Original Article

Pre-operative risk factors assessment to anticipate technical difficulty in laparoscopic cholecystectomy for acute cholecystitis

Parvin M[a], Khan MMH[b], Mondal SK[c], Roy S[d], Shorna SR[a]

ABSTRACT

Background: *Laparoscopic cholecystectomy (LC) has rapidly become the operation of choice for routine gallbladder (GB) removal. LC can be difficult in certain patients. This study aimed at finding out the pre-operative risk factors to anticipate technical difficulty in laparoscopic c holecystectomy in acute cholecystitis.*

Methods: *This cross sectional observational (analytical)study was performed in the department of Surgery, BIRDEM General Hospital, Dhaka for a period of 18 Months. Before starting this study ethical clearance was obtained from Institutional Review Board (IRB) of Bangladesh Institute of Research and Rehabilitation in Diabetes (BIRDEM) general Hospital. A total of 70 patients with acute cholecystitis undergoing laparoscopic cholecystectomy were enrolled in this study as per inclusion criteria. A written informed consent was taken from all the participants after explaining the objective and their role to the study. After the enrolment, detailed history and physical examination was done. A structured questionnaire was used for each of the participants to collect data. In all cases, patients underwent complete blood count (CBC), C-reactive protein (CRP), Liver function tests and abdominal ultrasonography to evaluate anatomical variations in the biliary tract , in some selected cases magnetic resonance cholangiopancreatography (MRCP) or endoscopic retrograde cholangio-pancreatography (ERCP) was also conducted before surgery when choledocholithiasis was suspected. Per-operative difficulty was anticipated based on longer operative time, amount of blood loss, pericholecystic odema and intraabdominal adhesion. Data regarding absence or presence of factors were collected and difficulty in laparoscopic cholecystectomy was noted. All the collected data was entered and analyzed on Statistical Packages for Social Sciences (SPSS version-26).*

Results: *The study included 70 participants with a mean age of 49.6 years, predominantly male (62.9%). Technical difficulty during laparoscopic cholecystectomy (LC) was observed in 64.3% of cases. Significant factors associated with technical difficulty included chronic liver disease (OR 1.6, p=0.022), previous surgery (OR 1.16, p=0.011), jaundice (OR 1.5, p=0.028), and a positive Murphy's sign (OR 1.7, p=0.018). Elevated WBC count (22.5 ± 15.9 x10^9/L) (p=0.008), CRP (112.7 ± 50.2 mg/L, p=0.001), ALP (181.7 ± 98.1 U/L) (p=0.001), increased gallbladder wall thickness (3.35±1.7 mm, p=0.019), pericholecystic edema (p=0.027), and intra-abdominal adhesions (p=0.010) were significantly correlated with increased surgical difficulty. The presence of a normal gallbladder was associated with a reduced likelihood of technical challenges (OR 5.0, p=0.001).*

Conclusion: *The identification of preoperative predictors allows anticipation of technical challenges with managing potential complication in laparoscopic cholecystectomy (LC) and enhances surgical safety in acute cholecystitis.*

Key word: *Acute Cholecystitis, Pre-operative risk factors, Difficult Laparoscopic Cholecystectomy.*

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INTRODUCTION

Laparoscopic cholecystectomy (LC) is the gold standard treatment for patients with acute cholecystitis (AC) but the procedure can be technically challenging. Preoperative risk prediction for the operative difficulty in LC is therefore an important issue.[1]

Anticipating the level of difficulty allows safer surgery with fewer complications, and in selected cases patients may be referred to more experienced surgeon or considered for open cholecystectomy. Previous studies have identified several predictors of difficult LC, including male gender, recurrent attacks, prior abdominal surgery, deranged liver function tests, and ultrasonographic findings such as a thickened gallbladder wall or pericholecystic inflammation.[2] Anatomical identification during LC, especially in calot's triangle is crucial as complication such as biliary and vascular injury, adhesion and port-site problems may arise. The definition of " difficult LC remains variable, since difficulty depends not only on patient related factors but also on the surgeon's skills and experienced.[3]

Traditionally, surgeon's often delayed LC for AC due to concerns about complications in the inflamed field, particularly around Clot's triangle. However, early surgery is now considered safe and offers both medical and socioeconomic benefits.[4,5,6]

Previous local data reported a 7.3% conversion rate, with risk factors such as previous surgery, preoperative ERCP, acute cholecystitis, increased gall bladder wall thickness, and older age showing no significant association.. Other study classified difficult cases as grade E (difficulty grading), characterized by severely contracted gallbladders, morbid adhesions, short cystic ducts, and bile duct injuries.[7,8]

LC is usually the first advanced laparoscopic procedure pereformed by general surgeon early in their careers.This study aim to evaluate pre-operative risk factor for anticipate technical difficulty in LC for AC , thereby guiding referral of high risk patient to tertiary centers or more experienced surgeon.

