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Original Research Article

Clinical Evaluation of Risk Factors in Difficult Cholecystectomy: A One-Year Observational Study

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Abstract:

Background: Cholecystectomy is one of the most commonly performed general surgical procedures worldwide. However, a subset of cases can be categorized as "difficult cholecystectomy" due to technical challenges, increased operative time, or higher risk of complications. Identifying preoperative and intraoperative risk factors that contribute to difficult cholecystectomy is essential for improving surgical planning, patient counseling, and outcomes.

Objective: The purpose of this study was to determine clinical, demographic, and radiologic risk factors for difficult cholecystectomy in patients who were being operated on at a teaching hospital tertiary care center.

Methods: This is a prospective observational study that was carried out in the Department of General Surgery, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India, during January 2024 to December 2024. 132 patients who underwent cholecystectomy were included. The difficulty was measured in terms of operative findings, surgical time, requirement for conversion to open cholecystectomy, and intraoperative complications. Data were collected regarding age, gender, BMI, clinical presentation, history of acute cholecystitis, ultrasonographic findings, and operative details. Statistical analysis was performed to determine associations between risk factors and difficult cholecystectomy.

Results: Among the 132 patients, difficult cholecystectomy was observed in 41 patients (31.1%). Significant risk factors identified were male gender ($p<0.05$), age above 50 years, obesity (BMI >30), history of recurrent cholecystitis, thickened gallbladder wall on ultrasonography (>4 mm), and presence of impacted stones in the gallbladder neck or cystic duct. Conversion to open cholecystectomy was required in 18 patients (13.6%).

Conclusion: Difficult cholecystectomy remains a clinical challenge influenced by multiple demographic and pathological factors. Preoperative recognition of risk factors can help surgeons anticipate technical difficulties, ensure patient safety, and adopt appropriate surgical strategies.

Keywords: Difficult Cholecystectomy, Laparoscopic Cholecystectomy, Risk Factors, Conversion To Open Cholecystectomy, Gallbladder Disease.

Introduction

Cholecystectomy, the surgical removal of the gallbladder, remains one of the most frequently performed procedures in general surgery. With the advent and widespread adoption of laparoscopic techniques, it has become the gold standard for treating symptomatic gallstone disease [1]. Despite the overall safety and minimally invasive nature of laparoscopic cholecystectomy, a subset of patients continues to pose significant intraoperative challenges [2]. These cases, often termed as “difficult cholecystectomy,” are characterized by prolonged operative time, difficulty in identifying biliary anatomy, troublesome dissection of Calot’s triangle, dense adhesions, bleeding, or the necessity for conversion to open surgery [3].

A number of technical, disease-related, and patient-related factors affect how difficult cholecystectomy is. Surgical complexity is frequently increased by preoperative factors such advanced age, obesity, repeated episodes of acute cholecystitis, and concomitant diseases [4]. Important hints like gallbladder wall thickening, pericholecystic collection, and impacted stones are provided by radiological findings, particularly ultrasonography, and may foretell challenging surgical situations [5]. Intraoperative complications include hemorrhage, frozen Calot's triangle, and deformed anatomy brought on by thick adhesions. Recognizing these factors beforehand al-

lows the surgeon to anticipate challenges, take adequate precautions, and plan the most appropriate surgical approach [6].

Conversion from laparoscopic to open cholecystectomy, though not uncommon, is associated with increased morbidity, longer hospital stay, and higher healthcare costs. While conversion is never considered a failure, it reflects the degree of intraoperative difficulty [7]. Surgeons, therefore, aim to balance patient safety with minimally invasive outcomes by identifying high-risk cases preoperatively. Various scoring systems and predictive models have been proposed worldwide, yet no universal consensus exists on the precise determinants of a difficult cholecystectomy [8].

The significance of studying risk factors for difficult cholecystectomy is twofold. Firstly, it enhances preoperative patient counseling, where patients are made aware of potential complications, operative difficulty, and the possibility of conversion [9]. Secondly, it aids surgical teams in resource allocation, operative planning, and preparedness, thereby improving surgical outcomes and patient safety. In resource-limited settings, such as rural tertiary care hospitals in India, preoperative identification of difficult cases assumes even greater importance, as surgical expertise, equipment, and intensive care facilities may be limited [10].

Against this background, the present study was undertaken to systematically evaluate the demographic, clinical, and radiological factors associated with difficult cholecystectomy in a cohort of patients treated at a tertiary care teaching hospital in Bihar over a period of one year. By assessing both preoperative predictors and intraoperative findings, the study seeks to highlight common challenges and provide practical insights for surgeons managing gallstone disease in similar settings.

