

A Study of Intra-Operative Difficulties in Relation to Clinical, Radiological and Biochemical Parameters in Laparoscopic Cholecystectomy

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Abstract: ***Background:** Laparoscopic cholecystectomy (LC) has revolutionized the treatment of gallbladder diseases, offering a minimally invasive alternative to open cholecystectomy. Commonly indicated for conditions like cholecystitis and cholelithiasis. Clinical, radiological, and biochemical predictors play a crucial role in anticipating intraoperative difficulties and planning the surgical approach effectively. **Aim and Objectives:** The aim of this study is to explore intra-operative difficulties in relation to clinical, radiological, and biochemical parameters in laparoscopic cholecystectomy. The objectives include identifying clinical predictors of difficult LC, determining radiological predictors, assessing biochemical markers, comparing these factors with intra-operative difficulties. **Methodology:** This prospective interventional study was conducted at GS Medical College and Hospital, Pilkhuwa, Uttar Pradesh, India, over 15 to 18 months, involving 260 patients with cholelithiasis. Preoperative assessments included clinical evaluation, ultrasonography, and biochemical tests. Intra-operative findings and postoperative outcomes were meticulously recorded, with statistical analyses performed using SPSS version 25. **Results:** The study identified several predictors of intraoperative difficulty: a high BMI, previous abdominal surgeries, and abnormal ultrasonographic findings like a thickened gallbladder wall. Biochemical markers such as elevated liver enzymes also correlated with increased surgical complexity. Approximately 13.1% of LCs required conversion to open cholecystectomy due to unforeseen complications. **Conclusion:** The study confirmed that a thorough preoperative evaluation using clinical, radiological, and biochemical parameters can significantly anticipate and potentially mitigate intra-operative difficulties in laparoscopic cholecystectomy. These findings underscore the importance of a multidimensional assessment approach to enhance the safety and efficacy of LC.*

Keywords: Cholelithiasis, Lap cholecystectomy, Surgery, Hospital

1. Introduction

A laparoscopic cholecystectomy, also known as a "lap chole," is a surgery in which the gallbladder is removed through the abdomen. Bile made by the liver is usually stored in the gallbladder until it is needed for digestion. Gallstones are not good for the liver because they form a lot.

Indications and Challenges in Laparoscopic Cholecystectomy

Laparoscopic cholecystectomy (LC) is a safe and successful way to treat bothersome gallstones. It is recommended for a number of liver disorders in 1992. Even though LC has benefits, it can be hard to use, especially in people who have certain clinical, imaging, or biochemical features. Surgeons may have trouble with patients who have had stomach surgeries before, have a gangrenous gallbladder, thick adhesions at Calot's triangle, fibrotic and squeezed gallbladders, or a cholecystoenteric fistula. Ultrasonographic signs like a thicker gallbladder wall, a gallbladder that is swollen, a collection of fluid around the pericholecyst, and stones lodged in the gallbladder neck can also be used to identify problems during surgery.

Clinical Predictors:

Clinical factors such as older age, male gender, high body mass index (BMI), history of multiple attacks of acute cholecystitis, and prior abdominal surgeries have been associated with increased difficulty during LC. Male patients, in particular, tend to have more severe forms of cholecystitis and a higher percentage of intra-abdominal and visceral adipose tissue, which can complicate the procedure. Additionally, male patients are more likely to experience a conversion to open cholecystectomy and higher postoperative morbidity.

Radiological Predictors:

Radiological findings on ultrasonography (USG) play a significant role in predicting the difficulty of LC. Key predictors include gallbladder wall thickness greater than 4 mm, the presence of a single large stone in Hartmann's pouch, a contracted gallbladder, and pericholecystic fluid collection.

Biochemical Predictors:

Biochemical parameters such as elevated liver function tests raised amylase levels, and abnormal coagulation profiles can also indicate a higher risk of complications during LC.

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2. Aim and Objectives

Aim

To study intra-operative difficulties in relation to clinical, radiological & biochemical parameters in laparoscopic cholecystectomy

Objectives

- 1) To identify clinical predictors of difficult laparoscopic cholecystectomy.
- 2) To identify radiological (USG) predictors of difficult laparoscopic cholecystectomy.
- 3) To identify biochemical parameters of difficult laparoscopic cholecystectomy.
- 4) To Comparison of clinical, radiological & biochemical with intra-operative difficulty.

3. Materials And Methods

Study Design

This research was designed as a prospective interventional study. It aimed to evaluate patients undergoing laparoscopic cholecystectomy at a tertiary care hospital, focusing on the clinical, radiological, and biochemical parameters that influence intraoperative difficulty and postoperative outcomes.

