

## Risk Factors for Conversion in Laparoscopic Cholecystectomy: A Single-Centre Experience in Perundurai, Tamil Nadu

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### Abstract:

**Background:** Laparoscopic cholecystectomy is a standard treatment for patients with gallstones in the gallbladder. However, multiple risk factors affect the probability of conversion from laparoscopic cholecystectomy to open surgery.

**Aim:** This study aimed to identify risk factors and circumstances that could lead to the conversion of laparoscopic cholecystectomy to open surgery. Laparoscopic cholecystectomy offers benefits like reduced hospitalization, reduced postoperative pain, accelerated recovery, and improved cosmetic outcomes. Understanding these factors is crucial for enhancing patient safety and preventing surgeons from being forced to switch to open surgery.

**Methods:** A prospective cohort research was conducted on a sample of 300 patients who were admitted to the Department of General Surgery at Government Erode Medical College Hospital in Perundurai, Tamil Nadu. The study was conducted between August 2022 and December 2023. The study comprised a total of 5 out of 300 patients who were initially scheduled for laparoscopic cholecystectomy but had to undergo open cholecystectomy instead. The recorded and analyzed factors were the patient's age and sex, presence of diabetes mellitus, previous episode of Acute Cholecystitis, Body Mass Index, existence of abdominal scar, total count, Ultrasonogram Abdomen findings of Gallbladder wall thickness, and presence of pericholecystic fluid.

**Results:** Out of the 300 patients in our study, a total of 5 individuals (2%) underwent a conversion to open surgery. Observations have shown that several factors related to the patient and the disease is significant risk factors for converting laparoscopic cholecystectomy to open cholecystectomy. These factors include age over 50 years, male gender, presence of diabetes mellitus, obesity, previous abdominal surgeries, previous episode of acute cholecystitis, presence of acute cholecystitis, gallbladder wall thickness over 4mm, and presence of pericholecystic fluid.

**Conclusions:** These risk variables aid in predicting the complexity of the treatment, enabling the surgeon to provide patients with more accurate information regarding the likelihood of needing to convert from laparoscopic to open cholecystectomy. Predictive risk assessments or nomograms are highly valuable tools for risk classification in clinical scenarios. By utilizing these predictive methods, doctors can enhance the quality of care by considering the established risk factors for the conversion, while patients can have a more comprehensive understanding of the potential hazards associated with their procedure.

**Keywords:** Gall Bladder, Laparoscopic Cholecystectomy, Ultrasonogram, Abdominal Scar, Cholecystitis.

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### Introduction

Cholelithiasis is a significant challenge in contemporary medicine. Cholecystectomy surgeries for the condition of cholelithiasis are the prevailing procedures conducted in the field of general surgery. Presently, the predominant method for performing cholecystectomies is through laparoscopic surgery. Recent epidemiological studies have shown a rise in the occurrence of gallstone disease in patients with coronary insufficiency and liver disorders [1,2].

Cholelithiasis is a prevalent condition that impacts the human population. The first cholecystectomy was performed by Langenbach in 1892, however, the first successful laparoscopic cholecystectomy was carried out in 1985 by Eric Muhe.[3] After a span of two years, Philip Mauret enhanced the technique. Over the course of the last twenty years, laparoscopic cholecystectomy has established itself as the most reliable and widely accepted surgical

procedure for treating gallbladder illness. Laparoscopic cholecystectomy has the benefit of a reduced hospital stay compared to open surgery. **Laparoscopic cholecystectomy** Remain in order to have reduced postoperative pain, expedited healing, and improved outcomes.[4]

Laparoscopic cholecystectomy (LC) is a commonly used procedure for the treatment of gallstone disease [5]. Laparoscopic cholecystectomy (LC) has been found to result in a reduced overall rate of complications and a shorter hospital stay after surgery, when compared to open cholecystectomy (OC) [6,7]. If laparoscopic cholecystectomy (LC) poses a risk, a surgeon may be compelled to switch to the open operation.

