



PREOPERATIVE PREDICTION OF DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY USING CLINICAL, BIOCHEMICAL AND ULTRASONOGRAPHIC PARAMETERS

General Surgery

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ABSTRACT

Introduction: Cholecystectomy, the most common elective surgery of the biliary system, is primarily performed to treat gallstone disease. Despite the availability of alternatives such as gallbladder dissolution agents and biliary lithotripsy, these treatments have limitations as they do not remove the gallbladder, leaving it prone to future stones. Laparoscopic surgery has significantly advanced, enabling surgeons to manage complex cases, although certain conditions such as intra-abdominal adhesions, acute inflammation, or gangrenous gallbladders can complicate the procedure.

Aim & Objective: The aim of this study is to pre-operatively predict difficult laparoscopic cholecystectomy using clinical, biochemical, and ultrasonographic parameters. The objectives include assessing intraoperative findings such as total duration of surgery, dissection time for Calot's triangle and gallbladder bed, and identifying complications like tear of the gallbladder and spillage of bile and stone. **Methodology:** The study will be conducted at the Department of General Surgery, RMC Jalaun, from July 2023 to May 2025, including 200 patients admitted for laparoscopic cholecystectomy. Inclusion criteria include patients with symptomatic gallstone disease, while exclusions include those with common bile duct stones, carcinoma, and other serious comorbidities. The study is prospective, cross-sectional, and descriptive. Data will be analyzed using SPSS version 21.0. **Results:** The study found that 51% of participants had a contracted gallbladder, and 80% had a gallbladder wall thickness of less than 4mm. Additionally, 24% showed impaction at the gallbladder neck, while 2.5% exhibited pericholecystic fluid collection. A small percentage (12.5%) experienced gallbladder tear and bile spillage. Only 3.5% of cases required conversion to open cholecystectomy. Logistic regression revealed that BMI significantly predicted conversion to open surgery, with $p = 0.024$, while age and gallbladder wall thickness showed no significant association. **Conclusion:** This study highlights significant predictors of difficult laparoscopic cholecystectomy, including gallbladder wall thickness, impaction at the gallbladder neck, and BMI. A majority of patients did not require conversion to open surgery. Identifying these predictors can help in preoperative planning, improving surgical outcomes and patient safety.

KEYWORDS

Cholecystectomy, laparoscopic surgery, gallstone disease, preoperative prediction, difficult surgery, gallbladder wall thickness, BMI, impaction, pericholecystic fluid collection, conversion to open cholecystectomy, clinical parameters, ultrasonographic parameters, intraoperative complications, surgical outcomes.

INTRODUCTION

Cholecystectomy is the most common elective surgery of the biliary system and the second most frequent abdominal surgery. It is primarily used to treat gallstone disease. While alternatives like gallbladder dissolution agents and biliary lithotripsy exist, these treatments have limitations as they don't remove the gallbladder, leaving it prone to future stones.

Laparoscopic surgery has advanced significantly, allowing surgeons to handle complex cases, but it still requires caution, particularly in complicated gallstone disease. Success largely depends on the surgeon's expertise and technical skill. Inexperienced surgeons may struggle with conditions like intra-abdominal adhesions, acute inflammation, or gangrenous gallbladders. Even experienced surgeons may find certain conditions difficult, such as a "frozen" Calot's triangle or a fibrotic gallbladder.

Factors complicating surgery include dense adhesions, gangrenous or inflamed gallbladders, prior abdominal surgery, and cholecystogastric fistulas. These issues increase risks during dissection. Establishing a pneumoperitoneum may also be difficult in patients with prior surgeries, requiring alternative methods like the open technique or Veress needle insertion at Palmer's point.

Anatomical variations in the cystic duct and hepatic ducts must be carefully managed during dissection to avoid complications.^{1,2} Laparoscopic cholecystectomy may need conversion to open surgery in cases of unclear anatomy, poor dissection progress, or injury to blood vessels, viscera, or the bile duct. Additionally, conversions can be necessary when pathology is uncertain.

Recent studies show that a surgeon's rank does not significantly affect patient outcomes, but all surgeons must undergo a learning curve in laparoscopic procedures.²⁻¹⁴ Conversion rates from laparoscopic to

open surgery range from 1.5% to 35%, and while conversions aren't failures, they ensure patient safety. Identifying predictors for conversion improves preoperative planning and resource management.¹⁵

Aims And Objectives

Aim: Pre-operative prediction of difficult laparoscopic cholecystectomy using clinical, biochemical & ultrasonographic parameters.

