and imaging findings to assess the likelihood of encountering complications during the procedure. In contrast, intraoperative scoring systems focus on real-time surgical observations, such as anatomical challenges, inflammation, and adhesions, to determine the level of complexity. Integrating both preoperative and intraoperative factors can provide a comprehensive assessment, aiding surgeons in anticipating difficulties and adapting their surgical approach accordingly.[4]

A widely used preoperative model is the American Society of Anesthesiologists (ASA) classification, which assesses the patient's overall health status. Studies have shown that higher ASA grades are associated with increased surgical difficulty. Other preoperative factors, such as obesity, history of acute cholecystitis, and gallbladder wall thickness, have also been linked to challenging laparoscopic cholecystectomies. Obese patients, in particular, often present anatomical difficulties due to increased intra-abdominal fat, which can obscure vital structures during surgery. The presence of severe inflammation or fibrosis, commonly observed in patients with a history of cholecystitis, can lead to longer operative times and higher conversion to open surgery.[5-6]

This study was conducted to validate and assess the effectiveness of established preoperative and intraoperative scoring systems, including the Nassar scale, in predicting the difficulty of laparoscopic cholecystectomy. The specific objectives were to examine the correlation between preoperative predictions and intraoperative findings in order to develop a comprehensive predictive framework and to assess the impact of predictive scoring on operative time, conversion rates, intraoperative complications, and postoperative recovery.

MATERIALS AND METHODS

Study design: This prospective observational study was conducted in the Department of General Surgery, Maharani Laxmi Bai Medical College, Jhansi, from May 2023 to June 2024, after obtaining approval from the Institutional Ethics Committee (Ref. No. 2271/IEC/I/2022-2023, dated 24th April, 2023) and written informed consent from all participants. A total of 166 patients were enrolled based on a calculated sample size of 162.22 using the formula $n = Z^2\ p(1\text{-}p)/d^2$ with expected prevalence of 12%, 95% confidence level, and 5% precision. Patients above 18 years of age presenting with symptomatic gallstone disease and requiring laparoscopic cholecystectomy were included, while those with jaundice, suspected malignancy, or hepatitis B/C infection were excluded. Eligible patients were recruited consecutively, and data were collected directly by the Principal Investigator using a structured proforma covering socio-demographic details, clinical parameters, ultrasonographic findings, and operative records. Preoperative risk was assessed using a validated difficulty scoring system, while intraoperative findings were graded by the Nassar scale.

Table 1: Preoperative risk scale for difficult laparoscopic cholecystectomy[5]

Variable	Points
Age (years)	
<40	0
40+	1
Gender	
Female	0
Male	1
ASA classification	
1	0
2	1
3	2
4	7
Primary diagnosis	
Pancreatitis	0
Biliary colic	0
Choledocholithiasis	1
Cholecystitis	4
Thick-walled gallbladder (≥3 mm)	
No	1
Yes	2
Common biliary duct dilation (>6 mm)	
No	1
Yes	2
Type of admission	
Elective	1
Delayed	2
Emergency	3
Previous admissions	
Yes	1
No	2
Admission to surgery	
0 day	1
1 day	2
2 days	3
3+ days	4

Risk for difficult laparoscopic cholecystectomy-Low risk: 0-1, intermediate risk: 2-6, high risk: 7-26[5]

Table 2: Intraoperative difficulty scale for laparoscopiccholecystectomy

Grade 1	• Gallbladder floppy, non-adherent • Cystic pedicle thin and clear • Adhesions simple up to the neck/Hartmann´s pouch
Grade 2	• Gallbladder mucocele, packed with stones • Cystic pedicle fat laden • Adhesions simple up to the body
Grade 3	• Gallbladder deep fossa, acute cholecystitis, contracted, fibrosis, Hartmann's adherent to common bile duct, impaction • Cystic pedicle abnormal anatomy or cystic duct short, dilated or obscured • Adhesions dense up to fundus; involving hepatic flexure or duodenum
Grade 4	• Gallbladder completely obscured, empyema, gangrene, mass • Cystic pedicle impossible to clarify • Adhesions dense, fibrosis, wrapping the gallbladder, duodenum or hepaticflexure difficult to separate

Easy: 1-2, difficult: 3-4

Relation between Preoperative and Intraoperative NASSAR Scale[5]:

Low Preoperative Risk (0-1 Points): These patients are likely to have a straightforward laparoscopic cholecystectomy with low intraoperative difficulty (Grade 1).