METHODS

This cross sectional observational study was conducted from 11th may 2023 to 13 October 2024 at department of General Surgery, BIRDEM General Hospital, Dhaka, Bangladesh. After institutional review board (IRB) (No. BIRDEM/IRB/372) approval and informed written consent, a total 70 adult patients with acute cholecystitis undergoing laparoscopic cholecystectomy in the department of Surgery at BIRDEM were consecutively enrolled in this study. in this study as per exclusion and inclusion criteria. A written informed consent was taken from all the participants after explaining the objective and their role to the study. After the enrolment detailed history and physical examination was done. A structured questionnaire was used for each of the participants to collect data. The collected data included age, gender, body mass index and co-morbid diseases, complications and other relevant information. Also biochemical test (CBC- WBCe" 15000 cell/microliter, CRP>5mg/dl, S. billirubin >1.2, S. ALP > 150IU/L) and Ultrasonography of whole abdomen was done to assess the patients. To evaluate anatomical variations in the biliary tract and choledocolithiasis, magnetic resonance cholangio-pancreatography (MRCP) or endoscopic retrograde cholangiopancreatography (ERCP) was also conducted in selective cases before surgery. Patients were briefed pre-operatively about the whole procedure. Intravenous antibiotics were administered to each patient before the operation. The standard four-trocar operative method was applied. For most cases except those with H/O previous surgery port position was according to previous abdominal scar. In every case, attempt to create a critical view of safety (CVS). Operative time, amount of bleeding, empyma or gangrenous gall bladder, bile or stone spillage, intraabdominal adhesion was assessed to evaluate operative difficulty. After the gallbladder was resected, irrigation inside the abdomen and insertion a drain close to the gallbladder bed was made. Specimen was histopathologically studied and all patients were provided standard care after operation. After surgery, all patients were thoroughly evaluated clinically, post operatively. Necessary investigations were done

according to patient's situation. During the period of hospital stay, minor and major as well as intra and postoperative complications were evaluated and noted.

RESULTS

These study included 70 participants, whose age and sex distributions were analyzed. The age distribution revealed a mean age of 49.6 years with a standard deviation of 13.6 years. The highest prevalence was observed in the 39 to 59 age group, which constituted 50% of the participants. In terms of sex distribution, 44 participants (62.9%) were male, and 26 participants (37.1%) were female.

The majority of participants were service holders, representing 29.0% of the total. Businessmen and housewives each accounted for 25.7% of the participants. Students made up 10% of the group, while bankers constituted 5.3%. Doctors represented 2.9% of the participants, and the smallest group was teachers, who accounted for just 1.4%.

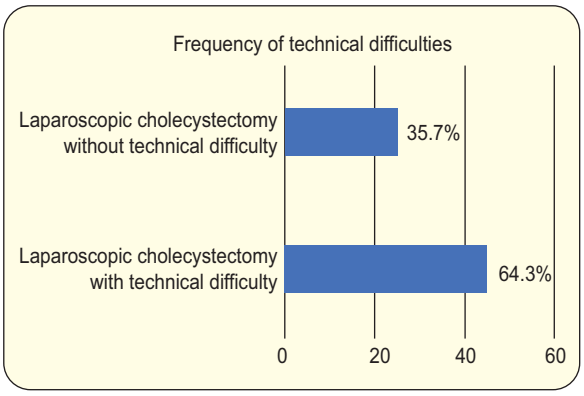

Figure 1. Frequency of technical difficulty among total sample.

Out of the total cases, 45 patients underwent laparoscopic cholecystectomy with technical difficulty, while the remaining 25 patients underwent the procedure without any technical difficulty.