According to literature statistics, the conversion rate from laparoscopic cholecystectomy to open surgery ranges from 2 to 15% due to various factors [8]. Peritoneal adhesions and inflammatory infiltration of the gallbladder are the primary culprits [9]. Converted cases are linked to a higher incidence of infections and other surgical problems [10], an increased likelihood of requiring additional procedures, and a greater rate of readmission within 30 days [11]. In addition, transitioning from laparoscopic to open surgery leads to extended postoperative hospital stays and increased rates of morbidity and mortality among these patients [12].

Common complications of laparoscopic cholecystectomy include hemorrhage, gall bladder perforation, bile leakage, bile duct damage, and perihepatic collection. Other less frequent complications include external biliary fistula, wound sepsis, hematoma, and foreign substance inclusions. Various difficulties and additional circumstances may require the conversion from laparoscopic cholecystectomy to open cholecystectomy [13].

The patient's outcome is significantly altered when a laparoscopic cholecystectomy is converted to an open cholecystectomy due to the increased risk of postoperative complications, longer hospital stays, and the long-term consequences of the conversion itself, which can be bile duct injury.[14] Sometimes, a conversion to an open cholecystectomy is required to address related disorders, identify unclear anatomic links, or prevent or treat harm.[15]

**Aim of the Study:** The aim of this study was to determine the conditions and risk factors that lead to the conversion of a laparoscopic cholecystectomy to an open surgery. Finding the patient- and disease-related factors that influence the switch from laparoscopic to open cholecystectomy was the study's goal. to identify the preoperative variables that may be used to forecast whether a laparoscopic or open cholecystectomy would be performed.

**Materials and Methods:** Study Design: This prospective cohort study was conducted at the Government Erode Medical College Hospital in Perundurai, Tamil Nadu. The study period spanned from August 2022 to December 2023.

**Sample Size and Selection:** A total of 300 patients scheduled for cholecystectomy were included in the study. The inclusion criteria were patients admitted for general surgery and planned for elective cholecystectomy. Patients who were already scheduled for elective open cholecystectomy or those requiring a laparoscopic cholecystectomy combined with other procedures were excluded from the study.

**Data Collection:** The following factors were recorded and analyzed for each patient:

- Demographic Information: Age and sex.
- Medical History: Presence of diabetes mellitus and previous episodes of acute cholecystitis.
- Physical and Clinical Assessments: Body Mass Index (BMI) and presence of abdominal scars.
- Laboratory and Imaging Findings: Total white blood cell count, ultrasound findings including gallbladder wall thickness and the presence of pericholecystic fluid.

Data collection was systematically carried out to ensure consistency and accuracy. All patients underwent a standardized preoperative assessment, and relevant clinical and demographic data were recorded in a structured format.

**Ethical Considerations:** This study was done in accordance with the Declaration of Helsinki and approved by Institutional Ethics Committee, Government Erode Medical College in Perundurai. Written informed consent was obtained from the participants before enrolling in the study and informed consent was obtained from all participants prior to inclusion in the study.

**Data analysis:** The statistical analysis for the required sample size per group was carried out using Statistical version 9 (StatSoft, Inc, 1984-2009, USA). All other statistical analyses were performed using the Statistical Package for Social Sciences for Windows 8.0 software. The results are presented as means with their respective standard deviations. To make comparisons, analysis of variance (ANOVA) was employed, followed by Tukey's post hoc test for multiple comparisons and the independent samples Student's t-test.

Pearson correlation analysis was used to calculate correlations between variables. The results were evaluated within a 95% confidence interval, and significance was determined with a probability level of less than 0.05.

**Results:**

Over the course of 18 months, almost 300 patients had laparoscopic cholecystectomy procedures. Five patients underwent an open cholecystectomy. Given that the study group members are somewhat older—

roughly 50 years old—age is a risk factor for the conversion to open surgery.

The gender structure is roughly equal.

**Table 1: Patient demographic details**

Demographic factors		Total cases	Converted cases	Conversion rate
Age (Years)	<50	180	5	2.78%
	>50	120	10	8.33%
Gender	Male	90	9	10.00%
	Female	210	6	2.86%

The table 1 presents the demographic factors influencing the conversion rates from laparoscopic to open cholecystectomy in a sample of 300 patients. It is observed that age significantly impacts the conversion rate: among patients under 50 years old, only 2.78% (5 out of 180) required conversion, whereas this rate increased to 8.33% (10 out of 120) for those over 50. Gender also plays a crucial role, with male patients showing a higher conversion rate of 10.00%

(9 out of 90) compared to female patients, who had a conversion rate of 2.86% (6 out of 210).

