Research Article

A Prospective Study on Pre-Operative and Intra Operative Factors Stratifying the Grade of Difficulty In Laparoscopic Cholecystectomy in Tertiary Care Centre

Dr. Nilutpal Bhattacharjee[*1], Dr. Manab Jyoti Gohain[2] & Dr. Stuti Singh[3]

[1,2]Associate Professor, Dept of General Surgery, Jorhat Medical College and Hospital

[3]Post-Graduate Trainee, Dept. of General Surgery, Jorhat Medical College and Hospital

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*Corresponding author:
Dr. Nilutpal Bhattacharjee
Associate Professor, Dept of General
Surgery, Jorhat Medical College and
Hospital

ABSTRACT

Introduction: Laparoscopic cholecystectomy (LC) is a common minimally invasive surgery for gallstones, yet complexities arise due to anatomical variations and inflammation, sometimes requiring conversion to open cholecystectomy (OC). Predicting LC's difficulty can help surgeons anticipate challenges, aiding in strategic planning and improving patient safety by ensuring appropriate preparations are in place, potentially reducing procedure time and resource use while enhancing overall surgical outcomes. **Objective:** This study aims to evaluate preoperative and intraoperative factors that influence the difficulty grade in LC and to develop a predictive scoring system for assessing LC complexity. **Methods:** A prospective study was conducted on 81 patients at Jorhat Medical College and Hospital. Demographic, clinical, biochemical, and radiological data were collected preoperatively. Intraoperative difficulty levels were documented, and a predictive scoring system was developed based on correlations between preoperative indicators and intraoperative challenges. **Results:** The patient cohort had a mean age of 41-50 years, with a higher prevalence in females (70.4%). Most patients reported right hypochondrial pain, and comorbidities included diabetes (13.6%) and hypertension (16%). Ultrasound findings revealed multiple calculi in 55.6% and gallbladder wall thickening in 24.7%. Predictive scores correlated strongly with intraoperative difficulty grades, with higher scores indicating greater surgical challenges (r = 0.810, p < 0.01). Adhesions were present in 32.5% of cases, and 8.8% required conversion to OC. **Conclusion:** The study validates a predictive scoring system for LC complexity, integrating age, sex, BMI, and gallbladder characteristics as significant indicators. This approach aids in anticipating difficult cases, allowing for resource optimization and enhanced patient outcomes. Further research with larger samples is recommended to refine the scoring model.

INTRODUCTION

Laparoscopic cholecystectomy (LC) was endorsed by the National Institutes of Health (NIH) in 1992 as a safe and effective treatment for patients with symptomatic gallstones. Since then, LC has largely replaced open cholecystectomy due to its minimally invasive nature and numerous advantages, including faster recovery times, reduced postoperative pain, and shorter hospital stays [1]. Today, it stands as one of the most frequently performed abdominal surgeries in the United States, with over 500,000 procedures conducted annually. Similar trends have been observed worldwide. For instance, a multicenter study by the Indian Associa-

-tion of Gastrointestinal Endoscopic Surgeons (IAGES) found that more than 95% of cholecystectomies in India are performed laparoscopically. This shift underscores LC's acceptance as the standard of care for gallstone disease, reflecting its broad efficacy and favorable outcomes across diverse populations and healthcare settings [2].

Despite its widespread success, LC is not without challenges. Surgeons encounter substantial difficulties, particularly in complex cases with specific anatomical or pathological issues. These challenges are more likely when there are unusual anatomical variations or severe inflammatory

changes within the gallbladder and surrounding structures. For example, conditions such as cholecystoenteric fistula (an abnormal connection between the gallbladder and intestines), fibrosis or constriction of the gallbladder, and extensive adhesions at Calot's triangle (an anatomical region near the gallbladder) can significantly complicate the procedure [3]. In addition, instances of acute inflammation, gangrenous cholecystitis, or other severe conditions increase the complexity of the operation. As these factors can make dissection more difficult and limit visibility, they often necessitate a switch from laparoscopic to open surgery. This conversion rate ranges from 1.5% to 19%, depending on the case complexity and patient characteristics [4].