Intermediate Preoperative Risk (2-6 Points): These patients may present with moderate intraoperative challenges, possibly correlating with Grade 2 on the intraoperative scale.

High Preoperative Risk (7-19 Points): These patients are at high risk for difficult surgeries, likely correlating with Grades 3 or 4 on the intraoperative scale, indicating severe inflammation, dense adhesions, or complex anatomy.

Definition of Operative Difficulty: To declare as a difficult laparoscopic cholecystectomy, at least one of the following parameters should be present: a) Time taken more than 27 min (more than 1.5 times the surgeon individual base time); b) Bile or stone spillage; c) Injury to duct; d) Conversion to open, and e) Drain insertion

Preoperative Assessment: Each patient was evaluated using a preoperative scoring system, which considered factors such as age, gender, ASA classification, type of admission, primary diagnosis, gallbladder wall thickness, and CBD diameter. Based on the preoperative scores, risk categories were defined as low (0-1), intermediate (2-6), or high (7-26).

Intraoperative Evaluation: Intraoperatively, the Nassar scale was utilized to evaluate the difficulty of the procedure, with conditions categorized from Grade 1 (easy) to Grade 4 (most difficult). Outcome measures, including conversion to open surgery, blood loss, operative time, bile or stone spillage, and the need for drain insertion, were thoroughly documented.

Inclusion Criteria: Patients aged 18 years or older, having Symptomatic gallstones, indicated for laparoscopic cholecystectomy and capable of giving informed consent were included in the study.

Exclusion Criteria: Patients with jaundice, Gallbladder malignancy, or chronic hepatitis B or C infections were excluded.

Statistical Analysis: Data were entered in Microsoft Excel and analyzed using SPSS version 26.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean±SD and compared using Student's t-test for normally distributed data or Mann-Whitney U test for non-parametric data, while categorical variables were analyzed using Chi-square test or Fisher's exact test when required. To identify independent predictors of difficult laparoscopic cholecystectomy, multivariate logistic regression analysis was performed, and results were expressed as odds ratios with 95% confidence intervals. A p-value <0.05 was considered statistically significant for all analyses

RESULTS

Univariate analysis (Table 3) demonstrated that several socio-demographic, clinical, and ultrasonographic variables were significantly associated with difficult laparoscopic procedures. The proportion of difficult operations increased progressively with advancing age and was notably higher among male patients. Higher ASA grades showed a rising trend toward operative difficulty. With respect to primary diagnosis, patients with choledocholithiasis and cholecystitis had a substantially greater likelihood of difficult surgery compared with those presenting with biliary colic. Ultrasonographic evidence of a thick-walled gallbladder was also significantly associated with operative difficulty. Furthermore, emergency admissions showed the highest proportion of difficult operations when compared with elective and delayed admissions.

On multivariate logistic regression analysis (Table 4), male gender and type of admission emerged as independent predictors of operative difficulty after adjustment for potential confounders. Elective admission was associated with a significantly lower likelihood of difficult surgery, whereas other variables lost statistical significance in the adjusted model. Intraoperative difficulty grading using the Nassar scale (Table 5) revealed a clear stepwise increase in the proportion of difficult operations with higher grades. While Grade 1 procedures were predominantly easy, Grade 4 procedures were associated with a very high rate of operative difficulty.