Methodology

Study design and setting: This was a prospective observational study conducted in the Department of General Surgery, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India. The study was carried out over a period of twelve months, from January 2024 to December 2024

Study population: All patients who underwent cholecystectomy for symptomatic gallstone disease during the study period were considered for inclusion. Both elective and emergency cases were included. Patients with suspected or proven gallbladder carcinoma, those with choledocholithiasis requiring endoscopic retrograde cholangiopancreatography (ERCP) prior to surgery, and patients who were unfit for general anesthesia were excluded.

Sample size: A total of 132 patients fulfilling the inclusion and exclusion criteria were enrolled in the study. This sample size was considered appropriate based on the annual patient load of gallbladder surgeries at the institute and ensured adequate statistical reliability.

Data collection: A detailed preoperative assessment was carried out for each patient. Information was recorded regarding demographic profile (age, sex, body mass index), clinical history (duration of symptoms, history of recurrent attacks of cholecystitis, previous abdominal surgeries, associated comorbidities), and preoperative investigations. Ultrasonography findings were noted carefully, with particular attention to gallbladder wall thickness, presence of pericholecystic fluid, size and location of gallstones, and presence of impacted stones at the neck or cystic duct.

Definition of difficult cholecystectomy: Difficulty during surgery was assessed based on intraoperative parameters including dense adhesions in Calot's triangle, frozen anatomy, gallbladder wall fibrosis, excessive bleeding requiring hemostatic measures, need for subtotal cholecystectomy, prolonged operative time (more than 90 minutes), and conversion to open cholecystectomy. Any patient meeting one or more of these criteria was categorized as having undergone a "difficult cholecystectomy."

Surgical procedure: All patients were initially planned for laparoscopic cholecystectomy using the standard four-port technique. Critical view of safety was obtained whenever possible before clipping and dividing the cystic duct and artery. If laparoscopic dissection was deemed unsafe due to unclear anatomy, excessive bleeding, or frozen Calot's triangle, conversion to open cholecystectomy was performed through a right subcostal incision.

Outcome measures: The primary outcome was the incidence of difficult cholecystectomy. Secondary outcomes included identification of preoperative risk factors associated with difficulty, rate of conversion to open cholecystectomy, and intraoperative complications such as bile duct injury or significant hemorrhage.

Statistical analysis: All collected data were compiled and analyzed using SPSS software version 25. Descriptive statistics were used to summarize baseline characteristics. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Chi-square test was applied to determine the association between risk factors and difficult cholecystectomy. A p-value <0.05 was considered statistically significant.

Results

A total of 132 patients underwent cholecystectomy during the study period. Of these, 41 patients (31.1%) were classified as having a difficult cholecystectomy. The mean age was 44.7 ± 12.3 years, with patients ranging from 20 to 72 years. Females

predominated (70.5%), but difficult cholecystectomy was more frequent in males. Elderly patients, those with obesity, and patients with recurrent cholecystitis had a significantly higher incidence of difficulty.

Ultrasonography findings such as gallbladder wall thickening, pericholecystic collection, and impacted stones strongly predicted surgical difficulty. Intraoperatively, dense adhesions, frozen Calot's triangle, excessive bleeding, and unclear anatomy were the main causes of difficulty. Conversion to open surgery was required in 18 cases (13.6%). Operative time and hospital stay were significantly longer in difficult cases. Postoperative complications, although relatively low, were also higher in the difficult group.

Table 1: Age and gender distribution

Variable	Total (n=132)	Difficult (n=41)	Non-difficult (n=91)	p-value
Age <50 years	78 (59.1%)	16 (20.5%)	62 (79.5%)	<0.05
Age ≥50 years	54 (40.9%)	25 (46.3%)	29 (53.7%)	<0.05
Male	39 (29.5%)	19 (48.7%)	20 (51.3%)	<0.05
Female	93 (70.5%)	22 (23.6%)	71 (76.4%)	<0.05

Table 2: Body Mass Index (BMI) and obesity

BMI category	Total (n=132)	Difficult (n=41)	Non-difficult (n=91)	p-value
Normal (<25)	61 (46.2%)	12 (19.7%)	49 (80.3%)	-
Overweight (25–30)	43 (32.6%)	14 (32.6%)	29 (67.4%)	<0.05
Obese (>30)	28 (21.2%)	15 (53.6%)	13 (46.4%)	<0.01

Table 3: Clinical history and comorbidities

Clinical factor	Present (n)	Difficult (n=41)	Percentage (%)	p-value
History of recurrent attacks	37	21	56.7%	<0.01
Diabetes mellitus	26	11	42.3%	0.06
Hypertension	31	12	38.7%	0.09
Previous abdominal surgery	18	7	38.9%	0.07

