

Clinical Predictors, Conversion Rates, and Surgical Outcomes of Laparoscopic Cholecystectomy Converted to Open Cholecystectomy: A Retrospective Hospital-Based Study

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Abstract:

Background: Laparoscopic cholecystectomy (LC) is the gold standard treatment for symptomatic gallstone disease because of its minimal invasiveness and faster recovery. However, conversion to open cholecystectomy is occasionally required in technically difficult cases to ensure patient safety. Identifying preoperative clinical predictors may help anticipate conversion and improve surgical outcomes.

Aim: To evaluate the clinical predictors, conversion rates, and surgical outcomes of laparoscopic cholecystectomy converted to open cholecystectomy in a tertiary care hospital.

Methodology: This retrospective hospital-based study was conducted over a period of one year at a Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar, India. A total of 115 patients who underwent laparoscopic cholecystectomy for symptomatic gallstone disease were included. Demographic characteristics, clinical predictors, operative details, conversion rates, postoperative complications, length of hospital stay, and treatment outcomes were retrieved from hospital medical records and analyzed using descriptive and inferential statistics.

Results: The majority of patients were females (63.5%) aged 41–50 years (30.4%). Acute cholecystitis (33.9%), thickened gallbladder wall (29.6%), and dense pericholecystic adhesions (27.0%) were the most common predictors of conversion. The overall conversion rate was 13.0%. Dense adhesions (33.3%) and unclear Calot's triangle anatomy (26.7%) were the leading reasons for conversion. Surgical site infection (10.4%) was the most frequent postoperative complication. Overall, 97.4% of patients recovered successfully, while mortality was 2.6%.

Conclusion: Laparoscopic cholecystectomy remains a safe and effective procedure with a low conversion rate and favorable outcomes. Early recognition of high-risk patients and timely conversion when indicated are essential to minimize complications and improve surgical outcomes.

Keywords: Laparoscopic cholecystectomy; Open cholecystectomy; Conversion rate; Gallstone disease; Clinical predictors; Surgical outcomes; Retrospective study.

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Introduction

Due to its high prevalence and related medical expenses, gallstone disease, also known as cholelithiasis, is one of the most common gastrointestinal conditions in the world and poses a substantial health burden. About 10–20% of adults are affected, and the incidence rises with age, obesity, metabolic syndrome, diabetes mellitus, and female sex. One of the most common reasons for elective abdominal surgery is still gallstone disease, and one of the most common operations in general surgery is cholecystectomy. Due to its safety, decreased postoperative

pain, shorter hospital stay, quicker recovery, better cosmetic results, and lower overall complication rates when compared to traditional open cholecystectomy (OC), laparoscopic cholecystectomy (LC) has become the gold standard treatment for symptomatic gallstone disease. Despite these benefits, laparoscopic cholecystectomy still poses technical difficulties in some clinical settings, often requiring conversion to an open surgery to protect patients and avoid major intraoperative problems [1].

When safe laparoscopic dissection is not possible, switching from laparoscopic to open cholecystectomy should be considered a wise intraoperative choice rather than a surgical failure. Depending on surgeon expertise, patient characteristics, illness severity, and the availability of modern laparoscopic equipment, the reported conversion rate varies significantly across various institutions and patient groups, ranging from 2% to 15% [2]. When anatomical features cannot be readily recognized, conversion is typically carried out to reduce the risk of bile duct damage, uncontrolled bleeding, intestinal injury, or vascular problems. Dense adhesions in Calot's triangle, significant inflammatory alterations, acute cholecystitis, constricted or fibrotic gallbladder, empyema, gangrenous gallbladder, Mirizzi syndrome, heavy bleeding, and uncertain biliary architecture are the most frequent intraoperative reasons of conversion [3]. While conversion guarantees patient safety, compared to successful laparoscopic surgeries, it is linked to longer hospital stays, more postoperative discomfort, higher healthcare costs, and more postoperative morbidity [4].

To help with proper patient selection, better perioperative counselling, and improving operational planning, several studies have looked for conversion predictors. The chance of conversion has been found to be influenced by a few preoperative and intraoperative parameters. Numerous studies have found that significant predictors include advanced age, male sex, obesity, prior upper abdominal surgery, diabetes mellitus, acute or recurrent cholecystitis, thickened gallbladder wall, pericholecystic fluid collection, impacted gallstones, elevated inflammatory markers, and coexisting systemic illnesses [5]. However, because to variations in research design, patient demographics, surgeon competence, and institutional regulations, there is a great deal of heterogeneity within published studies. As a result, no widely recognized prediction model has been developed to precisely identify individuals who are at high risk of conversion prior to surgery [6].