Table 3: Univariate Analysis of Socio-Clinical-ultrasonographic Factors (N=166)

Variable	Difficult Operations (%)	Total (%)	p-value
Age (Years)			
<40	19 (26.39)	72 (43.4)	0.03
40-49	13 (34.21)	38 (22.9)	
50-64	22 (52.38)	42 (25.3)	
65+	7 (50.00)	14 (8.4)	
Gender			
Male	22 (52.38)	42 (25.3)	0.01
Female	39 (31.45)	124 (74.7)	
ASA Classification			
I	24 (28.57)	84 (50.6)	0.05
II	35 (44.87)	78 (47.0)	
III	2 (50.00)	4 (2.4)	
IV	0 (0.00)	0 (0.0)	
Primary Diagnosis			
Pancreatitis	0 (0.00)	0 (0.0)	0.02
Biliary Colic	19 (25.33)	75 (45.2)	
Choledocholithiasis	5 (50.00)	10 (6.0)	
Cholecystitis	37 (45.68)	81 (48.8)	
Thick-walled Gallbladder			
No	27 (27.84)	97 (58.4)	0.04
Yes	34 (49.28)	69 (41.6)	
CBD Diameter			
<6mm	55 (35.71)	154 (92.8)	0.32
>6mm	6 (50.00)	12 (7.2)	
Admission Type			
Elective	35 (30.70)	114 (68.7)	0.007
Delayed	10 (37.04)	27 (16.3)	
Emergency	16 (64.00)	25 (15.0)	
Admission to Surgery Time			
0 days	39 (33.33)	117 (70.5)	0.32
1 day	13 (46.43)	28 (16.9)	
2 days	9 (42.86)	21 (12.7)	
3+ days	0 (0.00)	0 (0.0)	

Table 4: Multivariate Analysis of Predictive Factors

Variable	Adjusted Odds Ratio	95% CI	p-value
Age	0.505	0.229 - 1.114	>0.05
Gender (Male)	0.395	0.176 - 0.885	<0.05
ASA I	0.811	0.098 - 6.738	>0.05
ASA II	1.541	0.192 - 12.382	>0.05
Biliary Colic	0.559	0.247 - 1.264	>0.05
Choledocholithiasis	1.685	0.4 - 7.093	>0.05
Thick GB	0.483	0.223 - 1.05	>0.05
Elective Admission	0.228	0.085 - 0.616	<0.05
Delayed Admission	0.297	0.087 - 1.015	>0.05

Table 5: Intraoperative Difficulties Scale According to NASSAR

Nassar Grade	Easy Operations (%)	Difficult Operations (%)	Total (%)
1	68 (85.00)	12 (15.00)	80 (48.2)
2	27 (69.23)	12 (30.77)	39 (23.5)
3	6 (54.55)	5 (45.45)	11 (6.6)
4	4 (11.11)	32 (88.89)	36 (21.7)

Further analysis of intraoperative parameters across Nassar grades (Table 6) showed that increasing Nassar scores were consistently associated with longer operating times, higher intraoperative blood loss, increased incidence of bile or stone spillage, greater need for drain insertion, and a longer duration of hospital stay. Conversions to open surgery were observed exclusively in the highest Nassar grade, underscoring the strong correlation between intraoperative grading and surgical complexity.

DISCUSSION

Laparoscopic cholecystectomy (LC) remains the gold standard for symptomatic gallstone disease, but predicting surgical difficulty continues to be a challenge. Identifying preoperative and intraoperative predictors helps optimize surgical planning, patient counselling, and resource allocation. In the present study, several predictors were evaluated, and the findings were compared with existing literature.

Age has been variably associated with operative difficulty. Gupta N et al.[3] demonstrated that patients above 50 years had higher rates of complex LC, consistent with our findings in univariate analysis. However, multivariate analysis in our study did not confirm age as an independent predictor, similar to observations by Mohanty SK et al.[7], who found only modest correlation. This suggests that age, though contributory, may not be a standalone determinant of difficulty.

Gender was a strong predictor in our study, with males experiencing significantly more difficult operations. Yol S et al.[8] reported higher conversion and complication rates in men, attributing this to recurrent inflammation and fibrosis. Nassar AHM et al.[5] also validated male gender as a consistent risk factor across multicenter datasets. These findings reinforce the need for careful preoperative assessment in male patients.

