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Original Research Article

PREOPERATIVE PREDICTORS OF CONVERSION FROM LAPAROSCOPIC TO OPEN CHOLECYSTECTOMY: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the standard treatment for symptomatic gallstone disease. However, conversion to open cholecystectomy (OC) remains necessary in selected patients to ensure surgical safety. Identification of preoperative predictors of conversion facilitates better patient counselling and operative planning. **Materials and Methods:** This prospective observational study included 830 consecutive patients who underwent laparoscopic cholecystectomy for gallstone disease. Demographic characteristics, clinical history, body mass index (BMI), previous biliary hospitalization, history of endoscopic retrograde cholangiopancreatography (ERCP), and preoperative ultrasonographic findings including gallbladder wall thickness, contracted gallbladder, and impacted stones were recorded. Patients were categorized into successful LC and conversion to OC groups, and preoperative predictors of conversion were analyzed. **Result:** Of the 830 patients, 800 (96.39%) underwent successful LC, while 30 (3.61%) required conversion to OC. Conversion rates increased significantly with advancing age, reaching 15.79% in patients aged >60 years. Male patients had a higher conversion rate than females (14.85% vs. 2.06%). Previous hospitalization for acute cholecystitis (22.22%), prior ERCP (22.5%), obesity (17.91%), gallbladder wall thickness ≥7 mm (18.82%), contracted gallbladder (14.12%), and impacted stones (12.5%) were strongly associated with conversion. Patients without previous biliary hospitalization had no conversions. **Conclusion:** The overall conversion rate was low, confirming laparoscopic cholecystectomy as a safe and effective procedure. Advanced age, male gender, previous biliary hospitalization, prior ERCP, obesity, increased gallbladder wall thickness, contracted gallbladder, and impacted stones were significant preoperative predictors of conversion. Routine assessment of these factors may improve risk stratification, patient counselling, operative planning, and surgical outcomes.

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for the surgical management of symptomatic gallstone disease since its introduction in the late 1980s.[1] Compared with conventional open cholecystectomy (OC), LC offers several well-established advantages, including reduced postoperative pain, shorter hospital stay, faster recovery, earlier return to daily activities, lower wound-related complications, and superior cosmetic outcomes.[2] Continuous improvements in laparoscopic instrumentation and increasing surgical expertise have further enhanced the safety and effectiveness of this minimally invasive approach, making it the preferred procedure for the majority of patients with benign gallbladder diseases.

Despite these advantages, conversion from laparoscopic to open cholecystectomy remains an important intraoperative decision in selected patients. Conversion should not be regarded as a surgical failure but rather as a measure taken to ensure patient safety when laparoscopic dissection becomes hazardous or technically infeasible.[3] Conversion is associated with increased operative time, postoperative morbidity, prolonged hospitalization, higher healthcare costs, and delayed recovery compared with successful laparoscopic procedures. Therefore, predicting the likelihood of conversion before surgery is of considerable clinical importance.[4]

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Several patient-related, disease-related, and technical factors have been identified as potential predictors of conversion. Patient characteristics such as advanced age, male gender, obesity, previous upper abdominal surgery, and associated comorbidities may increase operative difficulty. Previous abdominal operations often result in intra-abdominal adhesions that obscure anatomical landmarks, while obesity can limit visualization and instrument maneuverability during laparoscopic dissection. Congenital biliary anatomical variations may further complicate identification of the cystic duct and artery, thereby increasing the risk of biliary injury.[5]

Disease severity also plays a significant role in determining operative complexity. Acute cholecystitis, chronic inflammatory changes, empyema of the gallbladder, gangrenous cholecystitis, Mirizzi syndrome, and dense pericholecystic adhesions frequently distort the anatomy of Calot's triangle, making safe laparoscopic dissection challenging.[5] In addition, intraoperative bleeding, unclear biliary anatomy, bile duct injury, or suspicion of gallbladder malignancy may necessitate conversion to an open procedure to minimize complications and facilitate safe completion of surgery.

The reported conversion rate from LC to OC varies widely, generally ranging between 2% and 15%, depending on patient characteristics, disease severity, surgeon experience, and institutional expertise.[4,5] Although increasing surgical experience has reduced conversion rates over time, conversion continues to occur in a significant proportion of complex cases.

The present study was undertaken to evaluate the preoperative factors associated with conversion from laparoscopic to open cholecystectomy in patients undergoing surgery for gallstone disease, with the objective of identifying predictors that may assist surgeons in preoperative planning and patient counselling.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Surgery at the Himalayan Institute of Medical Sciences, SRHU, Jolly Grant, Dehradun, over a period of 1 year, after approval was obtained from the institutional ethics committee.

Written informed consent was taken from the patients before their enrolment into the study.