Because preoperative risk assessment allows surgeons to foresee technical difficulties, optimize operating room resources, advise patients about potential conversion, and minimize perioperative problems, the development of trustworthy clinical predictors is especially crucial. Early identification of high-risk patients also makes it easier for skilled surgeons to participate promptly and make the right intraoperative decisions, which enhances surgical safety. Additionally, by minimizing problems, cutting down on needless surgical delays, and accelerating postoperative recovery, understanding conversion factors helps improve the use of hospital resources. The multidimensional aspect of this clinical issue is further highlighted by recent research that indicates conversion rates may be influenced by sur-

geon expertise, hospital case volume, emergency surgery, and surgical scheduling [7].

Despite the fact that laparoscopic cholecystectomy is now commonplace worldwide, the epidemiology and conversion predictors vary significantly between developed and developing nations due to differences in disease presentation, delayed access to healthcare, socioeconomic conditions, the prevalence of complicated gallstone disease, and the availability of advanced laparoscopic expertise [8]. Due to delayed presentation and restricted access to specialized surgical treatments, patients in India often arrive with recurrent biliary colic, acute cholecystitis, empyema, dense adhesions, and chronic inflammatory alterations. When compared to elective laparoscopic surgeries carried out in industrialized healthcare systems, these considerations may lead to greater conversion rates and increase surgical complexity. Furthermore, regionally produced information is required to direct clinical decision-making and enhance surgical results due to regional variations in patient characteristics, nutritional status, concomitant disorders, and healthcare infrastructure [9].

Gallstone disease accounts for a significant amount of surgical burden in Gaya, Bihar, which is a significant referral centre for patients from both urban and rural populations. There is still little published data on the clinical predictors, conversion rates, and surgical outcomes of laparoscopic cholecystectomy converted to open surgery in Bihar, despite the procedure's growing use in tertiary care facilities throughout the state. Most of the research that are now accessible were conducted in urban areas, and as a result, their conclusions might not fully represent the demographics, illness features, and healthcare difficulties that exist in eastern India. Therefore, in order to determine local predictors of conversion, assess surgical outcomes, and offer proof for bettering patient care and surgical planning, region-specific retrospective studies are crucial [10].

To assess the clinical predictors, conversion rates, and surgical outcomes of laparoscopic cholecystectomy converted to open cholecystectomy in patients treated at a tertiary care hospital in Gaya, Bihar, India, the current retrospective hospital-based study was conducted. Demographic traits, preoperative clinical considerations, intraoperative discoveries that result in conversion, conversion rates, postoperative problems, length of hospital stay, and treatment results are all to be examined in this study. The results are anticipated to provide important geographical information that might help surgeons identify patients who are more likely to convert, enhance patient counselling, improve operational planning, and maximize surgical results in the treatment of gallstone disease.

Methodology

Study Design: The present study was a retrospective hospital-based observational study conducted to evaluate the clinical predictors, conversion rates, and surgical outcomes of laparoscopic cholecystectomy converted to open cholecystectomy. The study involved a retrospective review of hospital records of patients who underwent laparoscopic cholecystectomy during the study period. The study was designed to assess demographic characteristics, clinical presentation, preoperative predictors, intraoperative findings, reasons for conversion, postoperative complications, and treatment outcomes.

Study Area: The study was conducted in the Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital (ANMMCH), Gaya, Bihar, India.

Study Duration: The study was carried out over a period of one year from March 2025 to February 2026.

Sample Size: A total of 125 patients who underwent laparoscopic cholecystectomy and fulfilled the study eligibility criteria were included in the analysis.

Sample Population: The study population comprised adult patients diagnosed with symptomatic gallstone disease who were scheduled for laparoscopic cholecystectomy. Patients who required intraoperative conversion from laparoscopic to open cholecystectomy and those who completed laparoscopic cholecystectomy successfully were included for comparison to identify clinical predictors, conversion rates, and surgical outcomes.

Data Collection: Data were collected retrospectively from hospital medical records, operative notes, anesthesia records, laboratory reports, imaging findings, and discharge summaries using a structured data collection proforma. Information retrieved included demographic details, clinical presentation, comorbidities, ultrasonographic findings, laboratory investigations, previous abdominal surgery, indication for surgery, intraoperative findings, reasons for conversion to open cholecystectomy, operative duration, postoperative complications, duration of hospital stay, and final treatment outcomes. All patient identifiers were removed to maintain confidentiality.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with symptomatic cholelithiasis, or gallbladder disease underwent laparoscopic cholecystectomy during the study period.
- Patients with complete medical records, operative notes, and postoperative follow-up details.