Out Of the 45 patients who experienced technical difficulty, there is no statistically significant association with age.

Regarding sex, 27 males (60%) and 18 females (40%) experienced technical difficulty, while among those without technical difficulty, 17 were male (68%) and 8 were female (32%). The OR for sex was 0.886 (95% CI: 0.6-1.2) with a P value of 0.507, showing no significant association between sex and technical difficulty.

The BMI of patients with and without technical difficulty was nearly identical, with a mean of 22.9±4.1 for the former group and 22.9±2.7 for the latter group. The P value for BMI was 0.939, indicating no significant difference between the two groups regarding BMI.

DM and HTN showed no statistical association with laparoscopic technical difficulty. In terms of chronic liver disease (CLD), 9 patients with technical difficulty had CLD (20%), while 36 did not (80%). Interestingly, none of the patients without technical difficulty had CLD, with all 25 being CLD-free. The OR for CLD was 1.6 (95% CI: 1.3-3.0) with a P- value of 0.022, indicating a statistically significant association between the presence of CLD and the likelihood of experiencing technical difficulty during laparoscopic cholecystectomy.

The data presents the prevalence of symptoms among the study participants. Pain in the hypochondriac region was the most common symptom, reported by 98.6% of the patients. Vomiting was also prevalent, occurring in 71.4% of the participants. Fever was less common, with 24.3% of the patients experiencing it.

Among patients with a history of previous surgery, 24 (53.3%) experienced technical difficulty, compared to 5 (20%) without technical difficulty. The odds ratio (OR) was 1.16 (1.1-2.2), with a p-value of 0.011, indicating a significant association between previous surgery and increased technical difficulty.

Jaundice was present in 17 (37.8%) of those with technical difficulty and 3 (12%) of those without technical difficulty. The OR was 1.5 (1.1-2.0) with a p-value of 0.028, suggesting a significant correlation between jaundice and technical difficulty.

Murphy's sign was positive in 37 (82.2%) patients with technical difficulty and 14 (56%) without technical difficulty. The OR was 1.7 (0.9-2.9), with a p-value of 0.018, indicating a significant association between a positive Murphy's sign and technical difficulty (Table I).

Table I. Association of clinical parameters with technical difficulty during laparoscopic cholecystectomy

Variables	Difficulty outcome (n=70)		OR	P value
	With technical difficulty (45)	Without technical difficulty (25)		
Symptoms onset	3.87±1.9	3.381.13	-	0.253[c]
H/O previous surgery				
Yes	24 (53.3%)	5 (20%)	**1.16 (1.1-2.2)**	**0.011[a]**
No	21 (46.7%)	20 (80%)		
Jaundice				
Yes	17 (37.8%)	3 (12%)	**1.5**	0.028[b]
No	28 (62.2%)	22 (88%)	(1.1-2.0)	
Murphy's sign				
Yes	37 (82.2%)	14 (56%)	**1.7**	0.018[a]
No	8 (17.8%)	11 (44%)	(0.9-2.9)	
Palpable gall bladder				
Yes	6 (13.3%)	1 (4%)	1.3	0.212[b]
No	39 (86.7%)	24 (96%)	(0.9-1.9)	

The mean total WBC count was significantly higher in patients with technical difficulty (22.5 ± 15.9 x10^9/L) compared to those without technical difficulty (13.6 ± 4.7 x10^9/L). The p-value of 0.008 indicates a significant association between elevated WBC count and technical difficulty.Patients with technical difficulty had a mean CRP level of 112.7 ± 50.2 mg/L, whereas those without difficulty had a mean CRP level of 61.12 ± 23.2 mg/L. The p-value of 0.001 suggests a significant correlation between elevated CRP levels and technical difficulty. The mean ALP level was significantly higher in patients with technical difficulty (181.7 ± 98.1 U/Lcompared to those without technical difficulty (104.68 ± 23.2 U/L). The p-value of 0.001 indicates a significant association between elevated ALP levels and technical difficulty.

The patient with increased GB wall thickness was significantly higher with technical difficulty(3.35 ± 1.7) compared to those without technical difficulty(2.33 ± 1.5). p-value of 0.019 indicates significant correlation between GB wall thickness and technical difficulty. Pericholecystic edema and collection was present in 39 (86.7%) patients with technical difficulty and 16 (64%) patients without difficulty. The odds ratio (OR) was 1.7 (0.9-3.37), with a p-value of 0.027, suggesting a significant correlation between pericholecystic edema and increased technical difficulty (Table II).

