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Risk Factors for Conversion from Laparoscopic to Open Cholecystectomy in Patients with Cholelithiasis: A Descriptive Study

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Abstract

Laparoscopic cholecystectomy (LC) is the gold-standard treatment for symptomatic Cholelithiasis, yet conversion to open cholecystectomy (OC) is still required in a subset of patients for safe surgical completion. Identifying preoperative risk factors for conversion can improve surgical planning and patient counseling. To determine the frequency of conversion of LC to OC in patients with cholelithiasis and to identify factors associated with conversion. This descriptive study was conducted in the Department of Surgery, Isra University Hospital, Hyderabad, from 20 March 2023 to 20 September 2023. A total of 173 patients aged 18–70 years with cholelithiasis undergoing cholecystectomy were included. Demographic, clinical, and ultrasound findings were recorded. Conversion from LC to OC and associated factors were analyzed using logistic regression, and adjusted odds ratios (aOR) with p-values were reported. Conversion from LC to OC was required in 15 patients, yielding a conversion rate of 8.67%. On multivariable analysis, age >50 years was significantly associated with conversion (aOR 20.741; $p = 0.010$). Smoking also showed a markedly increased risk (aOR 18.272; $p = 0.025$). The presence of multiple gallstones was the strongest predictor of conversion (aOR 70.179; $p < 0.001$). Gallbladder wall thickness >4 mm was independently associated with conversion (aOR 20.95; $p < 0.001$). Age over 50 years, smoking, multiple stones, and increased gallbladder wall thickness are significant predictors of conversion from LC to OC in patients with cholelithiasis. Recognition of these high-risk features preoperatively may aid in better case selection, operative planning, and informed patient counseling.

Keywords: Cholelithiasis, Laparoscopic Cholecystectomy, Open Cholecystectomy, Conversion, Risk Factors

Introduction

Cholelithiasis, or gallstone disease, is one of the most common gastrointestinal disorders worldwide and represents a significant cause of morbidity. It is estimated that 10–20% of adults in developed countries harbor gallstones, with higher prevalence observed in females, older individuals, and those with metabolic risk factors such as obesity and diabetes mellitus (Shaffer, 2005; Portincasa et al., 2006). Although many patients remain asymptomatic, approximately 20–30% develops symptoms including biliary colic, acute

cholecystitis, pancreatitis, and choledocholithiasis, necessitating surgical intervention (Stinton & Shaffer, 2012).

Laparoscopic cholecystectomy (LC) has become the gold standard for the treatment of symptomatic gallstones since its introduction in the late 1980s. Compared with open cholecystectomy, LC offers superior outcomes including reduced postoperative pain, shorter hospital stay, quicker return to daily activities, and lower overall healthcare costs (Litynski, 1998; Keus et al., 2006). Despite advancements in laparoscopic techniques and surgeon expertise, conversion to open cholecystectomy (OC) remains unavoidable in certain circumstances to ensure patient safety.

The reported rate of conversion from LC to OC varies in the literature, ranging from 2% to 15%, depending on patient characteristics, disease severity, and surgical experience (Hu et al., 2017; Goonawardena et al., 2015). Conversion is not considered a failure but rather a strategic decision to prevent life-threatening complications such as bile duct injury, uncontrolled hemorrhage, and misidentification of anatomy, particularly in cases with severe inflammation and fibrosis of Calot's triangle (Tang & Cuschieri, 2006).

Several studies have identified potential preoperative predictors of conversion, including advanced age, male gender, obesity, diabetes mellitus, previous abdominal surgery, acute cholecystitis, thickened gallbladder wall, and presence of multiple gallstones. Increased gallbladder wall thickness and repeated inflammatory episodes result in adhesions and distorted anatomy, making laparoscopic dissection technically demanding (Sippey et al., 2015; Ercan et al., 2010). Additionally, patients with multiple stones and chronic cholecystitis are at higher risk of conversion due to increased fibrosis and scleroatrophic gallbladder changes (Raman et al., 2012).

Conversion to open surgery is associated with increased operative time, longer hospitalization, higher postoperative complications, and greater psychological stress for patients (Sultan et al., 2013). Therefore, early identification of high-risk patients is crucial for optimal surgical planning, proper patient counseling, and improved surgical outcomes.

While numerous international studies have examined conversion rates and associated factors, there remains a lack of region-specific data, particularly from developing countries where patient demographics and disease patterns may differ. This underlines the importance of conducting localized studies to identify predictors of conversion and enhance evidence-based clinical decision-making.

Therefore, this study aims to determine the frequency of conversion from laparoscopic to open cholecystectomy and to identify the preoperative risk factors associated with this conversion among patients with cholelithiasis undergoing surgery.