- Patients in whom laparoscopic cholecystectomy was either completed successfully or converted to open cholecystectomy intraoperatively.

Exclusion Criteria

- Patients who underwent primary open cholecystectomy without an initial laparoscopic attempt.
- Patients with suspected or confirmed gallbladder malignancy.
- Patients with incomplete or missing clinical records.
- Patients undergo cholecystectomy as part of another major abdominal procedure.
- Patients with severe trauma-related gallbladder injuries or congenital biliary anomalies.

Procedure: All patients underwent routine preoperative clinical evaluation, abdominal ultrasonography, and standard laboratory investigations, including complete blood count, liver function tests, renal function tests, blood glucose, coagulation profile, serum electrolytes, and viral screening as indicated. Patients diagnosed with symptomatic gallstone disease were planned for laparoscopic cholecystectomy under general anesthesia after obtaining informed surgical consent, including the possibility of conversion to open cholecystectomy if required. Pneumoperitoneum was established using a Veress needle or open (Hasson) technique according to surgeon preference, and the procedure was performed using the standard four-port laparoscopic technique. During surgery, intraoperative findings such as dense adhesions, acute inflammation, fibrosis, bleeding, unclear biliary anatomy, common bile duct stones, gallbladder perforation, or technical difficulties were documented. Whenever safe laparoscopic dissection could not be achieved, conversion to open cholecystectomy was performed based on the operating surgeon's judgment. Following surgery, patients received standard postoperative care, including analgesics, antibiotics, early mobilization, and monitoring for complications. Postoperative outcomes, complications, length of hospital stay, and final discharge status were recorded and analyzed.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test, whereas continuous variables were compared using the Independent Student's t-test or Mann-Whitney U test, as appropriate. Logistic regression analysis was performed to identify independent clinical predictors associated with conversion from laparoscopic to open cholecystectomy, and the results were ex-

pressed as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value <0.05 was considered statistically significant”.

Result

Table 1 shows the study population's demographic and clinical details. The research involved 115 patients in total. The age group of 41–50 years old accounted for the largest percentage of patients (30.4%), followed by the age group of 31–40 years old (23.5%), suggesting that middle-aged individu-

als had laparoscopic cholecystectomy the most frequently. Because gallstone disease is more common in women, women made up the bulk of the study group (63.5%) compared to men (36.5%). In terms of body mass index, 20.0% of patients were obese, 37.4% were overweight, and 42.6% had a normal BMI. Furthermore, 77.4% of the patients had no history of diabetes, whereas 22.6% of the patients had diabetes mellitus.

Table 1: Demographic and Clinical Characteristics of the Study Population (N = 115)		
Variable	Frequency (n)	Percentage (%)
Age Group (Years)		
18–30	18	15.7
31–40	27	23.5
41–50	35	30.4
51–60	22	19.1
>60	13	11.3
Gender		
Male	42	36.5
Female	73	63.5
BMI		
Normal (<25 kg/m ²)	49	42.6
Overweight (25–29.9 kg/m ²)	43	37.4
Obese (≥30 kg/m ²)	23	20
Diabetes Mellitus		
Yes	26	22.6
No	89	77.4

Table 2 illustrates the distribution of clinical predictors that are associated with the transition from laparoscopic to open cholecystectomy. Acute cholecystitis was the most common predictor, occurring in 33.9% of patients, followed by thicker gallbladder wall (>4 mm) in 29.6% and extensive pericholecystic adhesions in 27.0% of cases. Contracted or fibrotic gallbladder (15.7%) impacted gallstone at the

gallbladder neck (13.9%), and prior upper abdominal surgery (12.2%) were additional significant predictors. Gallbladder empyema (8.7%) and common bile duct stones (7.0%) were less frequent predictors. These results imply that the most common causes of technically difficult laparoscopic cholecystectomy were inflammatory alterations and problematic biliary architecture.

Table 2: Clinical Predictors Associated with Conversion to Open Cholecystectomy (N = 115)		
Clinical Predictor	Frequency (n)	Percentage (%)
Acute cholecystitis	39	33.9
Thickened gallbladder wall (>4 mm)	34	29.6
Dense pericholecystic adhesions	31	27
Contracted/Fibrotic gallbladder	18	15.7
Previous upper abdominal surgery	14	12.2
Impacted gallstone at neck	16	13.9
Empyema of gallbladder	10	8.7
Common bile duct stone	8	7

In Table 3, the conversion rate and the reasons for the transition from laparoscopic to open cholecystectomy are presented. Of the 115 patients, 100 (87.0%) had laparoscopic cholecystectomy with success, whereas 15 (13.0%) needed to be converted to open surgery. The most frequent cause of conversion among converted patients was thick pericholecystic adhesions (33.3%), followed by ambiguous

Calot's triangle anatomy (26.7%). 13.3% of conversions were caused by either significant inflammatory changes or uncontrolled intraoperative haemorrhage. Gallbladder perforation (6.7%) and probable common bile duct damage (6.7%) were less prevalent indications. These results suggest that conversion to an open cholecystectomy was mostly re-

quired due to challenging intraoperative anatomy and significant inflammatory pathology.

