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Predictors of Conversion from Laparoscopic to Open Cholecystectomy: A Retrospective Observational Study

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the gold standard for symptomatic gallstone disease. However, conversion to open cholecystectomy (OC) remains a concern, occurring in 2–15% of cases, and is associated with increased morbidity, prolonged hospitalization, and higher costs. Identifying predictors of conversion can aid in preoperative counselling, case selection, and operative planning. This study was designed to evaluate clinical, radiological, and intraoperative factors associated with conversion of LC to OC in a simulated cohort of patients.

Materials and Methods: This retrospective observational study was conducted with 90 cases undergoing laparoscopic cholecystectomy. Data included demographic variables, comorbidities, clinical presentation, laboratory findings, imaging features, and surgeon experience. Conversion to OC was analysed as the primary outcome. Univariate analysis was performed using Chi-square and t-tests, while multivariate logistic regression identified independent predictors.

Results: The mean age of cases was 43.3 ± 11.2 years; 40 (44.4%) were male. Diabetes and hypertension were present in 30% and 41% of patients, respectively. Acute cholecystitis was the most common presentation (40%). The overall conversion rate was 26.7%. Higher conversion rates were observed among males (30%), patients with acute cholecystitis (38.8%), gallbladder wall >3 mm (38.7%), and those operated on by surgeons with <2 years' experience (40.9%). Multivariate analysis identified acute cholecystitis as an independent predictor of conversion (OR 3.20, 95% CI 1.02–10.04, p=0.046).

Conclusion: Acute cholecystitis significantly increases the risk of conversion from LC to OC, while male sex, obesity, radiological severity markers, and limited surgeon experience show contributory trends. Risk stratification and allocation of high-risk cases to experienced surgeons may reduce conversion rates and improve outcomes.

Keywords: *Laparoscopic cholecystectomy, open cholecystectomy, acute cholecystitis, predictors, risk factors.*

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1. INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold-standard surgical treatment for symptomatic gallstone disease,

offering reduced postoperative pain, shorter hospital stay, and faster return to normal activities compared to open cholecystectomy (OC) [1]. However, conversion from LC to OC remains a substantial concern, especially in patients with acute inflammation, obscured anatomy, or other complicating factors. Identifying preoperative predictors of conversion is essential for surgical planning, risk counselling, and optimizing patient outcomes.

Recent systematic reviews and meta-analyses have emphasized that acute cholecystitis is among the strongest predictors of conversion. For example, Magnano San Lio et al. found that acute cholecystitis increased the odds of conversion by over five-fold (OR ≈ 5.5, 95% CI 2.96-10.13) in pooled studies [2]. Other common risk factors reported in the literature include male gender, advanced age (often >60 years), obesity, diabetes mellitus, hypertension, wall thickening of the gallbladder observed on imaging, presence of pericholecystic fluid, and history of prior upper abdominal surgery [3-6].

Lee et al. reported that patients with wall thickness >3 mm, male sex, acute presentation, and prior surgery had significantly higher conversion rates, even up to 12-15% in certain settings [5]. In another large retrospective study from Turkey, acute cholecystitis, increased wall thickness, and older age were independently associated with conversion [6]. Single centric study underscore that wall thickening >3-4 mm is associated with higher conversion risk, particularly when combined with clinical signs of inflammation [7].

Despite the consistency of many risk indicators, effect sizes and statistical significance vary across studies. Some report that obesity or comorbidities like diabetes or hypertension are significant, while others find that after adjustment these lose significance, with acute disease status being the dominant predictor [2,4]. Surgeon-related factors including operative experience and case volume further modulate the risk and have been incorporated into risk stratification scores [8].

With above reference, the present study aimed to explore which preoperative factors are independently associated with conversion of LC to OC. Study also focus on how best to anticipate and reduce conversion rates through preoperative assessment, decision making, and resource allocation.

2. MATERIALS AND METHODS

This was a retrospective observational study conducted April 2024 to June 2025 at the KLE Co-operative Hospital and KLE Suchirayu Hospital, Hubli, Karnataka. A total of 90 consecutive adult patients above 18 years of age undergoing laparoscopic cholecystectomy for symptomatic gallstone disease were recruited. The sample size was determined using the formula for estimating a single proportion, based on an expected conversion rate of 10%, with a 95% confidence level and a 3% margin of error, yielding a minimum sample of 90 patients.