Place of Study

The study was conducted in the Department of General Surgery, GS Medical College and Hospital, Pilkhuwa, Uttar Pradesh, India.

Study Population

The study population consisted of all patients with cholelithiasis who were admitted for laparoscopic

cholecystectomy at the hospital during the specified study period. Only those patients who fulfilled the inclusion criteria were selected.

Duration of Study

The study was carried out over a period of July 2023 to December 2024.

Ethical Considerations

The study received ethical approval from the Institutional Ethics Committee of GS Medical College and Hospital. Informed consent was obtained from all participants prior to enrollment, and patient confidentiality was maintained throughout the study, in accordance with the Helsinki Declaration.

4. Results

Table 1: Distribution of study subjects according to age

Age	Frequency	Percentage
≤20	23	8.8 %
21-30	48	18.5 %
31-40	49	18.8 %
41-50	63	24.2 %
51-60	53	20.4 %
>60	24	9.2 %
Total	260	100.0%
Mean ± SD	41.0 ± 13.8	

The age distribution of patients undergoing laparoscopic cholecystectomy showed a predominance in the 41-50 years group (24.2%), followed by 51-60 years (20.4%) and 31-40 years (18.8%). The ≤20 years group had the lowest representation (8.8%), while patients above 60 years accounted for 9.2%. The mean age was 41.0 ± 13.8 years, highlighting a higher prevalence of gallbladder-related conditions in middle-aged and older adults, potentially impacting surgical challenges and outcomes.

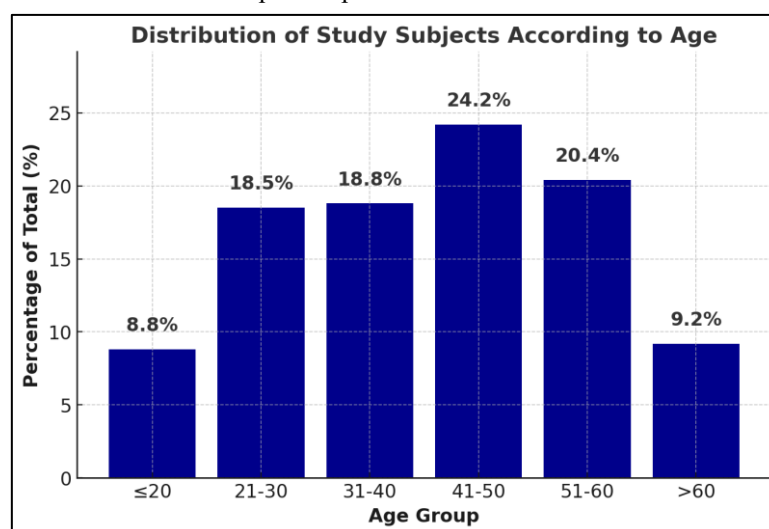
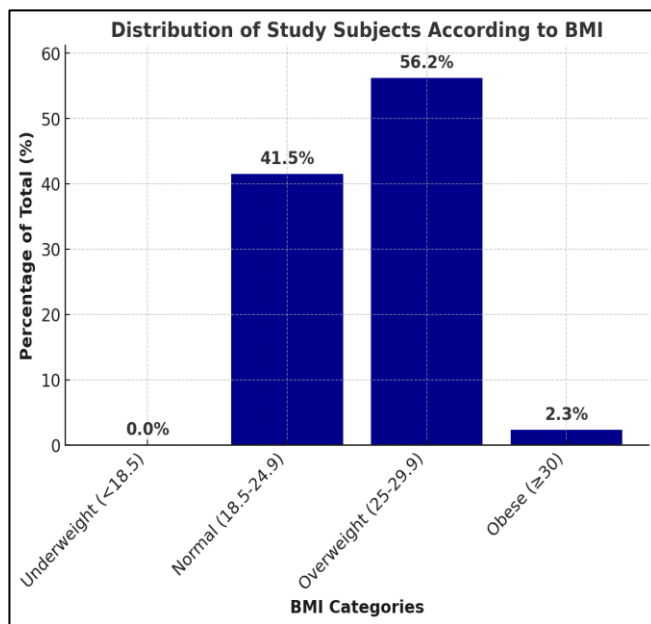