Intraoperative challenges during LC can vary widely in complexity and often arise unpredictably. These challenges underscore the importance of thorough preoperative assessment, skilled intraoperative technique, and readiness to adapt to unforeseen difficulties [5]. Complications following LC occur in 0.5% to 6% of cases, although the frequency of specific complications varies depending on the complexity of the case and the surgeon's experience [6]. The most serious potential complication is damage to the common bile duct, which can have severe implications for a patient's biliary function. Bile duct injury rates range from 0.1% to 0.6%, making it a rare but highly significant concern. Additionally, damage to major blood vessels, though less common, can result in severe bleeding [7]. The incidence of vascular injury ranges from 0.04% to 1.22%, highlighting the need for precision in areas where major vessels are in close proximity to surgical landmarks. Gallbladder perforation, which can lead to the spillage of gallstones, is another frequent complication, occurring in approximately 10% to 30% of cases. These spilt gallstones can result in abscess formation, infection, and other postoperative issues if not managed appropriately [8].

To minimize these risks, surgeons must adhere to several key principles during LC. First, extensive surgical training and experience with the laparoscopic technique are essential to prevent complications [9]. Precision is especially critical within Calot's triangle, where the biliary anatomy is complex, and slight deviations can lead to severe complications. Additionally, judicious use of electrocautery, as well as the careful placement of clips and cautery devices, reduces the risk of injuring nearby structures [10]. An intraoperative cholangiogram, which involves injecting dye into the biliary system to improve visibility, can further reduce the risk of bile duct injury by helping the surgeon visualize the biliary anatomy more clearly. In instances where there is uncertainty about the anatomy or when the gallbladder is too friable or inflamed, switching to an open cholecystectomy can help avoid further complications and ensure patient safety [11].

Assessing the difficulty level of LC before surgery is challenging, as the complexity of each case cannot always be predicted preoperatively. Although various scales, such as the Parkland, AAST, Cuschieri, and Sugrue scales, have been developed to gauge the level of difficulty, they rely heavily on the subjective assessment and experience of the surgeon [12]. These scales are useful in providing some context for the challenges a surgeon may face but often lack the objective parameters needed to reliably predict surgical difficulty across diverse cases [13]. For example, anatomical variations or adhesions cannot always be visualized accurately on preoperative imaging, limiting the ability to assess surgical difficulty before the procedure. This variability suggests that more standardized and objective tools are needed to predict intraoperative challenges [14].

Several preoperative factors from the patient's clinical history, biochemical profile, and radiological imaging can offer insights into potential challenges in LC. Certain clinical features, such as a history of previous abdominal surgery, obesity, and older age, are associated with increased intraoperative complexity and may serve as indicators of potentially challenging cases [15]. Biochemical markers, like elevated liver enzymes or increased inflammatory markers, may suggest underlying biliary obstruction or infection, which can complicate the laparoscopic approach [16]. Radiological imaging, particularly with ultrasound or computed tomography (CT) scans, is essential in assessing gallbladder morphology, thickness of the gallbladder wall, and the presence of stones or inflammation. Imaging can reveal potential complicating factors, such as a contracted gallbladder, significant pericholecystic fluid, or stones within the common bile duct. These indicators can help the surgical team anticipate possible obstacles and make informed decisions regarding the procedure [17].

A standardized grading system using objective, quantifiable preoperative data would improve the accuracy of assessing difficulty in laparoscopic cholecystectomy (LC). By integrating clinical history, biochemical markers, and imaging data, surgeons could better anticipate challenges and customize surgical plans, reducing the likelihood of unexpected conversions to open surgery [18]. Such a system would enhance team communication, guide training, and ultimately improve patient outcomes by supporting the safest and most effective approach. LC remains a widely accepted procedure for gallstone disease, and refining predictive tools will optimize its safety, solidifying its role as the gold standard for treating symptomatic gallstones [19].

The aim is to assess preoperative and intraoperative parameters that determine the difficulty grade in laparoscopic cholecystectomy. This includes evaluating preoperative clinical, biochemical, and radiological parameters of patients, examining intraoperative findings, and stratifying difficulty grades. Additionally, it involves correlating these preoperative and intraoperative findings to establish a reliable grading of surgical difficulty.

MATERIALS AND METHODS

This prospective study was conducted over one year in the Department of General Surgery at Jorhat Medical

College and Hospital, focusing on patients admitted for laparoscopic cholecystectomy. Consecutive sampling was used, with a calculated sample size of 81, based on prior studies (Lucchesi FD et al., 2019) and data from the department. Inclusion criteria included all patients admitted for laparoscopic cholecystectomy, while exclusions applied to patients under 12 years, those with stones in the hepatic or common bile duct, malignancies of the hepatobiliary system, or prior interventions on the gallbladder or hepatobiliary system.