Inclusion Criteria: Cases aged above18 years of both genders, diagnosed with symptomatic gallstone disease through clinical features including right upper quadrant pain, Murphy's sign, biliary colic, through ultrasound findings like gallstones, sludge, wall thickening >3 mm, pericholecystic fluid and by laboratory investigations like elevated C-reactive protein [CRP], cases allocated for elective or emergency laparoscopic cholecystectomy and cases undergoing either early surgery (<7 days) from symptom onset or delayed surgery (>7 days).

Exclusion Criteria: Cases with history of previous biliary surgery, pregnant women, cases with unstable haemodynamics requiring emergency open cholecystectomy and incidental gallbladder carcinoma diagnosed intraoperatively or on histopathology and cases not willing to participate were excluded.

Data Collection

Data pertaining to patients were extracted from electronic medical records, surgical documentation, radiological archives, and pathology reports. The sociodemographic and clinical information, encompassing age, sex, BMI, and comorbidities such as diabetes mellitus, hypertension, and liver disease, along with specifics of clinical diagnoses like acute or chronic cholecystitis, biliary colic, the duration of symptoms, and prior episodes of cholecystitis, were meticulously gathered. All subjects participated in essential laboratory investigations, including total leukocyte count, C-reactive protein, liver function tests, and serum albumin assessments. Radiological assessments encompass gallbladder wall thickness (greater than 3 mm versus less than or equal to 3 mm), the presence of pericholecystic fluid, the characteristics of calculi, and the diameter of the common bile duct. The relevant data encompassing the surgeon's expertise, intraoperative observations such as adhesions, bleeding, ambiguous anatomy, surgical duration, the decision to convert to open surgery, and details regarding postoperative complications were meticulously gathered.

The decision to convert from laparoscopic cholecystectomy to open cholecystectomy was made by the operating surgeon based on several critical factors, including the presence of adhesions that obscured anatomical landmarks, uncontrolled intraoperative bleeding, suspected injury to the bile duct, and challenges in safely identifying the structures of Calot's triangle.

Statistical Analysis

The collected data was extracted to Microsoft Excel sheet and data was analysed using SPSS v.26.0. The categorical variables were represented in frequencies and percentage and continuous variables in mean and standard deviation. Chi-square test was applied to assess associations between categorical variables and independent t-test was for continuous variables. Logistic regression was performed to identify independent predictors of conversion. Odds ratios (OR) with 95% confidence intervals (CI) were reported. A *p*-value <0.05 was considered statistically significant.

3. RESULTS

A total of 90 patients undergoing laparoscopic cholecystectomy were included. The mean age was 43.3 years, with 40 males (44.4%) and 50 females (55.6%). The mean BMI was 26.5 ± 4.1 kg/m². Comorbidities included diabetes mellitus in 30% and hypertension in 41% of patients. Clinical presentations included acute cholecystitis (40%), chronic cholecystitis (38%), and biliary colic (22%) (Table 1).

Table 1. Baseline demographic and clinical characteristics of study population (n=90).

Variables	Frequency (%)
Age (Mean±SD)	43.3 ± 11.2
Gender (Male: Female)	40:50
BMI (kg/m²)	26.5 ± 4.1
Associated comorbidities	
Diabetes mellitus	27 (30.0%)
Hypertension	37 (41.1%)
Clinical diagnosis	
Acute cholecystitis	36 (40.0%)
Chronic cholecystitis	34 (37.8%)
Biliary colic	20 (22.2%)
Pericholecystic fluid	25 (27.8%)
Impacted stone	26 (28.9%)
Gall bladder wall thickness	
>3 mm	31 (34.4%)
≤3 mm	59 (65.56%)
Surgeon experience	
<2 years	22 (24.4%)
2-5 years	32 (35.6%)
>5 years	36 (40.0%)

The overall conversion rate was 26.7%. Conversions were more frequent in males (30%), patients with acute cholecystitis (38.8%), gallbladder wall thickness >3 mm (38.7%), and when surgery was performed by less experienced surgeons (<2 years, 40.9%) (Table 2).