The mean duration of operation was significantly longer for patients with technical difficulty (101.16 ± 14.0 minutes) compared to those without technical difficulty (54.3 ± 12.3 minutes). Patients with technical difficulty experienced a mean blood loss of 71.1 ± 14.8 mL, whereas those without difficulty had a mean blood loss of 54.3 ± 12.36 mL. No patients with technical difficulty had a normal gallbladder, while 14 (56%) of those without difficulty had a normal gallbladder. The odds ratio (OR) was 5.0 (95% CI: 2.9-8.6) with a p-value of 0.001. This indicates a significant association between a normal gallbladder and the absence of technical difficulty, suggesting that a normal gallbladder condition reduces the likelihood of technical problems. All patients (100%) with technical difficulty had pericholecystic adhesions,compared to 12 (48%) without difficulty. The OR was 4.7 (95% CI: 2.8-7.8) with a p-value of 0.001. Intra-abdominal adhesions were observed in 17 (37.8%) of patients with difficulty and 2 (8%) without difficulty. The OR was 1.6 (95% CI: 1.2-2.1) with a p-value of 0.010. This significant association indicates that the presence of intra-abdominal adhesions is linked to an increased likelihood of technical difficulty during surgery. Stone spillage occurred in 6 (13.3%) of patients with technical difficulty and none of those without difficulty. The OR was 1.6 (95% CI: 1.3-1.9) with a p-value of 0.082. Although the association is not statistically significant, it suggests that stone spillage may be associated with technical difficulty (Table III).

Table II. Association of radiological parameters with technical difficulty during laparoscopic cholecystectomy

Variables	Difficulty outcome (n=70)		OR (95% CI)	P value
	With technical difficulty (45)	Without technical difficulty (25)		
GB wall thickness	3.35±1.7	2.331.5	-	**0.019[c]**
Pericholecystic edema and collection				
Yes	39 (86.7%)	16 (64%)	**1.7**	**0.027[a]**
No	6 (13.3%)	9 (36%)	**(0.9-3.37)**	
Stone impaction				
Yes	42 (93.3%)	23 (92%)	1.0 (0.5-	1.0[b]
No	3 (6.7%)	2 (8%)	2.2)	
Condition of liver				
Normal	16 (35.6%)	11 (44%)	-	
Fatty change/enlarged	27 (60%)	14 (56%)		0.484[a]
Cirrhotic	2 (4.4%)	0		

Table III. Association of per-operative factors with technical difficulty during laparoscopic cholecystectomy

Variables	Difficulty outcome (n=70)		OR (95% CI)	P value
	With technical difficulty (45)	Without technical difficulty (25)		
Duration of OT	101.16±14.0	54.312.3	-	0.001[c]
Blood loss	71.114.8	54.312.36	-	0.001[d]
Condition of gallbladder				
Normal	0	14 (56%)		
Contracted	5 (11.1%)	0	5.0	0.001[a]
Distended	23 (51.1%)	11 (44%)	(2.9-8.6)	
Empyema	15 (33.3%)	0		
Gangrenous	2 (4.4%)	0		
Peri cholecystic adhesion				
Yes	45 (100%)	12 (48%)	4.7	0.001[b]
No	0	13 (52%)	(2.8-7.8)	
Anatomical variation				
Yes	5 (11.1%)	0	1.6	0.152[b]
No	40 (88.9%)	25 (100%)	(1.3-1.9)	
Intra-abdominal adhesion				
Yes	17 (37.8%)	2 (8%)	1.6	0.010[b]
No	28 (62.2%)	23 (92%)	(1.2-2.1)	
Stone spillage				
Yes	6 (13.3%)	0	1.6	0.082[b]
No	39 (86.7%)	25 (100%)	(1.3-1.9)	
Cystic duct stump suturing				
Yes	5 (11.1%)	0	1.6	0.152[b]
No	40 (88.9%)	25(100%)	(1.3-1.9)	