Sample Size: 830

All patients requiring laparoscopic cholecystectomy and those who needed conversion to open cholecystectomy, gave consent for the study after the application of the inclusion and exclusion criteria, were included consecutively over the 1-year period.

Inclusion Criteria

1. Patients aged 18 years or above.
2. Patient with previous history of ERCP for biliary stones.
3. Patients planned for laparoscopic cholecystectomy

Exclusion Criteria

1. Patients already planned for open cholecystectomy
2. Patients with any proven Hepato- biliary malignancy

Demographic and clinical data including age, sex, body mass index (BMI), presence of comorbidities (diabetes mellitus, hypertension, and cardiovascular diseases), history of previous hospitalization for gallstone-related attacks, and any prior surgical interventions were recorded for all patients. A detailed clinical examination was performed, followed by routine laboratory investigations comprising blood grouping, complete blood count, blood urea, serum creatinine, electrolyte profile, fasting blood glucose, prothrombin time/international normalized ratio (PT/INR), serum bilirubin, alkaline phosphatase, aspartate transaminase (AST), alanine transaminase (ALT), and thyroid-stimulating hormone (TSH).

Preoperative radiological evaluation included chest X-ray and abdominal ultrasonography for all patients, while magnetic resonance imaging with magnetic resonance cholangiopancreatography (MRI/MRCP) was performed selectively when clinically indicated.

Statistical analysis: The data entry were done in the Microsoft EXCEL spreadsheet and all data were analysed with SPSS software (version 26). The collected data were analyzed using descriptive statistics such as mean, standard deviation, frequency, and percentage. The Chi-square test were used to identify the association between preoperative factors and the conversion rate. Multivariate logistic regression analysis were performed to identify independent factors responsible for the conversion rate. Student's t test were used for comparison of quantitative data. For statistical significance, p value of less than 0.05 were considered statistically significant.

RESULTS

Table 1: Distribution of Patients who underwent Laparoscopic Cholecystectomy and those who needed conversion to Open Cholecystectomy according to their Age Group.

Age Group	Total	LC	LC□OC
18-29 years	240(28.92%)	240 (100%)	0
30-45 years	371(44.70%)	364 (98.11%)	7 (1.89%)
46-60 years	124(14.94%)	116 (93.55%)	8 (6.45%)
> 60 years	95(11.45%)	80 (84.21%)	15 (15.79%)
Total	830(100%)	800 (96.39%)	30 (3.61%)

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In this study, among the total of 830 patients, 800(96.39%) underwent LC, 30(3.61%) underwent LC converted to OC. 240(28.92%) patients belong to ageigroupiofi18-29 years, 371(44.7%) patients belong to age group 30-45 years, 124(14.94%) patients belong toiageigroupiofi46-60iyears and 95(11.45%) patients belong to age group of >60iyears. Out of the 30 patients who underwent LC converted to OC, none belong to age group of 18-29 years, 7(1.89%) belong to the ageigroupiofi30-45iyears,i8i(6.45%)ibelongitoiageigroupiofi46-60 years and 15 (15.79%) belong to age group of >60iyears. Among the total 830 patients who underwent Cholecystectomy, 729(87.83%) were females and 101(12.17%) were male patients.

Among the 30 patients who underwent laparoscopy converted to open cholecystectomy, 15(2.06%) were females and 15 (14.85 %) were male patients.

Table 2: Distribution of Patients who underwent Laparoscopic Cholecystectomy and those who needed conversion to Open Cholecystectomy according to their history of previous hospitalization for biliary issues.

History of Previous Hospitalizations	Total	LC	LC□OC
Acute Cholecystitis (AC)	81(10.1%)	63 (77.78 %)	18 (22.22%)
Pancreatitis (P)	13(1.62%)	11 (84.62%)	2 (15.38%)
Cholangitis (C)	19(2.37%)	17 (89.47%)	2 (10.53%)
Acute on Chronic Cholecystitis	44(5.5%)	36 (81.82%)	8 (18.18%)
No previous history of hospitalization	673(84.12%)	673 (100%)	0
Total	830(100%)	800(96.39%)	30(3.61%)

Among the total 830 patients who underwent cholecystectomy, 673 (84.12%) patients had no history of previous hospitalization for biliary issues, 81 (10.1%) patients had previous history of hospitalization for acute cholecystitis, 13(1.62%) patients had history of pancreatitis, 19 (2.37%) patients had history of cholangitis, 44 (5.5%) patients had history of acute on chronic cholecystitis. Among the 30 patients who underwent Laparoscopic converted to open cholecystectomy, 18 (22.22%) patients had previous history of hospitalization for acute cholecystitis, 2 (15.38%) patients had history of pancreatitis, 2 (10.53%) patients had history of cholangitis, 8 (18.18%) patients had history of acute on chronic cholecystitis.

