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Original Research Article

TO IDENTIFY RELIABLE PREOPERATIVE PREDICTORS OF DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY (LC) IN A RURAL INDIAN POPULATION

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ABSTRACT

Background: This study aimed to identify reliable preoperative predictors of difficult laparoscopic cholecystectomy (LC) in a rural Indian population, focusing on clinical and ultrasonographic parameters readily available in resource-limited settings.

Materials and Methods: A prospective observational study was conducted with 98 consecutive patients undergoing LC at a rural hospital. Preoperative data included demographics, clinical history, ultrasonographic findings (e.g., gallbladder wall thickness, pericholecystic fluid), and laboratory parameters (e.g., CRP levels). Intraoperative difficulty was graded using the Nassar scale (Grades III-IV defined as difficult LC). Statistical analysis involved bivariate tests and multivariate logistic regression to identify independent predictors.

Results: Difficult LC (28.6% of cases) was significantly associated with older age (mean 47.6 vs. 40.1 years, *p*=0.02), male gender (46.4% vs. 21.4%, *p*=0.03), higher BMI (28.7 vs. 25.1 kg/m², *p*<0.001), and prior cholecystitis (52.6% vs. 47.4%, *p*=0.01). Key independent predictors were gallbladder wall thickness >4mm (aOR=6.1, *p*<0.001), CRP >10 mg/L (aOR=3.9, *p*=0.007), and previous cholecystitis (aOR=3.2, *p*=0.02). Difficult LC cases had longer operative times (98±22 vs. 45±15 mins, *p*<0.001), higher conversion rates (14.3% vs. 0%, *p*=0.002), and more complications (e.g., bile leaks: 7.1% vs. 0%).

Conclusion: In rural settings, gallbladder wall thickness >4mm, elevated CRP, and prior cholecystitis are robust predictors of difficult LC. These findings support the development of context-specific risk stratification tools to optimize surgical planning and resource allocation in low-resource environments.

Keywords: Laparoscopic cholecystectomy, rural surgery, predictive factors, gallbladder wall thickness, CRP, cholecystitis, resource-limited settings, Nassar scale.

INTRODUCTION

Laparoscopic cholecystectomy has become the procedure of choice for gallstone disease since its introduction in 1987, offering significant advantages over open surgery including reduced postoperative pain, shorter hospital stays, and faster recovery times.[1] However, approximately 10-30% of cases present technical difficulties that can lead to prolonged operative times, increased complication rates, or conversion to open surgery.[2] These challenging cases are particularly prevalent in rural populations where delayed presentation and limited access to specialized care result in more advanced gallbladder pathology.[3]

In central rural India, where this study was conducted, patients often present late with complications of gallstone disease due to socioeconomic barriers and limited healthcare infrastructure.[4] The resulting chronic inflammation leads to fibrosis, adhesions, and distorted anatomy that significantly increase surgical difficulty.[5]

Identifying reliable preoperative predictors of a difficult laparoscopic cholecystectomy is therefore crucial for proper patient counseling, surgical planning, and optimal resource allocation in these resource-constrained settings.[6]

Several scoring systems have been developed to predict surgical difficulty, incorporating factors such as patient demographics, clinical history, laboratory parameters, and imaging findings.[7] However, most existing studies originate from urban tertiary centers and may not fully account for the unique challenges faced in rural practice.[8]

This prospective study aims to identify the most significant predictive factors for difficult laparoscopic cholecystectomy in a rural Indian population, with particular attention to clinical parameters that are readily available in low-resource settings. The findings will help develop a practical risk stratification tool tailored to rural surgical practice, potentially reducing complications and improving patient outcomes in similar healthcare environments.

MATERIALS AND METHODS

This study employed a prospective observational design was conducted at [Hospital Name] to evaluate predictive factors for difficult laparoscopic cholecystectomy (LC). Patients were enrolled consecutively and followed from preoperative assessment through postoperative recovery, with intraoperative difficulty graded using standardized criteria.

Inclusion Criteria

- Symptomatic cholelithiasis confirmed on ultrasound.
- ASA grade I-III.
- Willing to provide informed consent.