This data suggests that older age and male gender are associated with higher conversion rates in cholecystectomy procedures. The table 2 summarizes the number of laparoscopic cholecystectomy cases completed by a surgeon. Out of 300 total cases, 285 were completed laparoscopically (95%) and 5 (2%) required conversion to open cholecystectomy.

**Table 2: Conversion rate**

Procedure	Total no. Of cases	No. of cases completed by lap-aroscopy	No. of cases converted to open	Conversion rate
No. of patients	300	285	5	2%

**Table 3: Patient and disease related factors.**

Factors		No. of cases		P value
		Lap	Open	
Diabetes mellitus	Present	51	9	<b>0.048</b>
	Absent	234	6	Significant
Previous episode of acute cholecystitis	Present	17	7	<b>0.05</b>
	Absent	268	8	Significant
Body Mass Index (BMI)	<25	261	3	<b>0.008</b>
	25-27.5	15	8	Significant
	>27.5	9	4	
Abdominal scar	Supra Umbilical Scar	6	4	<b>0</b>
	Infra Umbilical Scar	12	8	Significant
	No Scar	267	3	
Acute cholecystitis	Present	15	13	<b>0</b>
	Absent	270	2	Significant
Total count	>11000	15	13	0.09
	<11000	270	19	Not significant
Gall bladder wall thickness	<4mm	282	14	<b>0</b>
	>4mm	3	4	Significant
Pericholecystic fluid	Present	3	14	<b>0</b>
	Absent	282	1	Significant

The table 3 evaluates the impact of various factors on the likelihood of converting from laparoscopic to open cholecystectomy and their statistical significance. Among patients with diabetes mellitus, 9 out of 60 required conversion (p = 0.048), indicating a significant influence, compared to 6 out of 240 non-diabetic patients. A history of acute cholecystitis also significantly impacted conversion rates, with 7 out of 24 patients needing conversion (p = 0.05), compared to 8 out of 276 without such

history. Body Mass Index (BMI) was another significant factor (p = 0.008); 3 out of 264 patients with a BMI <25 required conversion, while 8 out of 23 with a BMI of 25-27.5 and 4 out of 13 with a BMI >27.5 required conversion.

Abdominal scars significantly influenced conversion rates (p = 0.00), with 4 out of 10 patients with supraumbilical scars and 8 out of 20 with infraumbilical scars needing conversion, compared to just 3 out of 270 patients without scars. Acute

cholecystitis was a significant factor as well ( $p = 0.00$ ), with 13 out of 28 affected patients requiring conversion, compared to 2 out of 272 without it. Although the total white blood cell count was not significantly impactful ( $p = 0.09$ ), patients with counts  $>11000$  had a higher conversion rate (13 out of 28) than those with counts  $<11000$  (19 out of 289).

Gallbladder wall thickness  $>4\text{mm}$  significantly increased conversion rates (4 out of 7,  $p = 0.00$ ), compared to a thickness  $<4\text{mm}$  (14 out of 296). Lastly, the presence of pericholecystic fluid was highly significant ( $p = 0.00$ ), with 14 out of 17 affected patients requiring conversion, compared to just 1 out of 283 patients without it. These findings indicate that diabetes, history of acute cholecystitis, higher BMI, presence of abdominal scars, acute cholecystitis, increased gallbladder wall thickness, and pericholecystic fluid presence are significant predictors of conversion from laparoscopic to open cholecystectomy.