RESULTS

In this study, the age and gender distribution of 81 patients undergoing laparoscopic cholecystectomy revealed that most patients (45.7%) were aged 41-50, followed by 31-40 years (25.9%), with smaller proportions in the 51-60 (14.8%) and 21-30 (13.6%) age groups, indicating a prevalence among middle-aged adults. Additionally, 70.4% of the patients were female, while 29.6% were male, suggesting that gallbladder issues requiring surgical intervention are more common in women. This gender disparity aligns with established trends showing a higher incidence of gallbladder disease in females.

Table 1: Description of Pain of the Samples

Pain		Frequency	Percent
Pain Location	Right Hypochondrium (RHC)	60	74.1
	Epigastrium (EPI)	21	25.9
	Total	**81**	**100.0**
Pain Character	Colicky	47	58.0
	Gripping	11	13.6
	Dull	23	28.4
	Total	**81**	**100.0**
Pain Radiation	Back	17	21.0
	No Radiation	64	79.0
	Total	**81**	**100.0**

In our study, most patients experienced pain in the right hypochondrium, with 58% reporting a colicky type, 13.6% a gripping type, and 28.4% a dull ache. Additionally, around 21% had pain radiating to the back.
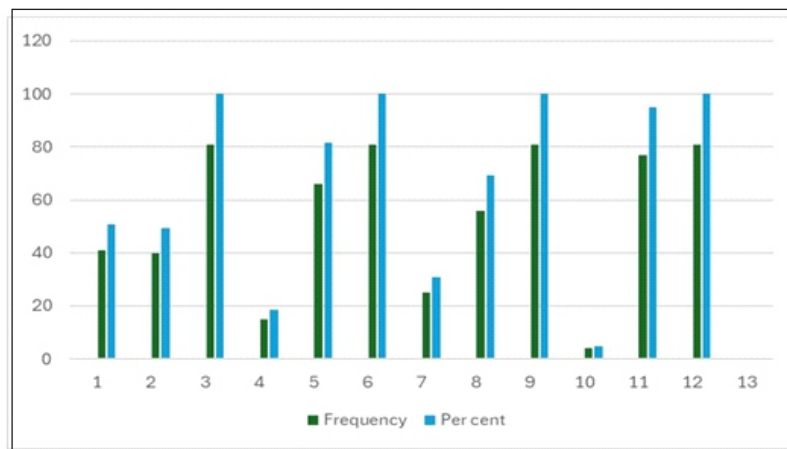

Figure 1: Graph of Signs and Symptoms

In our study, the most common presenting complaint was pain, followed by vomiting in 41 cases, dyspepsia in 25 cases, and fever in 15 cases. Jaundice was the least common symptom, present in only 4 cases.

Table 2: Description of the Comorbidities of the Samples

Past H/o Comorbidity	Condition	Frequency	Percent
Diabetes Mellitus	Present	11	13.6
	Not Present	70	86.4
Bronchial Asthma	Present	2	2.5
	Not Present	79	97.5
Hypertension	Present	13	16.0
	Not Present	68	84.0
Hypothyroidism	Present	1	1.2
	Not Present	80	98.8

The data indicates that among the samples, 13.6% had diabetes mellitus, 16% had hypertension, 2.5% suffered from bronchial asthma, and 1.2% had hypothyroidism.

This highlights that hypertension and diabetes were the most common comorbidities observed within the group.
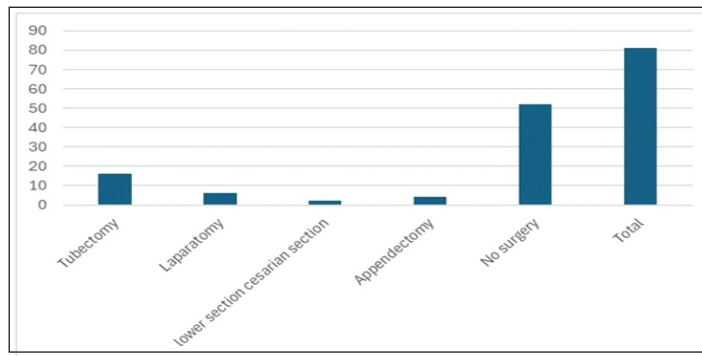

Figure 2: Graphs of Past Surgery

In the samples past surgical history, 19.8% had a tubectomy, 67.4% had undergone laparotomy, 4.9% had an appendectomy, and 2.5% had a history of lower segment cesarean section.