Literature Review

Gallstone disease remains one of the most prevalent biliary disorders worldwide and is a major indication for elective and emergency surgical intervention. The prevalence of cholelithiasis is estimated to range between 10–20% in adult populations, with higher incidence among females, elderly individuals, and those with metabolic disorders such as obesity, diabetes mellitus, and dyslipidemia (Shaffer, 2005; Stinton & Shaffer, 2012). Although the majority of gallstones remain asymptomatic, approximately 20–30% of patients develop complications that require surgical management, most commonly laparoscopic cholecystectomy (LC) (Portincasa et al., 2006).

Since its introduction in the late 1980s, laparoscopic cholecystectomy has become the gold standard treatment for symptomatic cholelithiasis due to its clear advantages over open cholecystectomy, including reduced postoperative pain, shorter hospital stay, faster functional recovery, and lower overall morbidity (Keus et al., 2006; Litynski, 1998). Despite technological advancements and improved surgical skills, conversion of LC to open cholecystectomy (OC)

remains necessary in a subset of cases to ensure procedural safety.

The reported rate of conversion varies considerably, generally ranging between 2% and 15%, depending on patient characteristics, operative findings, and institutional expertise (Hu et al., 2017). Tang and Cuschieri (2006) emphasized that conversion should not be viewed as surgical failure but rather as a safety strategy adopted in the presence of distorted anatomy, uncontrolled bleeding, or severe inflammation.

Multiple studies have attempted to identify predictors of difficult LC and conversion to OC. Advanced age has been consistently documented as a significant risk factor. Sippey et al. (2015) demonstrated that patients over 60 years have increased likelihood of conversion due to recurrent inflammatory changes and fibrosis within the Calot's triangle. Similarly, Ercan et al. (2010) reported that elderly patients presented a twofold higher conversion rate compared to younger cohorts.

Gallbladder wall thickness observed on ultrasonography has also been shown to correlate strongly with conversion. A thickened gallbladder wall (>4 mm) reflects chronic inflammation and repeated cholecystitis episodes, leading to adhesions and loss of clear anatomical planes, thus increasing operative difficulty (Raman et al., 2012). O'Leary et al. (2013) further confirmed that contracted or thick-walled gallbladders significantly predicted conversion.

Obesity has been identified as another important factor, as increased intra-abdominal fat obscures anatomical landmarks, prolongs operative time, and complicates instrument maneuverability.

Goonawardena et al. (2015) found that a body mass index (BMI) greater than 30 kg/m² significantly increased the probability of conversion due to technical challenges during dissection.

Previous upper abdominal surgery is also a well-recognized risk factor. Postoperative adhesions distort anatomy and prevent adequate visualization of Calot's triangle, increasing the likelihood of open conversion (Akyurek et al., 2008). In addition, comorbid conditions such as diabetes mellitus and smoking contribute to increased inflammation, poor tissue healing, and higher perioperative complications (Sultan et al., 2013).

The presence of multiple gallstones has also been linked to higher conversion rates due to chronic gallbladder inflammation and scleroatrophic changes. Raman et al. (2012) observed that patients with multiple stones exhibited significantly higher operative difficulty and risk of procedural failure.

Conversion to open surgery has been associated with longer hospital stay, increased postoperative pain, higher complication rates, and greater healthcare costs (Hu et al., 2017). Therefore, accurate preoperative identification of high-risk patients plays a crucial role in improving surgical planning, setting realistic patient expectations, and optimizing outcomes.

Although international literature has extensively explored predictors of conversion, there remains limited data from developing regions. Differences in healthcare infrastructure, delayed presentation, and variations in disease severity necessitate region-specific research to strengthen locally relevant surgical guidelines and improve decision-making.

Materials and Methods

Study Design and Setting

This descriptive observational study was conducted at the Department of Surgery, Isra University Hospital, Hyderabad, over a six-month period from 20 March 2023 to 20 September 2023. The study was designed to evaluate the frequency of conversion from laparoscopic to open cholecystectomy and to identify preoperative factors associated with such conversion in patients diagnosed with cholelithiasis.

Study Population

All patients aged between 18 and 70 years presenting with symptomatic cholelithiasis and scheduled for elective or emergency laparoscopic cholecystectomy during the study period were considered eligible for inclusion.