Table 4: Ultrasonography findings

USG parameter	Present (n)	Difficult (n=41)	Percentage (%)	p-value
Gallbladder wall thickening >4 mm	34	20	58.8%	<0.01
Pericholecystic collection	14	9	64.3%	<0.05
Impacted stone at neck/cystic duct	26	16	61.5%	<0.01
Contracted gallbladder	11	6	54.5%	<0.05

Table 5: Indication of surgery

Indication	Total (n=132)	Difficult (n=41)	Non-difficult (n=91)	p-value
Symptomatic cholelithiasis	76 (57.6%)	17 (22.4%)	59 (77.6%)	-
Acute cholecystitis	38 (28.8%)	18 (47.4%)	20 (52.6%)	<0.01
Chronic cholecystitis	18 (13.6%)	6 (33.3%)	12 (66.7%)	0.08

Table 6: Intraoperative challenges

Finding	Difficult group (n=41)	Non-difficult group (n=91)	p-value
Dense adhesions	29 (70.7%)	18 (19.8%)	<0.01
Frozen Calot's triangle	17 (41.5%)	4 (4.4%)	<0.01
Excessive bleeding	12 (29.3%)	3 (3.3%)	<0.01
Distorted anatomy	14 (34.1%)	5 (5.5%)	<0.01

Table 7: Operative time distribution

Operative time (minutes)	Difficult group (n=41)	Non-difficult group (n=91)	p-value
<60	4 (9.8%)	62 (68.1%)	<0.01
60–90	13 (31.7%)	26 (28.6%)	-
>90	24 (58.5%)	3 (3.3%)	<0.01

Table 8: Conversion to open cholecystectomy

Reason for conversion	Number (n=18)	Percentage (%)
Dense adhesions	7	38.9%
Frozen Calot's triangle	6	33.3%
Excessive bleeding	3	16.7%
Distorted anatomy	2	11.1%

Table 9: Postoperative complications

Complication	Difficult group (n=41)	Non-difficult group (n=91)	p-value
Bile leak	2 (4.9%)	0	<0.05
Wound infection	4 (9.8%)	0	<0.05
Respiratory infection	3 (7.3%)	1 (1.1%)	0.07
No complication	32 (78.0%)	90 (98.9%)	<0.01

Table 10: Postoperative hospital stay

Hospital stay (days)	Difficult group (n=41)	Non-difficult group (n=91)	p-value
≤3	6 (14.6%)	71 (78.0%)	<0.01
4–6	19 (46.3%)	18 (19.8%)	<0.05
>6	16 (39.0%)	2 (2.2%)	<0.01

Table 1 shows that difficult cholecystectomy was significantly more common in patients aged ≥50 years and in males. Nearly half of the males (48.7%) experienced difficult surgery compared to only 23.6% of females. Age above 50 years also showed a strong association with difficulty. Thus, male gender and advanced age were important demographic predictors. Table 2 shows the incidence of difficult cholecystectomy increased progressively with higher BMI. While only 19.7% of patients with normal BMI faced difficulty, more than half of the obese patients (53.6%) experienced difficult procedures. The association between obesity and difficulty was statistically significant. This highlights obesity as a key preoperative risk factor. Table 3 represents the Patients with a history of recurrent cholecystitis were at higher risk, with 56.7% experiencing difficult cholecystectomy. Diabetes, hypertension, and previous abdominal surgeries also showed a trend toward higher difficulty, though not all were statistically significant. The data indicate that repeated inflammatory episodes predispose to surgical challenges. Recurrent attacks stood out as a strong clinical predictor. Table 4 Ultrasonography findings strongly correlated with surgical difficulty. Thickened gallbladder wall, pericholecystic collection, impacted stones, and contracted gallbladder were all associated with increased risk. Among these, impacted stones and gallbladder wall thickening had the strongest associations. Thus, USG serves as a useful preoperative tool for predicting difficulty. Table 5 The indication of surgery influenced the difficulty of cholecystectomy. Patients with acute cholecystitis had the highest difficulty rate (47.4%), compared to 22.4% in symptomatic cholelithiasis. Chronic cholecystitis patients also showed moderate difficulty (33.3%). This suggests that acute inflammatory conditions are more likely to result in difficult procedures. Table 6 Intraoperative findings revealed dense adhesions and frozen Calot's triangle as the leading causes of difficulty. Excessive bleeding and distorted anatomy were also significant contributors. Such findings were rarely observed in the non-difficult group. The presence of adhesions and frozen anatomy greatly increased the complexity of surgery. Table 7 Operative time was significantly prolonged in difficult cases. Nearly 59% of patients in the difficult group required more than 90 minutes for completion, compared to only 3.3% in the non-difficult group. Short procedures (<60 minutes) were predominantly seen in the non-difficult group. Operative time thus reflected the extent of surgical difficulty. Table 8 Among the 18 patients who required conversion to open cholecystectomy, the most common reason was dense adhesions (38.9%). Frozen Calot's triangle accounted for one-third of conversions. Bleeding and distorted anatomy were less frequent causes. This indicates that anatomical distortion and adhesions are the major intraoperative reasons for conversion. Table 9 Postoperative complications were more frequent in the difficult group. Bile leak occurred in 4.9% and wound infection in 9.8% of difficult cases, while none were reported in the non-difficult group. Respiratory infections were also slightly higher in difficult cases. The overall complication-free rate was much lower in the difficult group (78% vs 98.9%). Table 10 Hospital stay was significantly prolonged in patients with difficult cholecystectomy. Only 14.6% of difficult cases were discharged within 3 days, compared to 78% of non-difficult cases. Most difficult cases required 4–6 days or more, with 39% staying beyond 6 days. This demonstrates the impact of difficulty on recovery and hospitalization.