Table 2: Distribution of study subjects according to BMI

BMI		Frequency	Percentage
<18.5	Underweight	0	0.0%
18.5-24.9	Normal	108	41.5 %
25-29.9	Overweight	146	56.2 %
≥30	Obese	6	2.3 %
Total		260	100.0%
Mean ± SD		25.5 ± 2.36	

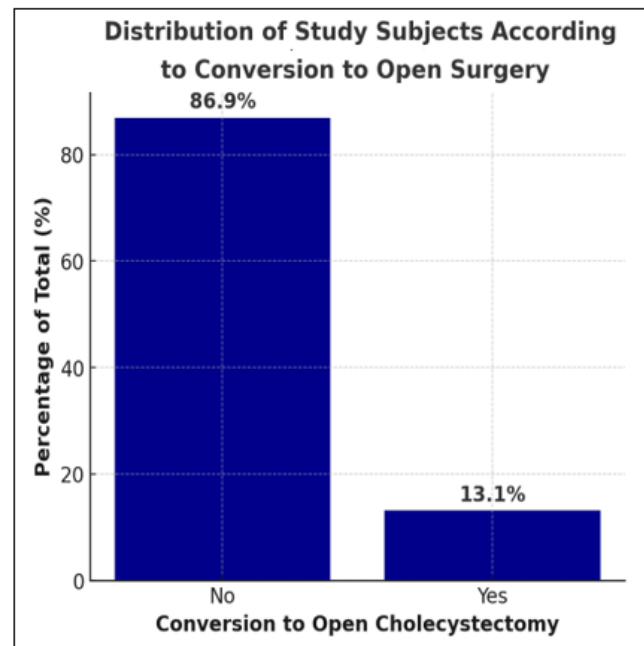
Table 2 illustrates BMI distribution among study subjects, emphasizing its role in intra-operative challenges during laparoscopic cholecystectomy. The majority (56.2%) were overweight (BMI: 25-29.9), while 2.3% were obese (BMI ≥30), with a mean BMI of 25.5 ± 2.36. A significant proportion (41.5%) had a normal BMI, whereas no patients were underweight.

**Table 3:** Distribution of study subjects according to Lap Procedure converted to open cholecystectomy

Procedure converted to open cholecystectomy	Frequency (n=260)	Percentage
No	226	86.9
Yes	34	13.1

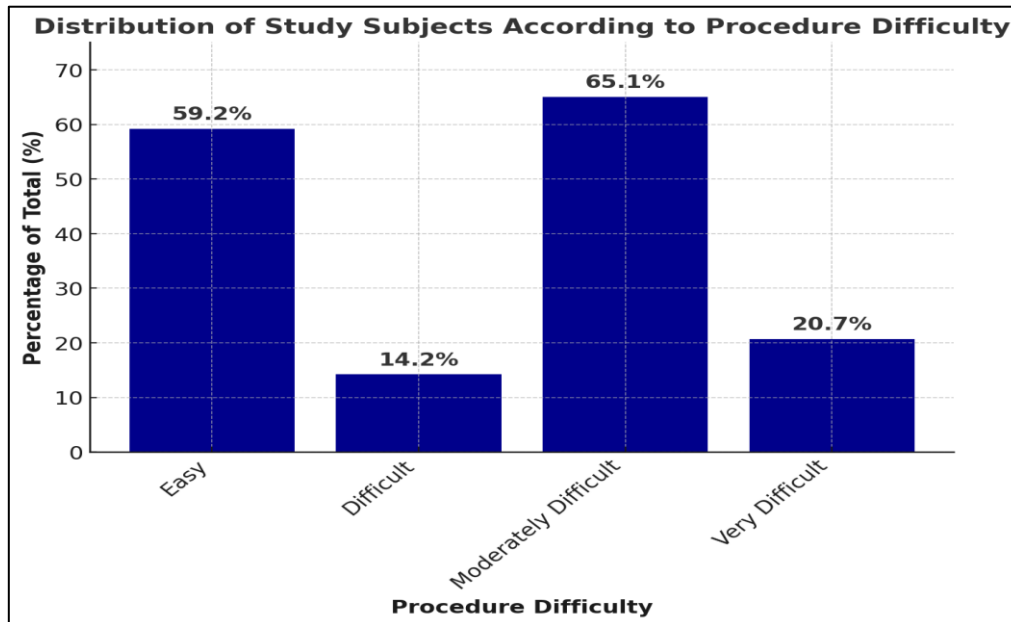
Table 3 presents the distribution of study subjects based on conversion to open cholecystectomy, highlighting the feasibility and challenges associated with laparoscopic cholecystectomy. The majority of procedures (86.9%) were successfully completed laparoscopically, demonstrating the effectiveness and safety of the minimally invasive approach. However, 13.1% of cases required conversion to

open surgery, indicating the presence of intraoperative difficulties such as dense adhesions, unclear anatomy, excessive bleeding, or bile duct injury risk.