Table 3: Distribution of Patients who underwent Laparoscopic Cholecystectomy and those who needed conversion to Open Cholecystectomy according to their history of undergoing ERCP.

History of ERCP	Total	LC	LC□OC
Yes	40 (4.82%)	31 (77.5 %)	9 (22.5%)
No	790 (95.18%)	769(97.34%)	21 (2.66%)
Total	830(100%)	800 (96.39%)	30(3.61%)

Among the total 830 patients who underwent cholecystectomy, 40 (4.82%) patients had history of ERCP. Among the 30 patients who underwent Laparoscopic converted to open cholecystectomy, 9 (22.5%) patients had history of ERCP.

Table 4: Distribution of Patients who underwent Laparoscopic Cholecystectomy and those who needed conversion to Open Cholecystectomy according to their BMI.

		Total	LC	LC□OC
Body mass index	Normal (18.5-24.9)	584 (70.36%)	580 (99.32%)	4 (0.68%)
	Overweight (25.0-29.9)	179 (21.56%)	165 (92.18%)	14 (7.82%)
	Obese (>30)	67(8.07%)	55 (82.09%)	12 (17.91%)
Total		830(100%)	800(96.39%)	30(3.61%)

Among the total 830 patients who underwent cholecystectomy, 584 (70.36%) patients had normal BMI, 179 (21.56%) were overweight, 67 (8.07%) were obese.

Among the 30 patients who underwent Laparoscopic converted to open cholecystectomy, 4 (0.68%) patients had normal BMI, 14 (7.82%) were overweight, 12 (17.91%) were obese.

Table 5: Distribution of Patients who underwent Laparoscopic Cholecystectomy and those who needed conversion to Open Cholecystectomy based on GB wall thickness in Preoperative Ultrasonography report.

GB Wall thickness	Total	LC	LC□OC
Normal (≤3 mm)	501(60.36%)	497 (99.2%)	4 (0.80%)
Mildly Thickened (4–6 mm)	244(29.40%)	234 (95.90%)	10 (4.10%)
Significantly Thickened (≥7 mm)	85(10.24%)	69 (81.82%)	16 (18.82%)
Total	830(100%)	800(96.39%)	30(3.61%)

Among the total 830 patients who underwent cholecystectomy, 501(60.36%) had normal GB wall thickness on preoperative USG report, 244 (29.4%) patients had mildly thickened walls and 85 (10.24%) patients had significantly thickened walls.

Among the 30 patients who underwent Laparoscopic converted to open cholecystectomy, 4 (0.8%) had

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normal GB wall thickness, 10 (4.1%) had mildly thickened walls, 16 (18.82%) had significantly thickened walls.

Table 6: Distribution of Patients who underwent Laparoscopic Cholecystectomy and those who needed conversion to Open Cholecystectomy based on Contracted gall bladder and impacted stone in Preoperative Ultrasonography report.

		Total	LC	LC□OC
Contracted_GB	NO	653 (78.67%)	648(99.23%)	5 (0.77%)
	YES	177 (21.32%)	152(85.88%)	25(14.12%)
Total		830(100%)	800(96.39%)	30(3.61%)
Impacted_Stone	NO	638 (76.86%)	632(99.06%)	6 (0.94 %)
	YES	192 (23.13%)	168 (87.5%)	24 (12.5%)
Total		830(100%)	800(96.39%)	30(3.61%)

Among the total 830 patients who underwent cholecystectomy, 177 (21.32%) had contracted GB and 653 (78.67%) had normal GB on their preoperative USG report.

Among the 30 patients who underwent Laparoscopic converted to open cholecystectomy, 25 (14.12 %) patients had contracted GB and 5 (0.77%) had normal GB on their preoperative USG report. Among the total 830 patients who underwent cholecystectomy, 192 (23.13%) patients had impacted stone on their preoperative USG report. Among the 30 patients who underwent Laparoscopic converted to open cholecystectomy, 24 (12.5%) patients had impacted stone on their preoperative USG report.

DISCUSSION

Laparoscopic cholecystectomy (LC) is the preferred treatment for symptomatic gallstone disease owing to its minimal invasiveness, reduced postoperative pain, shorter hospital stay, and faster recovery. Nevertheless, conversion to open cholecystectomy (OC) remains necessary in selected cases to ensure patient safety. In the present study, the overall conversion rate was 3.61%, which is comparable with previously reported rates ranging from 3–8%, confirming that LC remains a safe and effective procedure for the majority of patients.