Inclusion Criteria

- Patients aged 18–70 years
- Both male and female patients
- Diagnosed cases of cholelithiasis confirmed by ultrasonography
- Patients consenting to undergo laparoscopic cholecystectomy

Exclusion Criteria

- Patients with gallbladder malignancy
- Patients unfit for general anesthesia
- Patients with known bleeding disorders
- Patients who refused consent

Sample Size and Sampling Technique

The sample size was calculated using the WHO sample size calculator, based on an expected conversion rate of 7.78%, a margin of error of 4%, and a confidence level of 95%. The calculated sample size was 173 patients. Non-probability consecutive sampling technique was employed.

Data Collection Procedure

After obtaining informed written consent, demographic and clinical data were recorded using a pre-designed structured proforma. Variables collected included age, gender, body mass index (BMI), comorbidities (diabetes mellitus, hypertension), smoking status, duration of symptoms, and history of previous abdominal surgery.

All patients underwent preoperative laboratory investigations including complete blood count and liver function tests (bilirubin, ALT, AST, ALP, and GGT). Ultrasonographic findings such as gallbladder wall thickness and number of stones were also documented.

Operational Definitions

- **Conversion**: Intraoperative change of planned laparoscopic cholecystectomy to open cholecystectomy.
- **Older age**: Age greater than 50 years
- **Thickened gallbladder wall**: Wall thickness >4 mm on ultrasound
- **Multiple stones**: Presence of more than one gallstone on imaging
- **Raised TLC**: Total leukocyte count >11,000/mm³

Deranged liver function tests:

- Total bilirubin >1.2 mg/dl
- ALT >45 IU/L
- AST >35 IU/L
- ALP >120 IU/L
- GGT >30 IU/L

Surgical Procedure

All procedures were performed under general anesthesia by experienced consultant surgeons using the standard four-port laparoscopic technique. In cases of unclear anatomy, severe adhesions,

uncontrolled bleeding, or suspected bile duct injury, conversion to open cholecystectomy was undertaken for patient safety.

Outcome Measures

The primary outcome was the frequency of conversion from laparoscopic to open cholecystectomy. Secondary outcomes included identification of factors associated with conversion such as age, smoking status, and gallbladder wall thickness, number of stones, BMI, and comorbid conditions.

Statistical Analysis

Data were entered and analyzed using SPSS version 26. Quantitative variables were expressed as mean ± standard deviation or median with interquartile range as appropriate. Qualitative variables were expressed as frequencies and percentages.

Univariate logistic regression analysis was initially performed to identify potential predictors of conversion. Variables with p-values <0.25 were entered into multivariable logistic regression analysis. Adjusted odds ratios (aOR) with 95% confidence intervals were calculated, and a p-value ≤0.05 was considered statistically significant.

Ethical Considerations

Approval for the study was obtained from the Institutional Ethical Review Committee of Isra University Hospital. Written informed consent was obtained from all participants. Confidentiality and anonymity of patient data were strictly maintained throughout the study in accordance with the Declaration of Helsinki.

Results

A total of 173 patients with cholelithiasis underwent laparoscopic cholecystectomy during the study period. The mean age of the patients was 42.17 ± 10.39 years, with an almost equal gender distribution. The majority of patients belonged to urban areas. The average body mass index (BMI) was 26.76 ± 3.12 kg/m², and the mean duration of symptoms prior to surgery was 8.45 ± 3.94 days.

Demographic Characteristics

Table 1: Baseline Demographic Characteristics of Study Population (n = 173)

Variable	Mean ± SD
Age (years)	42.17 ± 10.39
Height (cm)	164.2 ± 5.18
Weight (kg)	72.12 ± 8.72
BMI (kg/m²)	26.76 ± 3.12
Symptom Duration (days)	8.45 ± 3.94

Laboratory Parameters

Table 2: Liver Function Test Results

Variable	Mean ± SD
Total Bilirubin (mg/dl)	2.61 ± 0.87
ALP (IU/L)	135.72 ± 21.07
ALT (IU/L)	45.47 ± 8.92
AST (IU/L)	45.1 ± 14.7
GGT (IU/L)	50.64 ± 15.66