ASA grade showed an association with difficult LC in univariate analysis but did not retain statistical significance after adjustment. In contrast, Randhawa JS and Pujahari AK [9] highlighted ASA grade as a reliable preoperative predictor, while Kanakala V et al.[10] suggested its role diminishes when other factors are considered. This variability reflects differences in patient populations and surgical experience.

Primary diagnosis strongly influenced surgical complexity. Our study found cholecystitis and choledocholithiasis to be high-risk conditions, consistent with the findings of Nassar AHM et al.[5] and Ashfaq A et al.[11], who emphasized that acute inflammatory pathology predisposes to adhesions, friable tissue planes, and increased conversion rates.

Ultrasonographic parameters were also significant, with gallbladder wall thickness >3 mm associated with increased difficulty. This aligns with Siddiqui MA et al.[12], who proposed a standardized ultrasound scoring system identifying wall thickness as a key predictor.

Table 6: Relation Between Intra-Op Difficulty Variables and NASSAR Scale

Intra-operative Variable	NASSAR Scale (Easy: 1-2, difficult: 3-4)			
	Score 1	Score 2	Score 3	Score 4
Mean Operating Time	23.93± 8.899 min	27.56± 6.504 min	30.55± 8.779 min	45.14± 14.025 min
Conversion to Open	0	0	0	3
Mean Blood Loss	16.78± 8.421 ml	21.90± 7.943 ml	17.73± 4.671 ml	31.38± 14.318 ml
Bile/Stone Spillage	4	0	1	8
Injury to Duct	0	0	0	0
Drain Insertion	0	0	0	10
Mean Time to Discharge	3.00± 0.000 days	3.05± 0.320 days	3.00± 0.000 days	3.77± 1.003 days

However, common bile duct (CBD) dilatation did not show significance in our cohort, differing from Vivek MA et al.[13], who found CBD diameter to be predictive. Such discrepancies may reflect differences in case selection and sample size.

Type of admission emerged as one of the most important predictors, with emergency cases showing a markedly higher risk of difficulty. Bourgouin S et al.[14] similarly demonstrated that emergency admissions significantly increase the likelihood of conversion and complications, underscoring the importance of timely elective intervention.

Intraoperatively, the Nassar scale was validated as a robust grading tool in our study. Higher grades (3-4) correlated with prolonged operative time, greater blood loss, and need for postoperative interventions. Sugrue M et al[4] and Nassar AHM et al.[5] have previously confirmed its reproducibility and predictive accuracy, supporting its routine application in surgical practice.

Overall, our study highlights that male gender and emergency admission are independent predictors of surgical difficulty, while factors such as age, ASA grade, and ultrasonographic findings contribute variably. These findings broadly align with earlier research but also emphasize population-specific variations. The combined use of preoperative predictors and intraoperative grading systems enhances risk stratification, improves preparedness, and contributes to safer surgical outcomes. Future multicentre studies with larger cohorts are warranted to refine predictive models further.

CONCLUSION

This study validates preoperative and intraoperative scoring systems to predict the difficulty of laparoscopic cholecystectomy, identifying advanced age, male gender, higher ASA classification, choledocholithiasis, cholecystitis, thick-walled gallbladder, and emergency admissions as significant predictors of difficulty on univariate analysis. Multivariate analysis highlighted male gender and emergency admission as statistically significant factors. Higher Nassar grades were strongly associated with complex surgeries, emphasizing the importance of preoperative evaluation and strategic planning for high-risk patients. These validated scoring systems can enhance surgical planning, improve patient outcomes, and optimize resource allocation, with future research needed to refine these models across diverse populations.

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Individual Author's Contribution: PKS assisted in patient recruitment, data management, literature review, and manuscript editing. **AV** conceptualized and designed the study, supervised data collection, and critically reviewed the manuscript and **RS** performed data acquisition, analysis, and interpretation, and contributed to drafting the initial manuscript. All authors read and approved the final manuscript.

Availability of data: The data that support the findings of this study are available from the corresponding author on reasonable request.

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