Table 3: Body Mass Index of the Samples

BMI Range	Frequency	Percent
<18.4 (Underweight)	5	6.2
18.5 - 24.9 (Normal)	57	70.4
>25 (Overweight)	19	23.5
Total	**81**	**100.0**

In our study, the majority of patients (70.4%) were in the normal weight category, while 19 patients were categorized as overweight, and 5 patients were underweight. This distribution highlights a predominance of normal weight among the study population, with fewer cases in the overweight and underweight categories.

Table 4: Ultrasonographic Findings

	Category	Frequency	Percent	Statical Test
USG - Number of Calculi	Multiple	45	55.6	$P<.000$
	Solitary	36	44.4	
USG - Impacted Stone	Present	11	13.6	$P<.000$
	Not Present	70	86.4	
USG - GB Wall Thickness	Present	20	24.7	$P<.000$
	Not Present	61	75.3	
USG - Pericholecystic Collection	Present	14	17.3	$P<.000$
	Not Present	67	82.7	

In our study, ultrasound revealed multiple calculi in 55.6% of cases and solitary calculi in 44.4%. An impacted stone was present in 13.6% of cases, gallbladder wall thickening in 24.7%, and pericholecystic fluid collection in 17.3% of cases.

Figure 3: Graph on Intra-Operative Findings
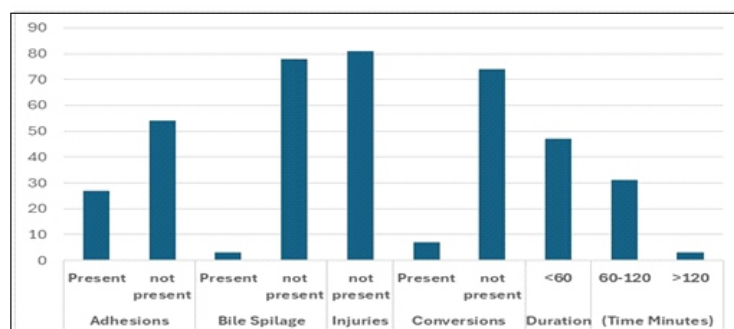
Our study found adhesions in 32.5% of cases and bile spillage in 3.8%, with no intraoperative injuries reported. Conversion to open cholecystectomy occurred in 8.8% of cases. The average laparoscopic surgery time was 59.82 minutes, with 58% completed under 60 minutes, 38.3% within 60-120 minutes, and 3.7% exceeding 120 minutes.

Table 5: Analysis of Pre-Operative Predictive Scores

Predictive Scores	Frequency	Percentage
0-5	63	77.7
6-10	15	18.5
11-15	3	3.7

In the study, 63 patients fell within the predictive score category of 0-5, 15 patients were in the 6-10 category, and 3 patients were in the 11-15 category, based on pre-operative findings.

Table 6: Correlation between Grades of Difficulty and Pre-Operative Parameters Scoring

		Predictive Score	Total Score of Factors
Laparoscopic Cholecystectomy.	Pearson Correlation	.810**	1
	Sig. (2-Tailed)	0.000	
	N	81	81
**. Correlation is Significant at the 0.01 Level (2-Tailed)			

The study shows a strong positive correlation between pre-operative predictive scores and the grading of difficulty in laparoscopic cholecystectomy based on intra-operative findings, with a correlation coefficient of $r = .810$ and $p < .01$. This indicates that higher predictive scores reliably correlate with increased surgical difficulty.

DISCUSSION

Pre-operative prediction of difficult laparoscopic cholecystectomy can be advantageous for both patients and surgeons, as it offers an objective approach to anticipating challenging cases. Factors such as male sex, older age, upper abdominal pain, history of acute cholecystitis, a thick-walled gallbladder, and prior upper abdominal surgery increase the risk of conversion to open procedures. Our study found that patients with higher pre-operative predictive scores were more likely to experience intra-operative difficulties [20].