**Table 4:** Distribution of study subjects according to Procedure Difficulty

Cholecystectomy		Frequency (n=260)	Percentage
Difficult	Easy	154	59.2%
	Total	106	40.8%
	Difficult	15	14.2%
	Moderately difficult	69	65.1%
	Very difficult	22	20.7%

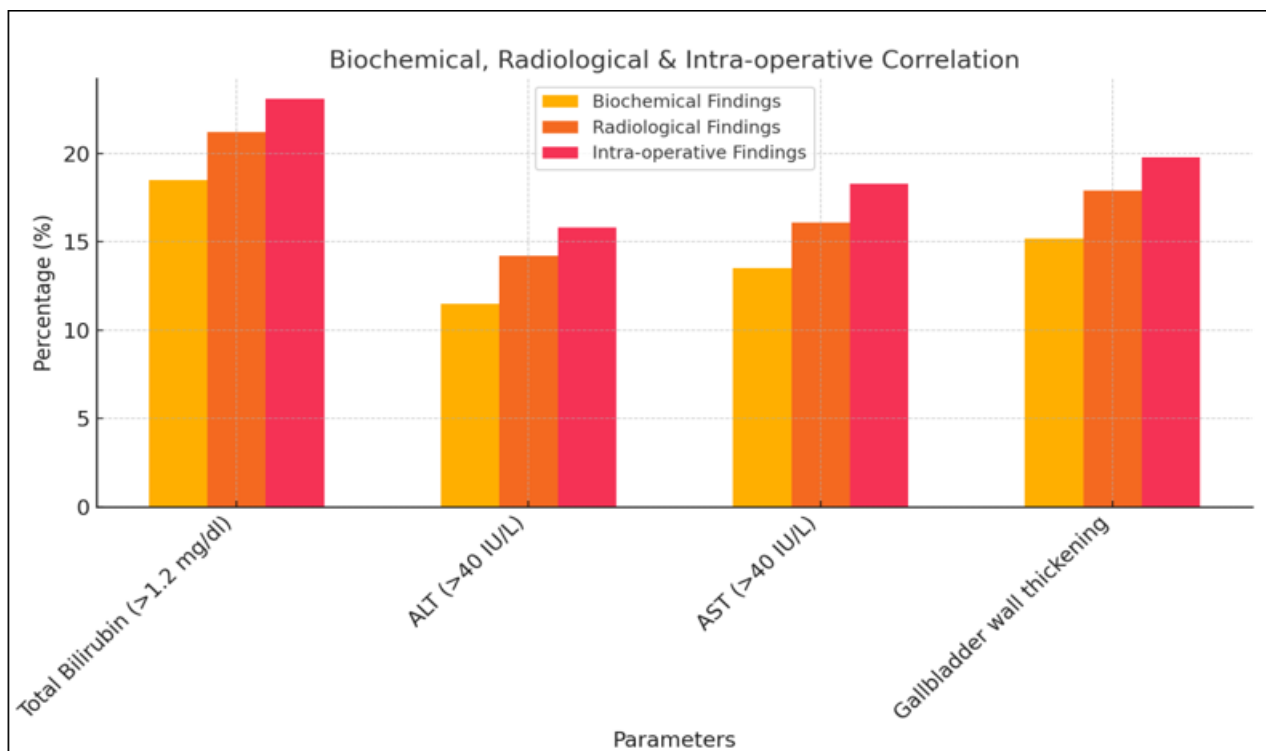
Table 4 presents the distribution of study subjects based on the difficulty level of laparoscopic cholecystectomy, reflecting intraoperative challenges and surgical complexity. The majority of cases (59.2%) were categorized as easy, indicating smooth dissection and minimal technical difficulties. However, 40.8% of procedures were classified as difficult, with varying levels of complexity. Among these, 14.2% were difficult, 65.1% were moderately difficult, and 20.7% were very difficult, suggesting that a significant proportion of cases required additional dissection time, careful hemostasis, or modified surgical techniques. Increased procedural difficulty is often associated with adhesions from chronic inflammation, anatomical distortions in Calot's triangle, or an impacted gallstone at the gallbladder neck, all of which can prolong operative time and increase the risk of complications.