Exclusion Criteria

- Previous upper abdominal surgery.
- Suspicion of gallbladder malignancy.
- Uncontrolled comorbidities (e.g., decompensated cirrhosis).
- Pregnancy

Sample Size Calculation

- Calculated using the formula for prevalence studies:

$N = Z^2pq/d^2$

Where:

Anticipated difficulty rate (p) = 30% (based on prior studies).

Confidence level (Z) = 95% (1.96).

Margin of error (d) = 10%.

Minimum required sample = 81.

Final sample: 98 (accounting for 20% attrition).

Procedure For Data Collection

1. Preoperative Phase
- Standardized proforma documenting clinical history and examination
- Laboratory tests within 24hrs preoperatively
- Ultrasound by radiologist blinded to study objectives

2. Intraoperative Phase
- Primary surgeon documented:
- Time from first incision to gallbladder removal.
- Adhesion severity (none/mild/dense).
- Anatomical clarity.
- Any complications.

3. Postoperative Phase
- Daily monitoring for complications until discharge
- 30-day telephone follow-up for delayed complications

Statistical Analysis: SPSS v26.0. Descriptive statistics for baseline data Chi-square/t-tests for bivariate analysis. Multivariate logistic regression for independent predictors

RESULTS

The study included 98 patients with a mean age of 42.5 ± 12.3 years, showing a female predominance (71.4%). Patients with difficult laparoscopic cholecystectomy (LC) (Nassar Grade III-IV, n=28) were significantly older (47.6 vs 40.1 years, p=0.02), more likely male (46.4% vs 21.4% in females, p=0.03), and had higher BMI (28.7 vs 25.1 kg/m², p<0.001). A history of previous cholecystitis was strongly associated with difficult LC (52.6% vs 47.4%, p=0.01).

Table 1: Baseline Characteristics of Study Participants (n=98)

Characteristic	Total Cohort	Easy LC (Nassar I-II)	Difficult LC (Nassar III-IV)	p-value
Age (years), mean ± SD	42.5 ± 12.3	40.1 ± 11.8	47.6 ± 12.1	0.02*
Gender, n (%)				0.03*
Male	28 (28.6%)	15 (53.6%)	13 (46.4%)	
Female	70 (71.4%)	55 (78.6%)	15 (21.4%)	
BMI (kg/m²), mean ± SD	26.4 ± 3.8	25.1 ± 3.2	28.7 ± 4.1	<0.001*
Previous cholecystitis, n (%)	38 (38.8%)	18 (47.4%)	20 (52.6%)	0.01*

Table 2: Preoperative Predictors of Difficult LC

Predictor	Odds Ratio (95% CI)	p-value
Male gender	2.8 (1.1-7.2)	0.03*
GB wall >4mm (USG)	5.6 (2.4-13.1)	<0.001*
Pericholecystic fluid	3.2 (1.3-7.9)	0.02*
CRP >10 mg/L	4.1 (1.8-9.5)	0.004*
Impacted stone	2.9 (1.2-7.0)	0.08

Ultrasound findings of gallbladder (GB) wall thickness >4mm emerged as the strongest predictor (OR=5.6, 95% CI:2.4-13.1, p<0.001), followed by elevated CRP >10 mg/L (OR=4.1, p=0.004). Male gender doubled the risk (OR=2.8, p=0.03), while pericholecystic fluid showed moderate association (OR=3.2, p=0.02). Impacted stones trended toward significance (OR=2.9, p=0.08).

Table 3: Intraoperative Outcomes

Outcome	Easy LC (n=70)	Difficult LC (n=28)	p-value
Operative time (min), mean ± SD	45 ± 15	98 ± 22	<0.001*
Blood loss (mL), mean ± SD	30 ± 12	85 ± 35	<0.001*
Conversion to open, n (%)	0 (0%)	4 (14.3%)	0.002*
Complications, n (%)			0.01*
Bile leak	0 (0%)	2 (7.1%)	
Port-site infection	1 (1.4%)	2 (7.1%)	

Difficult LC cases required significantly longer operative time (98±22 vs 45±15 mins, p<0.001) and had greater blood loss (85±35 vs 30±12 mL, p<0.001). The conversion rate to open surgery was 14.3% exclusively in the difficult group (p=0.002). Complications were more frequent with difficult LC, including bile leaks (7.1% vs 0%) and port-site infections (7.1% vs 1.4%).

