

Original Research Article

Validation of the G10 scoring system in predicting conversion from laparoscopic to open cholecystectomy in department of surgery at a tertiary medical centre of North India: a prospective observational study

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the gold standard for managing symptomatic cholelithiasis. However, intraoperative challenges may necessitate conversion to open cholecystectomy (OC), which increases morbidity. The G10 score aims to stratify surgical difficulty and predict conversion risk. To evaluate the effectiveness of the G10 scoring system in predicting the need for conversion from LC to OC.

Methods: This hospital-based, prospective observational study was conducted at GSVM Medical College, Kanpur, between November 2023 and November 2025. A total of 146 patients with chronic cholecystitis undergoing elective LC were included. G10 scores were recorded intraoperatively. Data analysis included descriptive statistics, chi-square tests, independent t-tests, logistic regression, and ROC curve analysis using SPSS v23.0.

Results: Among the 146 patients, 24 (16.4%) required conversion to OC. The mean G10 score in the converted group was 6.08 compared to 3.4 in the non-converted group ($p < 0.001$). ROC AUC was 0.87, indicating strong predictive value. Significant predictors included adhesions from previous surgeries, gallstones > 1 cm in Hartmann's pouch, and presence of pus or bile (all $p = 0.00$). Logistic regression model accuracy was 80%.

Conclusion: The G10 score is a reliable intraoperative predictor of conversion from LC to OC. Its application supports better surgical planning and improved patient outcomes.

Keywords: laparoscopic cholecystectomy, Intraoperative risk assessment, G10 scoring system, Conversion to open surgery, Cholelithiasis complications

INTRODUCTION

Cholelithiasis is a common biliary disorder characterized by the presence of gallstones, which can lead to complications such as cholecystitis, choledocholithiasis, and biliary pancreatitis.¹ LC has become the treatment of choice due to lower morbidity, shorter hospital stays, and quicker recovery times.²

However, certain intraoperative factors may necessitate conversion to OC, especially in difficult gallbladder

cases, leading to increased morbidity and longer recovery.^{3,4} Accurate intraoperative assessment is critical to reduce complications and improve outcomes. The G10 scoring system, developed by Sugrue et al assesses 10 operative factors to stratify difficulty levels and guide decisions regarding conversion.⁵ While validated in several international studies, further evaluation in diverse surgical settings remains essential.^{6,7} This study investigates the G10 scoring system's validity in predicting conversion in a North Indian tertiary care center.

METHODS

Study design and setting

A prospective observational study was prospectively conducted at the Department of General Surgery, GSVM Medical College, Kanpur.

Study duration

The duration of the study was from November 2023-April 2025.

Study population

All adult patients (>18 years) undergoing laparoscopic cholecystectomy (LC) for chronic cholecystitis with cholelithiasis.

Inclusion criteria

Patients included were those aged over 18 years undergoing elective laparoscopic cholecystectomy for chronic cholecystitis who provided informed consent.

Exclusion criteria

Patients were excluded for the following reasons: presence of choledocholithiasis, pregnancy, hemodynamic instability, chronic illnesses such as coronary artery disease (CAD) or chronic obstructive pulmonary disease (COPD), ascites, a palpable right upper quadrant mass, or uncontrolled diabetes mellitus (HbA1c > 7%).

Sample size

The sample size was of 146 patients selected via simple random sampling.

Ethical considerations

Ethical approval was obtained from the Ethics Committee, GSVM Medical College Kanpur issued approval EC/161/April/2024 and informed consent was secured from all participants.

Data collection

A detailed history and physical examination were performed preoperatively. Intraoperatively, the G10 scoring system score was assigned based on factors such as: degree of gallbladder adhesions, gallbladder distension/contraction, graspability, presence of impacted stones (>1 cm), BMI>30, adhesions from previous surgery, free bile/pus, cholecystoenteric fistula. Each parameter scored from 0-1 (some up to 3), yielding a maximum score of 10. Patients were observed intraoperatively to determine whether conversion occurred.

Statistical analysis

SPSS v23.0 was used. Quantitative data were expressed as mean±SD (standard deviation), and qualitative data as frequency and percentage. Independent t-tests, chi-square tests, and logistic regression were applied. ROC (receiver operating characteristic) curve analysis determined predictive accuracy. A p value <0.05 was considered statistically significant.

RESULTS

Demographic distribution

Of the 146 patients, 120 (82%) were female and 26 (18%) males, consistent with known female predominance in cholelithiasis. The highest representation was in the 41-60 age group (121 patients, 82.9%). Mean age was 50.19±9.4 years (Table 1).

Body mass index analysis

Mean BMI was 29.23 for females and 33.14 for males. Obesity (BMI >30) was present in 73 patients (50%) and showed a significant association with higher G10 scoring system scores and increased conversion risk (p<0.05).

Intraoperative variables and conversion

The presence of specific intraoperative findings and their association with conversion to open surgery is detailed in Table 2. Adhesions from previous surgeries, impacted stones >1 cm, and the presence of free bile or pus were all strongly associated with conversion (p<0.001).

Table 1: Demographic characteristics of the study population (n=146).

Variable	Frequency (n=146)	%
Sex		
Female	120	82.2
Male	26	17.8
Age group (in years)		
18-40	12	8.2
41-60	121	82.9
>60	13	8.9
Mean age (in years)	-50.19±9.4	

Table 2: Association of intraoperative variables with conversion (n=146).