### Discussion

The preferred approach for the treatment of symptomatic gallbladder stone disease is now laparoscopic cholecystectomy. [16-18] There have been reports of the benefits to the patient as well as the financial gains for society. But there's always a chance of switching to open surgery. The real conversion rates that have been published in the literature range widely, from 0% to 20%. [19] When safe completion of the laparoscopic treatment cannot be guaranteed, an open cholecystectomy must be converted. It is regarded as a wise decision to prevent complications and lower morbidity rather than a sign that laparoscopic surgery was unsuccessful. By converting to an open procedure when appropriate, the criteria that predict conversion can be identified, which aids in better perioperative planning, preoperative patient counseling, and the avoidance of issues related to laparoscopy. [20-23] In our study, we found that the following patient-related factors were associated with a significant risk of conversion from laparoscopic to open cholecystectomy: age  $>50$  years, male gender, presence of diabetes mellitus, obesity, history of abdominal surgeries, and disease-related factors: history of acute cholecystitis, presence of acute cholecystitis, gallbladder wall thickness  $>4\text{mm}$ , presence of pericholecystic fluid. Risk factors were analyzed in 2002 by Heng-Hui Lein and Ching-Shui Huang of Taiwan, in line with our findings. They discovered that male patients underwent open cholecystectomy at a higher incidence than female patients, and that male patients' operating times were considerably longer ( $p = 0.04$ ) than those of female patients. [16] According to a 1994 study by Fried et al., the most important factors influencing conversion were getting older, being obese, having a thicker gallbladder wall as determined by pre-operative ultrasonography, and having acute

cholecystitis. One of them was also male sex. [24] Male gender and age over 60 were found by Brodsky et al. to be pre-operative variables linked to conversion in acute cholecystitis. [18] In a similar vein, Liu and colleagues discovered that a thicker gallbladder wall, obesity, age more than 65, and elective laparoscopic cholecystectomy for acute cholecystitis all predicted a higher frequency of conversion. [25] In their research, Schrenk P et al. identified prior abdominal surgery as a risk factor for more difficult laparoscopic cholecystectomy procedures and increased conversion rates. [26] In their series, Michael Rosen, Fred Brody, and Jeffrey Ponsky discovered that in patients with acute cholecystitis, obesity was an independent predictor of conversion to open cholecystectomy. [27]

Diabetes was discovered by Simopon'os et al. to be a predictor of a challenging laparoscopic cholecystectomy. [28]

This preoperative risk factor prediction may aid the surgeon in better preparing for anticipated intraoperative technical challenges and in deciding early on conversion in the event that dissection appears to be extremely difficult and non-progressive, thereby averting unintended biliary tract injuries and complications.

### Conclusion

The study findings indicate that there are notable risk factors for the conversion of laparoscopic to open cholecystectomy. These factors include age over 50 years, male gender, diabetes mellitus, obesity, and prior abdominal surgeries. On the other hand, disease-related factors include prior episodes of acute cholecystitis, the presence of acute cholecystitis, gallbladder wall thickness greater than 4 mm, and the presence of pericholecystic fluid. Though none of the risk factors evaluated prevented a laparoscopic cholecystectomy, they might be useful in gauging how challenging the operation will be. Informing patients about the possibility of switching from laparoscopic to open cholecystectomy would be made easier for the surgeon as a result. During the procedure, the surgeon will make an individual and frequently subjective judgment regarding when to convert to an open cholecystectomy. The necessity of converting is an attempt to prevent complications rather than a sign of failure or difficulty.

**Limitations:** As this was a single center study with a comparatively short sample size, results of this study cannot be generalized. Generalization requires the support of results from similar large studies

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**Ethical statement:** Institutional ethical committee accepted this study. The study was approved by the institutional human ethics committee, Government Erode Medical College hospital in Perundurai. Informed written consent was obtained from all the study participants and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. The confidentiality of the study participants was maintained.

**Author's contributions:** Dr. K.P. Senthian Amudhan- conceptualization, data curation, investigation, methodology, project administration, visualization, writing—original draft, writing—review and editing; Dr. Senthil Sengodan-conceptualization, methodology, writing—original draft, writing—review and editing; Dr. K.Vinoth Kumar - conceptualization, visualization, supervision, writing—original draft. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work. All authors have read and agreed to the published version of the manuscript.

**Data Availability:** All datasets generated or analyzed during this study are included in the manuscript.

**Informed Consent:** Written informed consent was obtained from the participants before enrolling in the study

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