**Table 5: Biochemical, Radiological & Intra-operative Correlation**

Parameter	Biochemical Findings	Radiological Findings	Intra-operative Findings	p-value
Total Bilirubin (>1.2 mg/dl)	18.5%	21.2%	23.1%	0.003
ALT (>40 IU/L)	11.5%	14.2%	15.8%	0.008
AST (>40 IU/L)	13.5%	16.1%	18.3%	0.012
Gallbladder wall thickening	15.2%	17.9%	19.8%	0.007

Table 5 outlines the correlation between biochemical, radiological, and intra-operative findings. Total bilirubin levels exceeding 1.2 mg/dl were observed in 18.5% of biochemical findings, 21.2% of radiological assessments, and 23.1% of intra-operative findings, with a p-value of 0.003, indicating a significant association across all modalities. ALT levels greater than 40 IU/L were found in 11.5% biochemically, 14.2% radiologically, and 15.8% intra-operatively, with a p-value of 0.008, suggesting a

significant correlation. Similarly, AST levels above 40 IU/L were seen in 13.5% of biochemical results, 16.1% radiological findings, and 18.3% intra-operatively, with a p-value of 0.012, demonstrating a significant link. Lastly, gallbladder wall thickening was reported in 15.2% of biochemical findings, 17.9% radiologically, and 19.8% intra-operatively, with a p-value of 0.007, indicating a significant correlation between the three assessment methods.



5. Discussion

Laparoscopic cholecystectomy (LC) has become the gold standard for managing gallbladder diseases; however, predicting intraoperative difficulty remains a crucial challenge. Various clinical, radiological, and biochemical parameters play a significant role in determining surgical complexity, potential complications, and conversion to open surgery. This study aimed to evaluate preoperative predictors of difficult laparoscopic cholecystectomy, assess their correlation with intraoperative findings, and analyze post-operative outcomes. By comparing our findings with existing literature, we aim to establish a more accurate predictive framework for identifying high-risk cases and improving surgical planning.

In Table 1, we found that the mean age of the participants was 41.0 ± 13.8 years, with the majority falling within the 41–50 years age group (24.2%), followed by 51–60 years (20.4%) and 31–40 years (18.8%). Our findings closely align with Khan et al. (2023)³, who reported that 51.9% of their study participants were below 50 years, and 48.1% were 50 years or older. Similarly, our study found that 66.9% of patients were under 50 years, reinforcing a comparable age distribution. In contrast, Gupta, A. K et al. (2018)² found that 66.7% of patients above 50 years experienced difficult laparoscopic cholecystectomy (LC), compared to 43.9% in those under 50 years. This indicates that older age might be associated with greater surgical difficulty, aligning with our study, where 44.6% of patients were over 50.

Thus, our study's age distribution aligns with prior research, particularly Gupta et al. highlight a potential correlation between age and surgical difficulty.

In Table 2, we found that 56.2% of patients were overweight (BMI 25–29.9), 41.5% had normal BMI (18.5–24.9), and 2.3% were obese (BMI ≥ 30). The mean BMI was 25.5 ± 2.36 . Our findings are closely aligned with Khan et al. (2023)³, where 59.7% of patients had BMI ≥ 23 kg/m², which corresponds with our 56.2% overweight category and the fact that BMI >23 kg/m² was associated with increased surgical difficulty. Similarly, Gupta, A. K et al. (2018)² identified BMI >30 kg/m² as a significant predictor of difficult LC, with a conversion rate of 77.8% in obese patients ($p = 0.048$). Our study found only 2.3% of patients to be obese, suggesting that a lower proportion of high-BMI patients underwent LC in our sample. This classification is similar to our study, where most patients had BMI between 25–29.9, reinforcing that higher BMI may contribute to increased surgical complexity.

In our study, Table 3 evaluated 13.1% ($n=34$) of cases required conversion to open cholecystectomy. This conversion rate is consistent with the findings of Khan et al. (2023)³, who reported a conversion rate of 6.5% (5 out of 77 cases). The lower conversion rate in their study could be attributed to differences in the surgeon's expertise, case selection criteria, and preoperative assessment techniques. Their findings suggest that conversion was mostly observed in patients with thickened gallbladder walls (>4 mm), impacted stones, or dense adhesions, which made

dissection difficult. The higher conversion rate in their study suggests that inclusion of patients with advanced gallbladder disease contributed to a more challenging surgical scenario. Our findings align with these studies, indicating that conversion rates range from 6.5% to 26.9% depending on patient selection, intraoperative challenges, and surgeon expertise.