Objectives:-

The intra operative findings while were taken into consideration are –

- Total duration of surgery: >120 mins
- Total time taken to dissect calot's triangle: > 15 mins
- Total time taken dissect gall bladder from the gall bladder bed: > 15 mins
- Tear of gall bladder & spillage of bile and stone

MATERIAL AND METHOD

The study was conducted at the Department of General Surgery, RMC Jalaun, with a study population consisting of all patients admitted for laparoscopic cholecystectomy from July 2023 to May 2025. The sample size included 200 patients, selected from all indoor patients admitted for laparoscopic cholecystectomy during the study period. The study was descriptive, prospective, and cross-sectional. Inclusion criteria included all patients with symptomatic gallstone disease admitted for laparoscopic cholecystectomy. Patients were excluded if they had common bile duct stones, known carcinoma of the gallbladder, acute or chronic cholecystitis with cholelithiasis, a history of cholangitis, other surgeries combined, an ASA score of III or IV, or instrument failure.

The parameters studied to predict a difficult laparoscopic cholecystectomy included age, sex, present acute attack, number of

attacks, past upper abdominal operations, diabetes, hypertension, any chronic illness, total and differential WBC count, alkaline phosphatase levels, total bilirubin, and ultrasound findings. Predictors for difficult laparoscopic cholecystectomy were age ≥ 60 years, male gender, acute cholecystitis, ≥ 2 previous acute attacks, past upper abdominal surgery, WBC $\geq 10,000/\text{cumm}$, raised alkaline phosphatase ($> 310 \text{ IU/L}$), raised total bilirubin ($> 1 \text{ mg/dl}$), and ultrasound findings such as pericholecystic fluid collection, GB wall thickness $\geq 4 \text{ mm}$, contracted GB, stone impaction at the neck/cystic duct, and Mirizzi's syndrome. Cases converted to open cholecystectomy were classified as difficult.

Data collection involved a predesigned, pretested schedule, laboratory reports, abdominal ultrasound reports, individual patient files, and discharge certificates. Informed consent was obtained from the patients before their inclusion in the study. The data were analyzed using multivariate logistic regression and appropriate statistical methods via SPSS version 21.0.

RESULTS

Table 1: Distribution Of Study Subjects According To Age

Age	Frequency	% of Total	P
0-20	11	5.5 %	<0.001
21-30	29	14.5 %	
31-40	57	28.5 %	
41-50	47	23.5 %	
51-60	36	18.0 %	
61-70	11	5.5 %	
71-80	9	4.5 %	
Total	200	100.00%	

The above table illustrates that out of the total study participants, 5.5% were aged 0-20, 14.5% were aged 21-30, 28.5% were aged 31-40, 23.5% were aged 41-50, 18% were aged 51-60, 5.5% were aged 61-70, and 4.5% were aged 71-80. The p-value is <0.001.

Table 2: Distribution of study subjects according to Ultrasonographic (USG) Findings

		Frequency	% of Total	χ^2 value	P value
G.B contracted	Yes	102	51.0 %	0.080	0.77
	No	98	49.0 %		
G.B wall thickness	<4mm	160	80.0 %	24.3	<0.001
	$\geq 4\text{mm}$	40	20.0 %		
Impaction at G.B neck	Yes	48	24.0 %	18.0	<0.001
	No	152	76.0 %		
Pericholecystic collection	Yes	5	2.5 %	4.50	0.034
	No	195	97.5 %		
Mirizzi's syndrome	Yes	0	0.0 %	12.4	0.9
	No	100	100 %		

The above table illustrates that out of the total study participants, 51% had a contracted gallbladder, and 49% did not. Gallbladder wall thickness $<4\text{mm}$ was found in 80%, while 24% had impaction at the gallbladder neck. Pericholecystic collection was present in 2.5%, and no cases showed Mirizzi's syndrome.

Table 3: Distribution Of Study Subjects According To Tear Of Gall Bladder & Spillage Of Bile And Stone

Tear of gall bladder & spillage of bile and stone	Frequency	% of Total
Yes	25	12.5%
No	175	87.5%
Total	200	100.0%

The above table illustrates that out of the total study participants, 25 (12.5%) experienced tear of the gallbladder and spillage of bile and stone, while 175 (87.5%) did not. This indicates that the majority of participants did not have a tear or spillage during the study.