Advancing age was significantly associated with an increased likelihood of conversion. No conversions occurred among patients aged 18–29 years, whereas conversion rates progressively increased to 1.89% in patients aged 30–45 years, 6.45% in those aged 46–60 years, and 15.79% in patients older than 60 years. Similar observations have been reported by Iwashita et al., Chen et al., Shah et al., and Sutcliffe et al., who demonstrated that elderly patients have higher conversion rates because of chronic inflammation, fibrosis, distorted biliary anatomy, and multiple comorbidities. These findings suggest that advanced age should be considered an important preoperative predictor of difficult laparoscopic cholecystectomy.[6-9]

Although females constituted the majority of patients undergoing cholecystectomy (87.83%), male patients exhibited a substantially higher conversion rate (14.85% vs. 2.06% in females). Similar findings have been reported by Sutcliffe et al,[9] Stanisic et al,[10] and Kapoor et al,[11] who identified male gender as an independent predictor of conversion. The increased risk among males has been attributed to delayed presentation, more severe inflammatory disease, and dense pericholecystic adhesions that make laparoscopic dissection technically challenging.

Previous biliary hospitalizations also demonstrated a strong association with conversion. Patients with a history of acute cholecystitis had the highest conversion rate (22.22%), followed by acute-on-chronic cholecystitis (18.18%), pancreatitis (15.38%), and cholangitis (10.53%), whereas no conversions occurred in patients without previous biliary admissions. These findings are consistent with those of Stanisic et al,[10] who reported that repeated inflammatory episodes result in fibrosis, adhesions, and distorted Calot's triangle anatomy, thereby increasing operative difficulty.

A previous history of endoscopic retrograde cholangiopancreatography (ERCP) was another significant predictor of conversion. Patients who had undergone ERCP showed a conversion rate of 22.5% compared with only 2.66% among those without prior ERCP. Similar findings have been reported by Griniatsos et al,[12] suggesting that post-ERCP inflammation and fibrosis may obscure tissue planes and complicate laparoscopic dissection. Therefore, patients with previous ERCP require careful operative planning and counselling regarding the increased possibility of conversion.

Body mass index (BMI) demonstrated a progressive relationship with conversion. Conversion rates increased from 0.68% in patients with normal BMI to 7.82% in overweight individuals and 17.91% in obese patients. Although some investigators, including Enami et al,[13] and Al-Mulhim et al,[14] have suggested that obesity alone may not independently predict conversion, our findings indicate that increasing BMI substantially contributes to operative difficulty, particularly when associated with other adverse preoperative factors.

Preoperative ultrasonographic findings proved valuable in predicting conversion. Gallbladder wall thickness showed a strong positive correlation with conversion risk. Patients with normal wall thickness (≤3 mm) had a conversion rate of only 0.80%, which increased to 4.10% with mildly thickened walls and reached 18.82% among those with wall thickness ≥7 mm. These observations are consistent with studies by Kama et al,[15] Rosen et al,[16] whom identified

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gallbladder wall thickening as an important indicator of chronic inflammation and difficult dissection.

Similarly, contracted gallbladder and impacted stones were significant ultrasonographic predictors of conversion. Patients with contracted gallbladder demonstrated a conversion rate of 14.12% compared with only 0.77% among those with normal gallbladders. Likewise, impacted stones were associated with a conversion rate of 12.5%, whereas patients without impacted stones had a conversion rate below 1%.

The present study was conducted in a teaching hospital where senior residents and junior faculty members perform a considerable proportion of laparoscopic cholecystectomies under supervision. Despite this learning environment, the overall conversion rate remained low (3.61%) and comparable with contemporary published literature, reflecting the safety and effectiveness of laparoscopic cholecystectomy even in academic institutions.

Overall, the present study demonstrates that advanced age, male gender, previous biliary hospitalization, prior ERCP, obesity, increased gallbladder wall thickness, contracted gallbladder, and impacted stones are significant preoperative predictors for conversion from laparoscopic to open cholecystectomy. Careful assessment of these factors before surgery can facilitate appropriate patient selection, improve surgical planning, reduce intraoperative difficulties, and ultimately enhance patient outcomes.

CONCLUSION

The present study demonstrated that laparoscopic cholecystectomy is a safe and effective procedure, with a low overall conversion rate of 3.61%, consistent with contemporary literature. Advanced age, male gender, previous biliary hospitalization, prior ERCP, obesity, increased gallbladder wall thickness, contracted gallbladder, and impacted stones were identified as significant preoperative predictors of conversion to open cholecystectomy. Recognition of these factors before surgery can facilitate accurate risk stratification, improve patient counselling, optimize operative planning, and ensure the availability of experienced surgical teams for high-risk cases. Incorporating these readily identifiable clinical and ultrasonographic predictors into routine preoperative assessment may reduce unexpected conversions, enhance surgical safety, improve resource utilization, and ultimately lead to better patient outcomes.

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