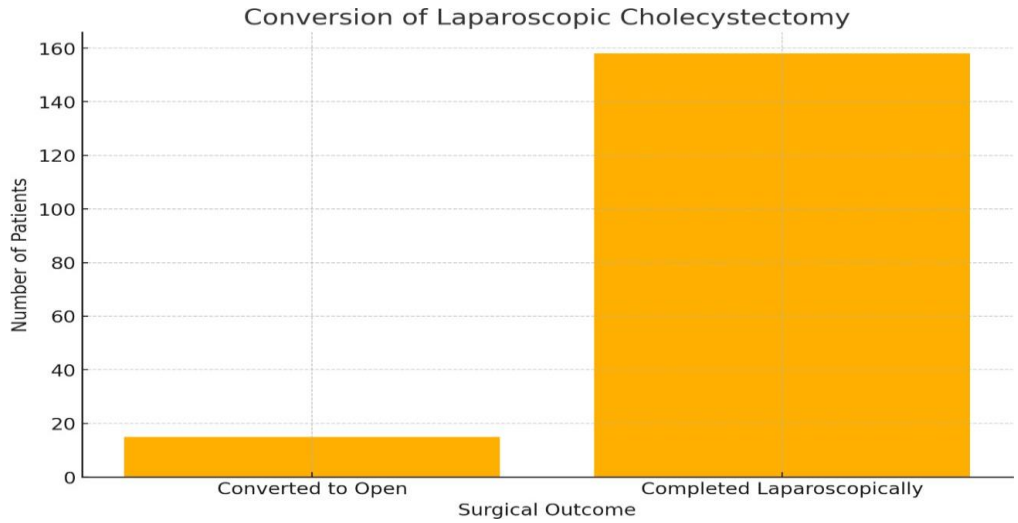
Frequency of Conversion

Out of 173 patients, 15 required conversion from laparoscopic to open cholecystectomy, resulting in a conversion rate of 8.67%, while 158 (91.33%) procedures were completed laparoscopically.

Table 3: Surgical Outcome

Outcome	Number (%)
Converted to Open Surgery	15 (8.67%)
Completed Laparoscopically	158 (91.33%)

Graph 1 illustrates the distribution of patients based on surgical outcome (conversion vs non-conversion).



Factors Associated with Conversion

Multivariable logistic regression analysis identified the following predictors as significantly associated with conversion from laparoscopic to open cholecystectomy:

Risk Factor	Adjusted Odds Ratio (aOR)	p-value
Age > 50 years	20.74	0.010
Smoking	18.27	0.025
Multiple gallstones	70.18	<0.001
Gallbladder wall thickness >4 mm	20.95	<0.001

Patients with multiple gallstones demonstrated the strongest association with conversion, followed by increased gallbladder wall thickness and age greater than 50 years. Smoking also significantly increased the likelihood of conversion.

Suggested Figure Legends for Journal

- **Figure 1:** Distribution of patients based on surgical outcome (conversion to open vs successful laparoscopic completion).
- **Figure 2:** Forest plot showing adjusted odds ratios of risk factors associated with conversion (optional – can be created if desired).

Discussion

This study evaluated the frequency of conversion from laparoscopic to open cholecystectomy and explored the preoperative factors associated with such conversion in patients with cholelithiasis. The overall conversion rate observed in this study was 8.67%, which aligns well with rates reported in previous international and regional studies, where conversion rates range from 2% to 15% (Hu et al., 2017; Tang & Cuschieri, 2006). This finding confirms that despite advancements in laparoscopic techniques, conversion to open surgery remains a necessary measure to ensure patient safety.

Advanced age emerged as a significant predictor of conversion, with patients older than 50 years demonstrating a markedly higher risk. This observation is consistent with findings by Sippey et al. (2015) and Ercan et al. (2010), who reported that elderly patients exhibit increased operative difficulty due to chronic inflammation, fibrosis, and repeated attacks of cholecystitis, which obscure anatomical landmarks in Calot's triangle. Age-related tissue fragility and comorbid conditions further contribute to increased surgical complexity.

Smoking was also found to significantly increase the likelihood of conversion. This may be attributed to smoking-induced chronic inflammation, impaired microcirculation, and delayed tissue healing, which can complicate laparoscopic dissection. Although smoking has been less frequently evaluated as a sole predictor, Sultan et al. (2013) highlighted its association with higher perioperative complications, indirectly supporting this study's findings.

One of the most prominent predictors of conversion in this study was the presence of multiple gallstones, which showed the highest adjusted odds ratio. Multiple stones are often associated with chronic cholecystitis and scleroatrophic changes, leading to thickened gallbladder walls and loss of normal anatomical planes. Raman et al. (2012) and O'Leary et al. (2013) similarly reported that multiple gallstones and contracted gallbladders significantly increase operative difficulty and conversion rates.

Gallbladder wall thickness greater than 4 mm was another strong predictor of conversion. Thickened walls reflect chronic inflammation and repeated episodes of cholecystitis, resulting in adhesions and fibrosis around the gallbladder and Calot's triangle. These findings are supported by studies demonstrating that gallbladder wall thickness is one of the most reliable ultrasonographic predictors of difficult cholecystectomy and conversion to open surgery (Raman et al., 2012; Goonawardena et al., 2015).