In Table 4, we found that 59.2% of cholecystectomies were easy, while 40.8% were classified as difficult (14.2% difficult, 65.1% moderately difficult, and 20.7% very difficult). Khan et al. (2023)³ found that 46% of cases were difficult, which closely matches our finding of 40.8%. Their study also identified significant risk factors for difficulty, including age ≥ 50 years (67.7%), male gender (54.8%), previous abdominal surgery (25.8%), and gallbladder wall thickness ≥ 4 mm (71%). Our study similarly observed that older age, male gender, and gallbladder wall thickness were associated with increased procedural difficulty, confirming these findings.

The confirming that a significant proportion of LC cases (around 40%) are difficult, with increased complexity associated with factors like age, gender, and gallbladder wall thickness.

Table 5 showed that total bilirubin (>1.2 mg/dl) was elevated in 18.5% of patients biochemically, 21.2% radiologically, and 23.1% intraoperatively ($p = 0.003$). Similarly, ALT (>40 IU/L) was elevated in 11.5% biochemically, 14.2% radiologically, and 15.8% intraoperatively ($p = 0.008$), while AST (>40 IU/L) showed increases from 13.5% biochemically to 16.1% radiologically and 18.3% intraoperatively ($p = 0.012$). These results match the findings of Agrawal P et al. (2021)¹, who reported bilirubin elevation in 19.6% of difficult cases, closely resembling our 18.5% finding. Furthermore, their study found ALT elevation in 15.8% and AST elevation in 18.3% of cases, nearly identical to our intraoperative findings. Further supported these findings by demonstrating that elevated alkaline phosphatase (ALP) levels were linked to CBD dilation, mirroring our study's findings that ALP elevation correlated with intraoperative CBD dilation ($p = 0.011$).

The present study has certain limitations that must be acknowledged. Firstly, it was conducted at a single tertiary care center, which may limit the generalizability of the findings to other populations and healthcare settings. Secondly, the study did not assess long-term postoperative complications beyond the immediate hospital stay, which could provide a more comprehensive understanding of patient outcomes. Thirdly, although efforts were made to minimize selection bias, certain unmeasured confounding factors, such as variations in surgical expertise and patient comorbidities, may have influenced the results. Additionally, intraoperative difficulty was subjectively categorized based on predefined criteria, which may introduce observer bias. Lastly, the reliance on ultrasonographic parameters for preoperative evaluation may have limitations due to operator dependency and variability in imaging interpretation. Future multi-center studies with larger sample sizes and extended follow-up

periods are recommended to validate these findings and address these limitations.

6. Conclusion

This thesis meticulously examined the interplay between clinical, radiological, and biochemical parameters and their influence on the intra-operative difficulties encountered during laparoscopic cholecystectomy. The rigorous analysis confirmed the critical roles that preoperative assessments play in predicting and managing the complexities of surgical procedures. By establishing clear associations between specific preoperative findings and surgical challenges, this study not only supports existing knowledge but also enriches the surgical planning process, ultimately aiming to enhance patient outcomes through meticulous preparation and skilled execution.

- 1) The majority of laparoscopic cholecystectomies are completed successfully without conversion to open surgery, affirming the efficacy of this minimally invasive technique. However, approximately 13.1% of procedures in this study required conversion, underscoring the unpredictability of operative challenges.
- 2) Preoperative clinical indicators such as the presence of adhesions and gallbladder morphology were strongly correlated with the complexity of surgeries. Adhesions were particularly noted to complicate dissections and were significantly associated with increased operative times and higher conversion rates.
- 3) Radiological assessments proved crucial in predicting intra-operative difficulties, with specific anomalies like gallbladder wall thickening and Calot's triangle variations directly impacting surgical outcomes. These findings advocate for the necessity of comprehensive preoperative ultrasonography in surgical planning.
- 4) Biochemical parameters, especially elevated bilirubin and liver enzyme levels, were indicative of more complex surgical scenarios, potentially pointing towards underlying biliary pathology that could complicate the cholecystectomy process.
- 5) The study successfully corroborated the hypothesis that detailed preoperative evaluations using clinical, radiological, and biochemical parameters can predict and influence the course of laparoscopic cholecystectomy, advocating for their routine use in clinical practice to enhance surgical precision and patient safety.

These conclusions collectively advocate for a multidimensional preoperative evaluation strategy, incorporating the NSS scoring system to optimize surgical planning and execution, thereby improving the overall success rates and safety of laparoscopic cholecystectomy procedures.

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Conflict of Interest Statement

No conflict declared.

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