In our study, 57 females and 24 males were included, with an approximate male-to-female ratio of 1:2.5. The majority (45.7%) of patients were in the 41-50 age group. Nineteen patients (23.5%) were overweight (BMI > 25), and these cases were significantly associated with intraoperative difficulties (p < 0.00). Studies by Patil S et al. (2016), Saleem et al. (2018), and Joshi MR et al. (2015) also identified high BMI as a predictor of difficult laparoscopic cholecystectomy. Pain was the most common symptom, with 74.1% experiencing right hypochondrial discomfort and 25.9% reporting epigastric pain. Colicky pain occurred in 58%, dull aching in 28.4%, and gripping pain in 13.6%, with 21% experiencing radiation to the back [21,22,23].

Among patients experiencing pain, 41 (50.6%) also reported vomiting, typically occurring spontaneously during pain episodes. Four patients presented with jaundice and underwent further evaluation before surgery. Dyspepsia was noted in 25 (30.9%) patients, with five diagnosed with pepticulcers during endoscopy and treated with an anti-H. pylori regimen. Fever of varying severity, often with chills, was observed in 15 (18.5%) patients. Regarding surgical history, six had prior laparotomies, two had undergone lower segment cesarean sections, four had appendectomies, and 16 had a tubectomy. Eleven patients with acute cholecystitis were hospitalized for conservative management, and one patient with acute pancreatitis also received conservative care. Co-morbid conditions included diabetes (11 patients), bronchial asthma (2), and hypertension (13). One patient with hypothyroidism was on thyroid hormone supplements. Consistent with Saleem et al. (2018), a prior hospitalization for acute cholecystitis was a predictor of difficult laparoscopic cholecystectomy (LC), while Joshi MR et al. (2015) also linked difficult LC with conditions like diabetes and chronic obstructive pulmonary disease [22,23].

For every patient, an ultrasound was conducted as part of standard assessment. Sonological criteria for diagnosing gallstones included acoustic shadowing of gallbladder opacities and shifts in opacity position with patient movements. Findings showed that 20 patients had gallbladder wall thickening, 14 had pericholecystic fluid collection, 45 had multiple calculi, 36 had solitary calculi, and 11 had impacted calculi, with all 81 patients presenting with gallstones. According to Saleem et al. (2018), increased gallbladder wall thickness is associated with challenging dissections, as a thicker wall complicates grasping, manipulation, and anatomical definition at Calot's triangle and the gallbladder bed. Their univariate and multivariate analyses demonstrated a significant relationship (P=0.007 and 0.02, and P=0.001 and 0.02) between wall

thickness and surgical difficulty. However, Randhawa JS et al. (2009) noted that other sonological features, such as impacted stones and pericholecystic collections, did not significantly correlate with surgical outcomes [22,24].

Our analysis revealed that adhesions were present in 32.5% of cases, bile spillage in 3.8%, with no intraoperative injuries noted. Conversion from laparoscopic cholecystectomy (LC) to open cholecystectomy (OC) occurred in 8.8% of cases, with an average laparoscopy duration of 59.82 minutes. Most patients (58%) completed LC in under 60 minutes, 38.3% between 60-120 minutes, and only 3.7% exceeded 120 minutes. Saleem et al. (2018) reported a 12% conversion rate due to dense adhesions at Calot's triangle, while Patil S. et al. (2016) found that 7 of 50 LC patients converted to OC due to intraoperative complications. In our study, 63 patients fell within a predictive score of 0-5, 15 scored 6-10 and 3 scored 11-15 pre-operatively. Intra-operatively, 62 cases were graded as easy, 13 as difficult, and 6 as very difficult; only one patient predicted to be easy (0-5) was found difficult intra-operatively. Limitations include the smaller sample size, short study period, and subjective variation in ultrasound and intraoperative assessment. Limited resources prevented the use of predictors like intraoperative cholangiography. However, this study's strength lies in its simple pre-operative scoring system, enabling timely conversion to OC after initial inspection, ultimately conserving time, resources, and prioritizing patient safety [21,22].

CONCLUSION

Our study supports the use of an intraoperative scoring system to predict difficult laparoscopic cholecystectomy (LC), considering variables like age, male sex, high BMI, prior acute cholecystitis hospitalization, gallbladder wall thickening, and impacted stones. These factors were significant indicators of procedural difficulty. While this scoring system has limitations-including a small sample size, single-centre scope, operator variability, and some infrastructure constraints-it provides a straightforward method for preoperative scoring and intraoperative assessment. This approach can guide timely surgical decisions, potentially reducing procedure time, preserving resources, and, most importantly, enhancing patient safety.

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