Table 4: Distribution of study subjects according to conversion to open cholecystectomy

Conversion to open cholecystectomy	Frequency	% of Total
Yes	7	3.5 %
No	193	96.5 %
Total	200	100.0%

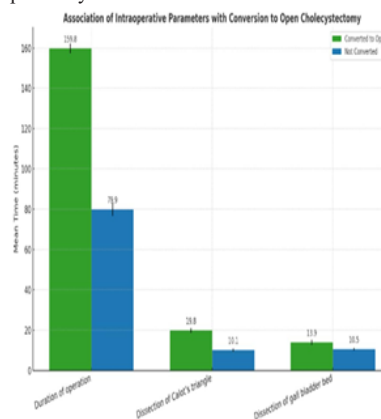
The above table illustrates that out of the total study participants, 7 (3.5%) underwent conversion to open cholecystectomy, while 193

(96.5%) did not. This shows that the majority of participants did not require a conversion to open cholecystectomy, with a small percentage undergoing the procedure.

Table 5: Logistic Regression Model for Predicting Conversion to Open Cholecystectomy

Predictor	Estimate	SE	Z	P
Intercept	4.1792	1.5125	2.7632	0.006
Age	-0.0254	0.0195	-1.3022	0.193
BMI	-0.0812	0.0358	-2.2649	0.024
G.B wall thickness:				
$\geq 4\text{mm} - <4\text{mm}$	-21.5376	1704.7173	-0.0126	0.99

The above table illustrates that out of the total study participants, BMI showed a significant negative association with the outcome (Estimate: -0.0812, $p = 0.024$), while age and gallbladder wall thickness ($\geq 4\text{mm} - <4\text{mm}$) did not show significant associations, with p-values of 0.193 and 0.99, respectively.



DISCUSSION

In our study of 200 subjects, the majority (28.5%) were aged 31–40 years, followed by 41–50 years (23.5%) and 51–60 years (18%). Fewer participants were in the younger (0–20 years, 5.5%) and older age brackets (61–70 years, 5.5%; 71–80 years, 4.5%). The age distribution was statistically significant ($P < 0.001$), suggesting that middle-aged individuals may be more affected or more likely to seek medical care. Gender distribution showed 79% females and 21% males, which was statistically significant ($P = 0.005$). This may indicate a gender-related predisposition or differences in healthcare-seeking behavior. Regarding procedural ease, among 158 females, 140 found the procedure easy, while 18 found it difficult. Among 42 males, 24 found it easy, and 18 found it difficult. This suggests that while most female cases were easier to manage, more difficulties were observed in male cases. Further analysis is needed to explore whether gender impacts procedural outcomes significantly. Singh S et al.¹⁶ The study analyzed clinical parameters across participants, focusing on age and gender distributions. The highest proportion of patients were in the 41–50 years age group (31.60%), followed by 31–40 years (30.40%). The 51–60 years group made up 17.60%, and the 21–30 years group represented 16.40%. The least represented age group was those above 60 years, comprising only 4.00% of participants. This suggests that middle-aged individuals were more affected. Gender distribution showed that females accounted for 66.00% of the cases, while males made up 34.00%, indicating a higher prevalence or greater healthcare-seeking behavior among females. Regarding procedural difficulty, 91.52% of females (152/165) and 88.24% of males (75/85) found the procedure easy. While more males faced difficulty (11.76% vs. 8.48%), the statistical analysis ($p = 0.314$) showed no significant association between gender and procedural difficulty.

In our study, we analyzed various factors affecting the gallbladder. Gallbladder contraction showed no significant association with the condition, as the chi-square value was 0.080 with a p-value of 0.77. However, a gallbladder wall thickness of less than 4mm was strongly associated with the condition, with a chi-square value of 24.3 and a p-value of <0.001, indicating a significant correlation. Impaction at the gallbladder neck also showed a significant relationship, with a chi-square value of 18.0 and a p-value of <0.001. Pericholecystic collection was significantly linked, as reflected by a chi-square value of 4.50 and a p-value of 0.034. On the other hand, no cases of Mirizzi's syndrome were observed, and its association with the condition was

not significant (chi-square value of 12.4 and p-value of 0.9). Therefore, gallbladder wall thickness, neck impaction, and pericholecystic collection were identified as significant factors, while gallbladder contraction and Mirizzi's syndrome showed no such associations. We did not find any relevant study which is related to Distribution of study subjects according to Ultrasonographic (USG) Findings.