The clinical significance of these findings lies in their ability to guide preoperative risk stratification. Early identification of high-risk patients allows surgeons to plan appropriate operative strategies, consider senior surgical involvement, and counsel patients regarding the potential need for conversion. This not only improves surgical preparedness but also reduces psychological stress for patients by setting realistic expectations.

In comparison to studies conducted in developed nations, the conversion rate observed in this study falls within the acceptable range. However, delayed presentation, limited access to early specialist care, and higher prevalence of chronic gallbladder disease in developing regions may contribute to more advanced pathological changes at the time of surgery, potentially increasing operative difficulty.

Strengths and Limitations

A key strength of this study is its well-defined sample size and use of multivariable logistic regression analysis, which allowed identification of independent predictors of conversion. Additionally, the inclusion of both clinical and Ultrasonographic parameters provided a comprehensive assessment of preoperative risk factors.

However, the study has certain limitations. It was conducted at a single center, which may limit the generalizability of the findings. Surgeon experience and intraoperative decision-making variability were not quantitatively assessed, which may have influenced conversion rates. Furthermore, postoperative complications and long-term outcomes were not evaluated, which could have provided additional insight into the clinical impact of conversion.

Clinical Implications

The findings emphasize the importance of thorough preoperative assessment, particularly in older patients, smokers, and those with Ultrasonographic evidence of multiple stones or increased gallbladder wall thickness. Incorporating these factors into routine surgical planning may improve patient selection and operative outcomes.

Future research should focus on multicenter prospective studies with larger populations and inclusion of additional variables such as surgical expertise, operative time, and postoperative morbidity to enhance the predictive value of conversion risk models.

Conclusion

This study demonstrates that conversion from laparoscopic to open cholecystectomy remains a relevant and necessary component of safe surgical practice in patients with cholelithiasis. The observed conversion rate of 8.67% falls within the internationally reported range, confirming that despite advancements in laparoscopic techniques, certain patient and disease-related factors continue to pose significant operative challenges.

Advanced age (>50 years), smoking, presence of multiple gallstones, and increased gallbladder wall thickness (>4 mm) were identified as significant independent predictors of conversion. These factors likely reflect chronic inflammatory changes and anatomical distortion, making laparoscopic dissection difficult and increasing the risk of complications if the procedure is continued without conversion.

Preoperative recognition of these high-risk features is essential for optimal surgical planning, appropriate allocation of experienced surgical teams, and effective patient counseling. Informing patients about the potential need for conversion can reduce perioperative anxiety and improve overall satisfaction with surgical care. Furthermore, targeted risk stratification may help in selecting the most appropriate surgical approach and minimizing preventable complications.

Although laparoscopic cholecystectomy remains the preferred method for treating cholelithiasis, conversion to open surgery should not be regarded as a failure but rather as a judicious decision to enhance patient safety. Future multicenter studies with larger sample sizes and inclusion of postoperative outcomes are recommended to further refine predictive models and improve surgical decision-making.

Recommendations

Based on the findings of this study, the following recommendations are proposed to improve clinical practice and enhance surgical outcomes in patients undergoing laparoscopic cholecystectomy:

1. **Preoperative Risk Stratification**: Patients scheduled for laparoscopic cholecystectomy should undergo thorough preoperative evaluation, with particular attention to age, smoking status, number of gallstones, and gallbladder wall thickness. These factors should be incorporated into routine assessment protocols to identify high-risk cases.
2. **Enhanced Imaging Assessment**: Detailed Ultrasonographic evaluation of the gallbladder, including precise measurement of wall thickness and evaluation for multiple stones, should be emphasized to assist in predicting operative difficulty and likelihood of conversion.

3. **Patient Counseling and Informed Consent**: Patients identified as high-risk should be counseled preoperatively regarding the increased possibility of conversion to open surgery. This will help manage expectations, reduce anxiety, and improve patient satisfaction.
4. **Surgical Planning and Expertise**: High-risk cases should be scheduled with experienced surgical teams, and consideration should be given to early conversion when intraoperative difficulties are anticipated, rather than prolonged attempts that may increase complication rates.
5. **Smoking Cessation Programs**: Preoperative smoking cessation should be encouraged as part of surgical optimization, as smoking was identified as a significant predictor of conversion.
6. **Development of Predictive Scoring Systems**: Hospitals and surgical departments should consider developing or adopting standardized scoring systems for predicting difficult laparoscopic cholecystectomy based on local data.
7. **Future Research Directions**: Multicenter prospective studies with larger sample sizes are recommended to validate these findings and enhance their generalizability. Future studies should also incorporate additional variables such as surgical experience, postoperative complications, and long-term patient outcomes.

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