Variable	Present in patients (N)	Conversion rate (%)	P value
Adhesions from previous surgeries	48	37.5	<0.001
Impacted stone >1 cm	57	31.5	<0.001
Free bile or pus	19	42.1	<0.001
Buried gall bladder	31	32.2	0.01
Cholecysto-enteric fistula	7	42.8	0.05
BMI >30	73	26	<0.05

Table 3: Comparison of mean G10 scores between groups.

Group	Mean G10 score	Standard deviation	P value
Converted (n=24)	6.08	±1.22	<0.001
Non-converted (n=122)	3.4	±1.11	

Conversion rate and G10 score

Conversion to open cholecystectomy was required in 24 patients (16.4%). The mean G10 score was significantly higher in the converted group (6.08±1.22) compared to the non-converted group (3.40±1.11) ($p<0.001$) (Table 3). A G10 score ≥ 5 was associated with a 75% conversion rate.

Predictive model performance

The ROC analysis showed an area under the curve (AUC) of 0.87, indicating excellent predictive ability (Figure 1). The logistic regression model had an accuracy of 80%, a precision of 1.00, a recall (sensitivity) of 0.67, and an F1-score of 0.40. The correlation coefficient (r) between the G10 score and conversion was 0.51.

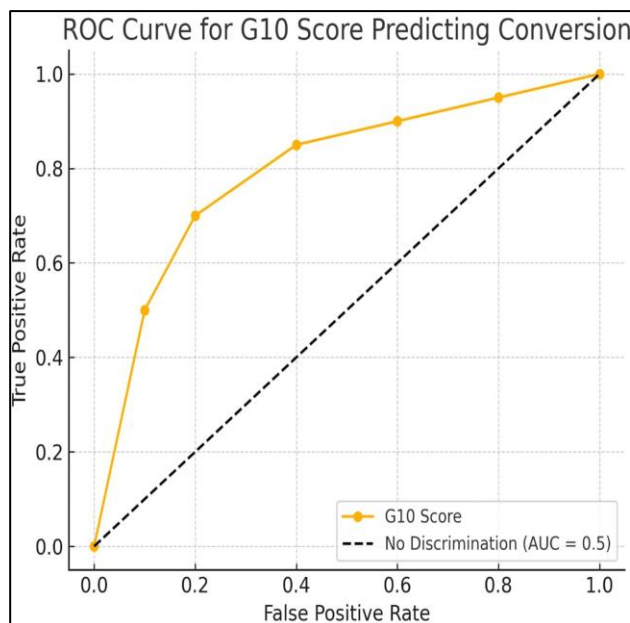


Figure 1: Receiver operating characteristic (ROC) curve for the G10 score predicting conversion from laparoscopic to open cholecystectomy.

DISCUSSION

The results of this study affirm the effectiveness of the G10 scoring system in predicting conversion from laparoscopic to open cholecystectomy. With a conversion rate of 16.4% and a mean G10 score of 6.08 among converted cases, our findings align with prior research by Sugrue et al who originally proposed the G10 scoring model.⁵ The moderate correlation ($r=0.51$) and high ROC AUC (0.87) suggest that the G10 score is not only statistically significant but also clinically relevant in operative planning.⁸

Studies conducted in other geographic regions, such as by Baral et al in Nepal and Umer et al in Pakistan, reported similar findings, reinforcing the external validity of the G10 system across diverse populations. These studies reported AUCs above 0.85, comparable to our findings, and identified similar predictors for conversion including BMI, previous surgery, and impacted stones at Hartmann's pouch.^{6,7,9} Adhesions from previous surgeries remain a universally accepted risk factor for difficult cholecystectomy and conversion, echoed by Thakur et al and Shrestha et al in their respective analyses.^{10,11} The findings support this with strong statistical significance ($p<0.001$).

The identification of large, impacted stones and presence of pus or bile as conversion predictors also aligns with clinical observations and previously published data.^{7,11} Interestingly, while factors like gallbladder distension and fistula presence were associated with higher G10 scores, they did not independently predict conversion with the same strength. This discrepancy emphasizes the value of a cumulative scoring system over reliance on individual findings.^{5,12}

The logistic regression model achieved an 80% accuracy rate, with perfect precision but moderate recall (0.67), indicating a strong ability to correctly identify true conversion cases while potentially missing some borderline cases. The model's F1 score of 0.40 suggests

room for refinement, potentially through the inclusion of intraoperative imaging or machine learning-enhanced prediction tools.⁸

Firstly, the relatively modest sample size from a single center may limit the generalizability of our findings. Secondly, intraoperative scoring, while based on defined criteria, inherently carries a degree of subjectivity. Future implementations could benefit from video-based assessments or dual scoring by surgeons to improve standardization and reduce bias.¹³ Despite these limitations, our results contribute to the growing body of evidence supporting the use of the G10 score in clinical practice.

CONCLUSION

The G10 scoring system is an effective intraoperative tool for predicting the likelihood of conversion from laparoscopic to open cholecystectomy. In this study reaffirms that a G10 scoring system score above 4 is significantly associated with difficult surgical cases and higher conversion rates. Major predictors of conversion include adhesions due to previous surgery, impacted stones in Hartmann's pouch, and presence of pus or bile in the operative field.

The G10 scoring system score enhances intraoperative decision-making by allowing surgeons to anticipate conversion early and prepare accordingly. This can lead to reduced operative time, fewer complications, and improved patient safety.

Future directions include the incorporation of real-time scoring systems with artificial intelligence-assisted surgical video analysis for predictive modeling in high-risk cases.

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