In our study of 200 patients undergoing gallbladder surgery, 12.5% (25 patients) experienced gallbladder tears and spillage of bile and stones, while 87.5% (175 patients) did not face these complications. Gallbladder tears and the spillage of bile and stones pose significant surgical challenges, often leading to increased postoperative complications like infections and bile leakage. The occurrence of such complications in 12.5% of patients highlights the importance of careful surgical techniques to minimize these risks. However, the fact that the majority (87.5%) did not experience these issues suggests that with proper surgical interventions and management, risks can be effectively controlled. This finding may also reflect the expertise of the surgical team and the effectiveness of preoperative preparation in minimizing such adverse outcomes. We did not find any relevant study which relates to Distribution of study subjects according to tear of gall bladder & spillage of bile and stone.

In our study, 200 patients underwent laparoscopic cholecystectomy, with only 7 (3.5%) requiring conversion to open surgery. This indicates that laparoscopic cholecystectomy can be safely performed in most patients, with a minimal need for conversion. The low conversion rate aligns with existing evidence supporting laparoscopic cholecystectomy as the preferred method for gallbladder removal. Factors like patient anatomy, disease severity, and intraoperative complications can influence conversion decisions, but overall, the high success rate in our study underscores the effectiveness and safety of the procedure. **Disiar D et al.**¹⁷ evaluated laparoscopic to open cholecystectomy conversion rates, 96 out of 100 patients (96%) had successful laparoscopic surgeries, while 4 patients (4%) required conversion to open cholecystectomy. The low conversion rate aligns with standard practice, where conversion occurs due to factors like dense adhesions, unclear anatomy, excessive bleeding, or complications during dissection. Such intraoperative challenges may compromise patient safety if the laparoscopic procedure continues, thus requiring an open surgery switch. Overall, the study highlights the effectiveness of laparoscopic cholecystectomy and the selective nature of conversions when necessary for patient safety.

Our study analyzed factors influencing the conversion to open cholecystectomy and the intraoperative parameters affecting the procedure. We found that the duration of the operation was significantly longer in patients who required conversion to open surgery, with a mean of 159.8 minutes compared to 79.9 minutes in those who did not need conversion. Statistical analysis showed a significant difference (t-value = 39.47, $p < 0.001$), indicating that prolonged surgery time is a predictor for conversion. Similarly, the dissection time for Calot's triangle and the gallbladder bed were also significantly longer in the conversion group, with p-values less than 0.001, suggesting these factors correlate with the need for open surgery. In terms of predicting conversion, body mass index (BMI) was found to be a significant factor, with higher BMI associated with a lower likelihood of conversion, although the effect was modest ($p = 0.024$). Age and gallbladder wall thickness did not significantly influence conversion rates. When assessing factors contributing to surgical difficulty, BMI and age were significant predictors. Older age and higher BMI were associated with more challenging procedures. Furthermore, longer dissection time for Calot's triangle was a strong predictor of surgical difficulty ($p < 0.001$), while the time spent dissecting the gallbladder bed did not significantly impact the difficulty of surgery ($p = 0.909$). These findings provide insights into the factors affecting laparoscopic cholecystectomy outcomes. We did not find any relevant studies which relates to Association of intraoperative parameters with Conversion to open cholecystectomy and Logistic Regression Model for Predicting Conversion to Open Cholecystectomy and Logistic Regression Model for Factors Influencing Difficulty in Laparoscopic Cholecystectomy.

CONCLUSION

The study reveals several important findings. The majority of participants were aged between 31 and 40 years (28.5%), with a p-value of <0.001 indicating significant age distribution. Gallbladder wall thickness of less than 4mm was observed in 80% of the

participants, showing a significant association ($p < 0.001$). Impaction at the gallbladder neck was found in 24% of the participants, also showing a significant association ($p < 0.001$). Pericholecystic collection was seen in 2.5%, with a p-value of 0.034, while no cases of Mirizzi's syndrome were detected. A small percentage of participants (12.5%) experienced a tear of the gallbladder and spillage of bile and stone. Conversion to open cholecystectomy occurred in only 3.5% of cases. Logistic regression analysis indicated that BMI significantly predicted conversion to open cholecystectomy ($p = 0.024$), whereas age and gallbladder wall thickness did not show significant associations.

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