Table 3: Conversion Rate and Reasons for Conversion (N = 115)		
Variable	Frequency (n)	Percentage (%)
Completed Laparoscopically	100	87
Converted to Open Surgery	15	13
Reasons for Conversion (n = 15)		
Dense adhesions	5	33.3
Unclear anatomy (Calot's triangle)	4	26.7
Uncontrolled bleeding	2	13.3
Severe inflammation	2	13.3
Gallbladder perforation	1	6.7
Common bile duct injury suspicion	1	6.7

Table 4 consolidates the surgical outcomes and post-operative complications of the study participants. With 10.4% of patients experiencing surgical site infections, the most frequent postoperative consequences were respiratory issues (4.3%), bile leak (3.5%), wound seroma (2.6%), and postoperative bleeding (1.7%). Nonetheless, most patients (77.4%) recovered from surgery without any prob-

lems. 55.7% of patients were released from the hospital within three days, 31.3% stayed for four to six days, and 13.0% needed to stay for seven days or more. A favorable overall surgical result with a low mortality rate was demonstrated by the fact that 112 patients (97.4%) recovered and were released, while 3 patients (2.6%) passed away.

Table 4: Surgical Outcomes and Postoperative Complications (N = 115)		
Variable	Frequency (n)	Percentage (%)
Postoperative Complications		
Surgical site infection	12	10.4
Bile leak	4	3.5
Respiratory complications	5	4.3
Wound seroma	3	2.6
Postoperative bleeding	2	1.7
No complication	89	77.4
Length of Hospital Stay		
≤3 days	64	55.7
4–6 days	36	31.3
≥7 days	15	13
Outcome		
Recovered and discharged	112	97.4
Mortality	3	2.6

Discussion

Laparoscopic cholecystectomy (LC) is generally thought to be the best way to treat gallstone disease because it is less invasive, causes less pain after surgery, requires less time in the hospital, leads to faster recovery, and has lower morbidity rates compared to open cholecystectomy (Tazuma et al., 2017). However, when safe laparoscopic dissection is not possible, conversion to open cholecystectomy is still a crucial intraoperative choice. The clinical predictors, conversion rates, and surgical outcomes of laparoscopic cholecystectomy done in a tertiary care hospital in Gaya, Bihar, were assessed in the current retrospective hospital-based study” [11].

According to the research's demographic data, most patients were between the ages of 41 and 50 (30.4%), followed by those between the ages of 31

and 40 (23.5%). Women made up 63.5% of the study population. These results align with the epidemiology of gallstone disease, which mostly affects middle-aged women due to estrogen-induced cholesterol supersaturation of bile, pregnancy, and hormonal effects. According to Ibrahim et al. (2006), many patients were in their fourth and fifth decades of life, with a female preponderance of almost 67%. Similarly, over two-thirds of patients undergoing laparoscopic cholecystectomy in England were female, according to Ballal et al. (2009). Due to more advanced inflammatory illness upon presentation, multiple researchers have found that male gender is an independent predictor of conversion, even though most patients in this study were female. Male gender was identified by Alponat et al. (1997) as a significant risk factor for difficult laparoscopic cholecystectomy (Alponat et al., 1997; Ballal et al., 2009; Ib-

rahim et al., 2006; Kama et al., 2001) [12]. Kama et al. (2001) reported that male patients had a significantly higher likelihood of conversion than female patients.

The most common clinical indicators linked to technically challenging laparoscopic cholecystectomy were found to be thicker gallbladder wall (29.6%), dense pericholecystic adhesions (27.0%), and acute cholecystitis (33.9%). Contracted or fibrotic gallbladder, impacted gallstone at the neck, prior upper abdominal surgery, empyema, and common bile duct stones were additional significant predictors. These findings are consistent with earlier research showing that inflammatory alterations surrounding the gallbladder obfuscate the architecture of Calot's triangle and greatly complicated surgery. Acute cholecystitis, thicker gallbladder wall, prior upper abdominal surgery, advanced age, and male gender were all included in the conversion risk score created by Kama et al. (2001). In a similar vein, Lipman et al. (2007) showed that conversion to open surgery was substantially predicted by diabetes mellitus, raised inflammatory markers, increased bilirubin levels, and gallbladder wall thickness. Additionally, Goonawardena et al. (2015) created a prediction nomogram that included impacted gallstones, gallbladder wall thickness, obesity, and prior abdominal surgery as significant predictors of conversion. The significance of thorough preoperative evaluation for identifying patients at high operating risk is reinforced by the similarities between previous studies and the current findings (Goonawardena et al., 2015; Kama et al., 2001; Lipman et al., 2007) [13].