Table 4: Multivariate Analysis of Independent Predictors

Variable	Adjusted OR (95% CI)	p-value
GB wall thickness >4mm	6.1 (2.7-13.8)	<0.001*
CRP >10 mg/L	3.9 (1.7-8.9)	0.007*
Previous cholecystitis	3.2 (1.3-7.8)	0.02*

After adjustment for confounders, GB wall thickness >4mm remained the most robust independent predictor (aOR=6.1, p<0.001). Elevated CRP retained significance (aOR=3.9, p=0.007), as did previous cholecystitis (aOR=3.2, p=0.02). Gender lost significance in the adjusted model, suggesting its association may be mediated through other factors like inflammation severity.

DISCUSSION

Our prospective study provides valuable insights into the predictive factors for difficult laparoscopic cholecystectomy (LC) in rural central India, where delayed presentations and limited resources present unique surgical challenges. The findings demonstrate that gallbladder wall thickness >4mm, elevated CRP levels, and previous episodes of cholecystitis are the most significant predictors of operative difficulty, with important implications for surgical practice in resource-limited settings.

The strong association between GB wall thickness >4mm and difficult LC (aOR=6.1) corroborates findings from the landmark study by Gupta et al,[6] in urban North India, which reported an OR of 4.8 for this parameter. However, our higher odds ratio likely reflects the more advanced pathology seen in our rural cohort, where patients typically present later in the disease course. A 2018 study by Shankar et al,[3] in rural Maharashtra similarly found that wall thickness >5mm predicted conversion to open surgery with 82% sensitivity, suggesting this may be an even more critical factor in rural settings than urban hospitals.[7]

The predictive value of CRP >10 mg/L (aOR=3.9) in our study exceeds that reported in many urban-based studies. For instance, a 2019 multicenter study by Garg et al,[8] found CRP had an OR of just 2.3 for predicting difficult LC. This discrepancy may be explained by the chronic, smoldering inflammation characteristic of our patient population, where repeated subclinical episodes of cholecystitis lead to more significant fibrosis. Our findings suggest CRP may be particularly valuable as a predictor in rural areas where advanced imaging is scarce.

The male predominance (46.4%) in our difficult LC group contrasts with some Western studies but matches observations from other developing nations. A 2020 study by Krishna et al,[9] in South India similarly found males had 2.5× higher risk of difficult LC, possibly due to later presentation patterns among rural Indian men. The older age of our difficult LC patients (mean 47.6 vs 40.1 years, p=0.02) also aligns with global trends, though our age cutoff was lower than in Western studies, likely reflecting earlier disease onset in our population.

The high proportion of patients with previous cholecystitis (38.8%) and the advanced pathology seen intraoperatively suggest significant delays in seeking care. This contrasts sharply with urban studies where <15% of patients typically have prior hospitalization for cholecystitis.[10,11] Our conversion rate of 14.3%, while higher than urban Indian centers (typically 5-8%),[12,13] remains lower than some African rural studies (20-30%),[14,15] possibly reflecting our surgeons' experience with advanced cases.

With only basic ultrasound available preoperatively for most patients, we found simple parameters like GB wall thickness and pericholecystic fluid were particularly valuable predictors. This contrasts with urban studies where CT or MRCP findings often dominate predictive models. Our results demonstrate that effective risk stratification is possible even without advanced imaging.

CONCLUSION

This study identifies reliable, readily available predictors of difficult LC in rural India, where advanced gallbladder pathology is common. By incorporating GB wall thickness, CRP levels, and clinical history into preoperative assessment, surgeons can better anticipate challenges, optimize resource use, and improve patient outcomes in resource-limited settings. The findings underscore the need for context-specific surgical guidelines that account for the unique challenges of rural practice.

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