Table 2. Conversion rates according to patient and clinical factors.

Factor	Conversion Rate	
	Frequency	Percentage
Overall	24	26.7%
Gender		
Male	12	30%
Female	12	24%
Pericholecystic fluid	08	32%
Impacted stone	08	30.7%
Gall bladder wall thickness		
>3 mm	12	38.7%
≤3 mm	12	20.3%
Surgeon experience		
<2 yrs	09	40.9%
2-5 yrs	09	28.1%
>5 yrs	06	20%

Univariate analysis showed higher conversion rates among patients with acute cholecystitis, male sex, BMI >25, and gallbladder wall >3 mm. Multivariate logistic regression identified acute cholecystitis as an independent predictor of conversion (OR 3.20, 95% CI 1.02–10.04, *p=0.046*). Other variables (male sex, high BMI, wall thickness, pericholecystic fluid) showed trends but did not reach statistical significance (Table 3) (Graph 1).

Graph 1: **Conversion rates according to Clinical diagnosis.**

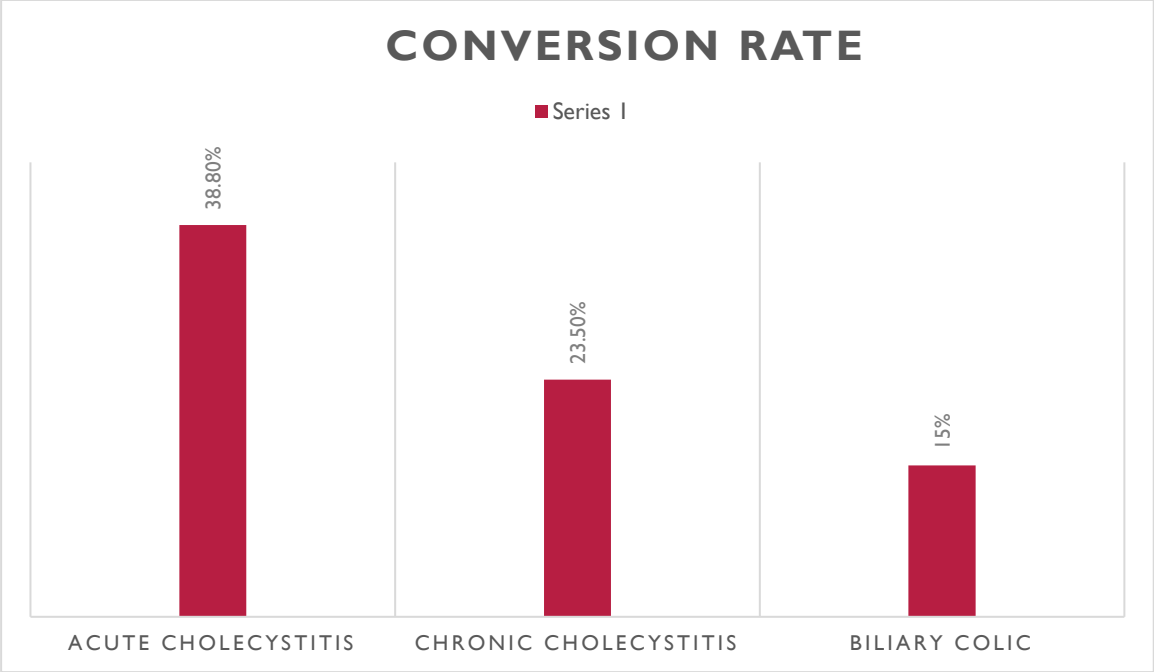

Table 3. Logistic regression analysis of predictors of conversion.