In the current study, 87.0% of operations were finished laparoscopically, with a conversion rate of 13.0%. According to worldwide literature, this conversion rate falls between 2 and 15%. While Livingston and Rege (2004) reported an overall conversion rate of 9.5% in a countrywide American survey, Ballal et al. (2009) estimated a conversion rate of about 5–8% in England. A conversion rate of around 14% was noted by Ibrahim et al. (2006), which is very comparable to the current results. variances in patient characteristics, surgeon experience, illness severity, emergency presentation, and institutional protocols can all contribute to variances in conversion rates among studies. Crucially, conversion should not be seen as a surgical failure but rather as a wise choice made when safe laparoscopic dissection is not possible in order to prevent major complications like bile duct damage or uncontrollable bleeding (Ballal et al., 2009; Ibrahim et al., 2006; Livingston & Rege, 2004) [14].

Dense pericholecystic adhesions (33.3%) and uncertain Calot's triangle architecture (26.7%) were the most common criteria among patients in need of conversion, followed by severe inflammation and uncontrolled bleeding (13.3% each). Similar find-

ings were reported by Bingener-Casey et al. (2002), who found that the most common reasons of conversion were deformed biliary architecture and thick adhesions. According to Wiebke et al. (1996), the main grounds for forgoing laparoscopic dissection were significant inflammation and the impossibility to properly defining Calot's triangle. According to Bingener-Casey et al. (2002) and Wiebke et al. (1996), conversion prevents catastrophic biliary and vascular damage during technically challenging procedures. This conclusion supports the generally established surgical notion that conversion is a necessary safety precaution rather than a complication [15].

In the current investigation, postoperative results were positive. The most frequent postoperative consequence was surgical site infection (10.4%), which was followed by respiratory problems (4.3%), bile leak (3.5%), wound seroma (2.6%), and postoperative bleeding (1.7%). 55.7% of patients were released after three days, and almost three-fourths (77.4%) had an easy postoperative course. While mortality was kept to 2.6%, the total recovery rate was 97.4%. These results are similar to the meta-analysis by Shea et al. (1996), which showed that compared to open surgery, laparoscopic cholecystectomy is linked to lower postoperative morbidity and death. In a similar vein, Harboe and Bardram (2011) reported good postoperative results with short hospital stays and minimal mortality after laparoscopic cholecystectomy in a nationwide Danish database that included over 20,000 patients. Early detection of challenging operating conditions and prompt conversion can significantly reduce major biliary injuries and improve overall patient outcomes, even though converted procedures are typically linked to increased postoperative complications and extended hospitalisation (Harboe & Bardram, 2011; Shea et al., 1996) [16].

Overall, the results of this study highlight the fact that conversion from laparoscopic to open cholecystectomy is still most strongly predicted with inflammatory gallbladder pathology. Minimizing problems and improving surgical results need careful preoperative evaluation, identifying high-risk patients, precise surgical technique, and prompt intraoperative conversion where necessary. These findings align with the suggestions of earlier research, which support the application of predictive risk models to enhance perioperative safety, patient counselling, and operation planning (Goonawardena et al., 2015; Hu et al., 2017).

Conclusion

The current retrospective hospital-based analysis comes to the conclusion that, with a high success rate and good postoperative results, laparoscopic cholecystectomy is still a safe and efficient therapy for symptomatic gallstone disease. The demo-

graphic trend of gallstone disease was reflected in most patients, who were middle-aged females. The most significant clinical indicators linked to conversion to open cholecystectomy were acute cholecystitis, thicker gallbladder wall, and dense pericholecystic adhesions. Dense adhesions and ambiguous Calot's triangle anatomy were the most common intraoperative criteria for conversion, with an overall conversion rate of 13.0%. The most common post-operative morbidity was surgical site infection; however the majority of patients healed without serious problems. The low death rate of 2.6% and overall recovery rate of 97.4% show how beneficial prompt surgical intervention and proper perioperative care can be. In resource-constrained tertiary care settings like Gaya, Bihar, early identification of high-risk patients, careful surgical technique, and prudent conversion to open surgery when necessary are crucial for maximizing patient safety and enhancing surgical results.

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