DISCUSSION

The study analyzed 70 participants, revealing a mean age of 49.6 years with a standard deviation of 13.6 years, with the highest prevalence observed in the 39 to 59 age group, constituting half of the participants (50%). The sex distribution showed a predominance of males, with 44 participants (62.9%) compared to 26 females (37.1%). A notable majority of the participants were service holders (29.0%). Same sociodemographic observations were seen by the study.[9,10,11] Although some study found females with high BMI faced significant difficulty during LP but the present study found no such associations.[12,13,14]

The most common presenting symptom was pain in the hypochondriac region, reported by 98.6% of the patients, followed by vomiting, which occurred in 71.4% of participants, and fever, which was less prevalent at 24.3%. Abdominal pain was also found to be the most prevalent symptom by the study.[1, 15]

Among the 70 cases, 45 patients (64.3%) underwent laparoscopic cholecystectomy (LC) with technical difficulty, while the remaining 25 patients (35.7%) underwent the procedure without any complications.

The analysis did not find significant correlations between age, BMI, DM, and HTN, and the likelihood of technical difficulties during LC. However, the presence of chronic liver disease (CLD) was significantly associated with technical difficulty (20). The odds ratio (OR) for CLD was 1.6 (95% CI: 1.3-3.0) with a p-value of 0.022, indicating a statistically significant association. This suggests that CLD may contribute to anatomical and physiological changes that complicate the surgical procedure. Although not CLD but Siddiqui et al., (2017) found that enlarged liver was a pre-operative factor for difficult LC.[16]

In patients with a history of previous surgery, 24 (53.3%) experienced technical difficulty. The OR was 1.16 (95% CI: 1.1-2.2) with a p-value of 0.011, indicating a significant association between previous surgeries and increased technical difficulty. This findings was similar with some study.[17] This could be due to the formation of intra-abdominal adhesions from previous surgeries, which can obscure anatomical landmarks and complicate the dissection process also observed an association between difficulty and with previous surgery but it was not statistically significant.[1,13]

Jaundice was present in 17 (37.8%) patients with technical difficulty, with an OR of 1.5 (95% CI: 1.1-2.0) and a p-value of 0.028, suggesting a significant correlation. Murphy's sign was positive in 37 (82.2%) of patients with technical difficulty, with an OR of 1.7 (95% CI: 0.9-2.9) and a p-value of 0.018. A positive Murphy's sign and jaundice indicated an inflamed gallbladder with biliary obstruction which could increase the likelihood of encountering adhesions or other complications during surgery.

The mean total WBC count was significantly higher in patients with technical difficulty (22.5 ± 15.9 x10^9/L) compared to those without (13.6 ± 4.7 x10^9/L), with a p-value of 0.008, suggesting a significant association between elevated WBC count and technical difficulty. Similarly, patients with technical difficulty had a mean CRP level of 112.7 ± 50.2 mg/L (p=0.001). The mean ALP level was significantly higher in patients with technical difficulty (181.7 ± 98.1 U/L, p= 0.001), indicating a significant association. Elevated WBC counts are indicative of an inflammatory response, possibly due to cholecystitis, which may lead to

elevated levels further suggest an ongoing inflammatory process that could complicate surgery. Elevated parameters showed similar elevated levels,[12,13,14] although not all statistically significant. Elevated ALP levels could reflect biliary obstruction, which may complicate the surgical approach due to altered anatomy or increased tissue friability. Elevated CRP in difficult LC was observed, but the association was not statistically significant.[15,18]

Gallbladder (GB) wall thickness was significantly greater in patients who faced technical difficulties during LC (3.35±1.7 mm, p=0.019). This increased thickness could be due to chronic inflammation or fibrosis, making dissection more challenging. Increased GB wall thickness was found to be significant predictor.[10,14,16,19,20]

Pericholecystic edema and collection was present in 39 (86.7%) patients with technical difficulty and 16 (64%) patients without difficulty, with an OR of 1.7 (95% CI: 0.9-3.37) and a p-value of 0.027, suggesting a significant correlation. This edema may obscure anatomical landmarks and increase the risk of intraoperative complications.[14-16,19]

The mean duration of the operation was significantly longer for patients with technical difficulty (101.16 ±

14.0 minutes) compared to those without (54.3 ± 12.3 minutes), indicating the additional time required to manage complications or challenging anatomy. Similarly, patients with technical difficulty experienced a mean blood loss of 1.1 ± 14.8 mL, whereas those without difficulty had a mean blood loss of 54.3 ± 12.36 mL. This discrepancy in blood loss might be due to increased surgical time and difficulty in achieving hemostasis in inflamed or fibrotic tissues. These observations were also true,[1,15] Notably, none of the patients with technical difficulty had an anatomically normal gallbladder, while 14 (56%) of those without difficulty had a normal gallbladder. The OR was 5.0 (95% CI: 2.9-8.6) with a p-value of 0.001, suggesting that a normal gallbladder condition significantly reduces the likelihood of technical problems.