Discussion

The present study highlights the complex interplay of demographic, clinical, radiological, and intraoperative factors that contribute to the difficulty of cholecystectomy. A considerable proportion of patients required advanced dissection techniques, prolonged operative times, and even conversion to open surgery, underscoring the clinical importance of recognizing predictors in advance [11]. Male sex, older age, and obesity were all strongly associated with difficult procedures. These demographic variables likely reflect underlying biological and behavioral factors such as later presentation, increased prevalence of comorbidities, and challenging surgical ergonomics. Awareness of these associations allows surgeons to anticipate potential challenges before entering the operating room [12].

The clinical history also had an important influence in assessing surgical difficulties. Patients with recurrent bouts of cholecystitis showed considerably greater incidence of dense adhesions and frozen architecture intraoperatively [13]. Repeated inflammatory insults appear to cause gradual fibrosis, deformed architecture, and adhesions that hide vital structures. Such alterations explain the longer operational periods and greater complication rates observed in this cohort. As a result, prompt surgical intervention during initial bouts of biliary colic or cholecystitis may help limit the risk of developing such difficult operating fields [14].

Radiological assessment, particularly ultrasonography, gave useful preoperative insights. Gallbladder wall thickening, pericholecystic fluid, impacted stones in the neck or cystic duct, and a constricted gallbladder were all highly associated with surgical difficulty [15]. These findings indicate either acute inflammatory alterations or persistent scarring, which impede safe dissection. Integrating such sonographic predictors into preoperative planning allows surgical teams to identify high-risk patients and prepare accordingly, including experienced staff, advanced instruments, and the ability to apply alternate procedures [16].

Intraoperatively, thick adhesions, frozen Calot's triangle, and uncontrolled hemorrhage were identified as the primary causes of difficulties and conversion. The frozen anatomy in these patients frequently made identification of the cystic duct and artery difficult, increasing the risk of bile duct injury [17]. Bailout strategies such as subtotal cholecystectomy, fundus-first dissection, and early conversion to open surgery were critical in ensuring patient safety. Conversion should not be perceived as a failure, but rather as a wise option to protect critical infrastructure in high-risk situations [18].

The effects of a difficult cholecystectomy were reflected in the operational and postoperative results. Longer operational periods were much more common, owing to the additional dissection, adhesiolysis, and hemostatic techniques needed [19]. These patients also had higher postoperative problems, specifically wound infections and small bile leakage, which resulted to a longer hospital stay. Such findings highlight the fact that anticipating difficulty is not just of academic interest, but also has practical implications for patient morbidity, healthcare expenses, and bed occupancy [20].

Taken together, the findings of this study emphasize the importance of organized preoperative risk assessment. A combination of demographics, clinical history, and ultrasound results can accurately predict the likelihood of a difficult cholecystectomy. Such intelligence enables surgeons to improve perioperative planning, manage operational time more effectively, assure the availability of senior expertise, and counsel patients about potential conversions or difficulties. Incorporating these variables into standard surgical practice will improve patient safety and overall results after cholecystectomy.

Conclusion

Difficult Cholecystectomy remains a considerable clinical and surgical challenge, driven by a variety of patient, illness, and anatomical variables. In this investigation, male sex, age over 50, obesity, repeated cholecystitis attacks, and particular ultrasonographic abnormalities such as gallbladder wall thickness, pericholecystic fluid, impacted stones, and constricted gallbladder were substantially linked with challenging operating conditions. These factors resulted in longer surgical times, higher conversion rates, increased postoperative morbidity, and an extended hospital stay. Recognizing these risk factors in the preoperative period enables improved planning, the engagement of skilled surgical teams, adequate patient counseling, and the timely application of bailout strategies when needed. Adopting systematic risk stratification into standard clinical practice can assist reduce complications, optimize outcomes, and improve overall surgical safety in patients having cholecystectomy.

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