Variable	Odds Ratio (OR)	95% CI	p-value
Acute cholecystitis	3.20	1.02–10.04	0.046 *
Male sex	1.21	0.43–3.39	0.714
Age	0.99	0.95–1.04	0.764
BMI	1.12	0.98–1.27	0.090
Diabetes	1.91	0.61–5.98	0.265
Hypertension	1.19	0.38–3.67	0.767
Gallbladder wall >3 mm	1.98	0.65–5.99	0.228
Pericholecystic fluid	1.64	0.49–5.53	0.424
Impacted stone	0.48	0.13–1.71	0.256

4. DISCUSSION

This study exhibited the overall conversion rate to open cholecystectomy (OC) was 26.7%, and acute cholecystitis emerged as the only independent predictor of conversion (OR 3.20, 95% CI 1.02–10.04, p = 0.046). Other factors gender, higher BMI, gallbladder wall thickening and presence of pericholecystic fluid showed risk trends but did not reach statistical significance. These findings are in agreement with earlier studies that emphasize acute inflammation as a dominant driver of conversion risk [9-11].

Conversion rates in the literature vary widely, from 2–15%, depending on case-mix, patient selection, and surgeon expertise [9, 12]. A Cochrane review confirm that conversion remains a clinically relevant outcome, associated with increased operative morbidity, longer hospital stay, and higher cost [13]. Our observed rate of 26.7% is higher than most contemporary reports, but this can be explained by the relatively high proportion of acute cholecystitis cases included in the sample.

Several studies have specifically addressed the impact of acute cholecystitis on conversion risk. Ibrahim et al. reported that acute inflammation increases the odds of conversion nearly fourfold [14], while Kortram et al. found conversion rates up to 30% in acute cases compared to <10% in elective cases [15]. Similarly, Tang and Cuschieri demonstrated that acute

cholecystitis remains the most consistent and strongest predictor across prospective cohorts [16]. Our OR of 3.2 closely parallels these reports, reinforcing the established role of acute disease in predicting conversion.

The influence of patient factors such as obesity and male sex has been repeatedly investigated. Obesity increases operative difficulty by limiting exposure and obscuring anatomy, while male patients are reported to have more advanced or complicated disease at presentation [17,18]. In our cohort, BMI demonstrated a trend toward higher risk (OR 1.12, p=0.09), and male sex was associated with a slightly higher conversion rate (30% vs 24%) but did not reach significance. This finding is consistent with Rosen et al., who found that obesity and male sex predicted conversion in univariate but not multivariate analysis [19]. Similarly, Livingston and Rege, using a nationwide database, noted higher conversion among older and male patients, though the effect was attenuated after adjusting for disease severity [18].

Radiological markers are also useful in predicting conversion. Gallbladder wall thickening (>3 mm), pericholecystic fluid, and impacted stones have been linked with difficult anatomy and intraoperative hazards [20,21]. In our series, both thickened walls and pericholecystic fluid were associated with higher crude conversion rates but lost statistical significance in multivariate analysis, likely due to collinearity with acute disease. Lipman et al. demonstrated similar findings, noting that thickened gallbladder walls and impacted stones significantly predicted conversion in imaging-based preoperative assessments [20].

Surgeon experience is another crucial determinant. Less experienced surgeons tend to have lower thresholds for conversion when encountering unclear anatomy, bleeding, or adhesions. In our cohort, conversion was highest among surgeons with <2 years' experience (40.9%) compared to those with >5 years (20%). These findings are consistent with Giger et al., who analyzed over 22,000 LC cases and showed that operative difficulty and conversion rates decline significantly with increased experience [22]. Nassar et al. also emphasized that proper allocation of high-risk cases to senior surgeons reduces both conversion and bile duct injury [23].

Because of the multifactorial nature of conversion, several predictive scoring systems have been proposed. The Randhawa and Pujahari scoring method incorporate clinical and imaging findings to anticipate a "difficult cholecystectomy" [24], while Sugrue et al. developed an intraoperative scoring tool to predict the likelihood of conversion [25]. Despite their promise, these tools require validation across diverse populations. In our study, acute cholecystitis alone emerged as a strong predictor, but combining this with radiological and patient factors may improve accuracy, as supported by the literature.

5. CONCLUSION

This study findings concluded that acute cholecystitis is the most significant independent predictor of conversion from LC to OC, while male sex, high BMI, gallbladder wall thickening, and surgeon inexperience contribute to increased risk but with less consistent independent significance. Risk stratification using clinical, imaging, and surgeon factors and allocating high-risk cases to experienced surgeons may reduce unplanned conversions and improve outcomes. Prospective, multicenter validation of predictive models remains a priority.

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