All patients with technical difficulty had pericholecystic adhesions (100, with an OR of 4.7 (95% CI: 2.8-7.8) and a p-value of 0.001. The presence of these adhesions can complicate the dissection process and increase the risk of injury to surrounding structures pericholecystic collection/adhesion was an important factor for difficulty during LC but they found no statistical significant.[10,19]

Intra-abdominal adhesions were observed in 17 (37.8%) of patients with difficulty and 2 (8%) without, with an OR of 1.6 (95% CI: 1.2-2.1) and a p-value of 0.010. This significant association indicates that intra-abdominal adhesions are linked to an increased likelihood of technical difficulty during surgery, likely due to altered anatomy and the challenge of safe dissection.

Stone spillage occurred in 6 (13.3%) of patients with technical difficulty, with an OR of 1.6 (95% CI: 1.3-1.9) and a p-value of 0.082. Although this association is not statistically significant, it suggests that stone spillage may be associated with technical difficulty, potentially due to increased manipulation of the gallbladder during a difficult dissection. found stone impaction not spillage; to be a significant factor.[10,19,20]

The study found that male patients were generally older, had more comorbidities, and underwent emergency surgery more frequently than female patients. The median postoperative hospital stay was one day, which was positively correlated with the complexity of the surgery. Conversion rates were higher in male patients (OR 1.47, p = 0.047) compared to females and were also increased in patients with greater comorbidity. Emergency surgery (OR 1.75, p = 0.005), male gender (OR 1.68, p = 0.005), increasing comorbidity, and complexity of surgery were all positively associated with the incidence of complications, which occurred in 153 out of 2,117 patients (7.2%). Notably, only male gender was significantly associated with mortality (OR 5.71, p = 0.025). The study concluded that adverse outcomes from LC are particularly associated with male gender, as well as with the patient's comorbidities, the complexity of the surgery, and the urgency of the procedure. The authors suggest that a risk-adjusted outcome analysis is desirable to ensure that the informed consent process adequately reflects these risks .[12,13,21-23]

There are some anticipated per operative factor like certain amount of bleeding and operative time were also analyzed. The mean duration operation time 101.16 ± 14.8 min with a p value of 0.001 compared to those without 54.3±12.3 min and mean amount of blood loss also higher,it suggests that significant association with difficult cholecystectomy.[9,10,24-26]

Our study found distended, gangrenous gall bladder had more technical difficulty associated with intraabdominal adhesion this finding also similar with some study. But some study

found bile duct injury, intestinal injury, fail to achived critical view of safety was more significant predictor for difficult cholecystectomy.[16,20,27-31.]

Previous study found that inflammatory adhesions were the main cause, followed by fibrosis of the Calot triangle and intraoperative hemorrhage of the bed of the gallbladder. Other less common causes were the migration of stones to the peritoneal space or the thickening of the wall of the gallbladder. The rare causes included the presence of a cholecystoduodenal fistula (0.08%), bleeding from cystic artery lesions (0.04%) or hepatic lesions (0.02%), damage to the bile ducts (0.02-0.06%), duodenal or colonic drilling (0.02%), stones in the common bile duct (0.02%), and suspicion of malignancy (0.02%).[32,33]

Conclusion

The results of this study underscore several critical factors that contribute to technical difficulties during laparoscopic cholecystectomy (LC).The findings reveal that certain factor like history of previous surgery,

clinical finding, raised biochemical finding, altered minimal liver function test and imaging directly influence the complexity of the procedure. Gross liver dearrangment change the modality.

Authors' contribution: MP, SKM, SR planned the research. MP drafted the manuscript. All authors read and approved the manuscript.

Conflict of Interest : Nothing to declare

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