

Gender as a Predictive Pre-Operative Factor for Difficult Laparoscopic Cholecystectomy

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Author's Contribution

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ABSTRACT

Objective: The aim is to establish the rate of difficult laparoscopic cholecystectomy (DLC) and to evaluate the correlation between difficult laparoscopic cholecystectomy and demographic, clinical, and intraoperative variables.

Methodology: The cross-sectional analytical study was carried out in the Department of general surgeries, Jinnah international hospital, Abbottabad between April and December 2025. One hundred and forty patients aged 18 to 90 years undergoing elective laparoscopic cholecystectomy were enrolled consecutively. Demographic data, comorbidities, and preoperative diagnosis, intraoperative diagnoses, and postoperative outcomes were collected. DLC was characterized by the existence of thick adhesions, severe inflammation, or abnormal anatomy of the biliary in a way that made the dissection of the gallbladder difficult. The analysis of data was performed with SPSS v26. Continuous variables were presented as the mean standard deviation; categorical variables in terms of frequencies and percentages. Chi-square tests were used to evaluate the associations with the DLC, considering the p-value <0.05 as significant.

Results: The mean age of the study sample was 44.6 ± 12.3 years consisting of 65.7% female patients. Difficult Laparoscopic Cholecystectomy occurred in 58 (41.4%) patients. DLC was more likely in male patients in comparison with female (54.2% vs. 34.8%, p-value = 0.028). DLC was significantly associated with intraoperative adhesions (67.9% vs. 23.8%, p-value < 0.001). The DLC rates were associated with older age and with acute cholecystitis but not statistically significant.

Conclusion: When gallbladder surgery is elective, a difficult laparoscopic cholecystectomy is prevalent. Two important factors include intraoperative adhesions and male gender. Surgical results, operative planning, and preoperative risk assessment can all be improved by raising awareness of these aspects.

Key Words: Gallbladder Surgery, Difficult Laparoscopic Cholecystectomy, Gallstones.

Introduction

Gallstone disease is classified as one of the most prevalent gastrointestinal diseases globally, and one of the key pointers of abdominal surgery. The incidence of cholelithiasis differs by geographical location with an incidence of 10-20% in the west and 4-10% in most Asian populations.¹ The incidence of gall stone disease in Pakistan is also noteworthy, with a number of studies locally showing incidence of 10-20% among persons undergoing abdominal imaging.² Numerous factors such as age, gender, obesity, metabolic syndrome, and diet contribute to the occurrence of gallstones development. Hormonal factors, especially, estrogen-induced saturation of biliary cholesterol with saturated fatty acids and decreased gallbladder motility, play a role in the increased prevalence in women especially aged 30-50 years.³

Since its introduction in the late 1980s, laparoscopic cholecystectomy (LC) has become the gold standard care in the management of symptomatic gallstone and gallbladder disease. The laparoscopic procedure has several benefits over the open cholecystectomy such as reduced postoperative pain, shorter length of stay, faster healing, and better cosmetic results.⁴ As a result, LC is among the most common surgical operations that take place globally. Although laparoscopic

cholecystectomy is widely accepted and generally safe, it is sometimes difficult to do technically. Difficult laparoscopic cholecystectomy is generally characterized by dense adhesions, severe inflammation, fibrosis, or distorted anatomy of Calot's triangle that complicates safe identification of biliary structures during dissection.⁵

Operative difficulty during laparoscopic cholecystectomy is clinically significant because it may increase operative time, raise the risk of bile duct injury, and lead to conversion to open surgery. Therefore, predicting difficult laparoscopic cholecystectomy before or during surgery is of considerable importance for surgical planning, patient counseling, and risk reduction.⁶ Several demographic, clinical, and radiological factors have been investigated as potential predictors of difficult LC. These include advanced age, obesity, previous abdominal surgery, acute cholecystitis, thickened gallbladder wall, impacted stones, and anatomical variations of the biliary tract.⁷

Among the various proposed predictors, gender has received particular attention. Although gallstone disease is more prevalent in females, several studies

have suggested that laparoscopic cholecystectomy may be technically more difficult in male patients. One explanation proposed in the literature is that men often present later in the course of the disease due to delayed healthcare-seeking behavior, resulting in more severe inflammation, fibrosis, and adhesion formation at the time of surgery.⁸

These pathological alterations may blur the normal anatomical features, and dissecting in the triangle of Calot will become more challenging, which will complicate the operations. Other research has indicated that difficult laparoscopic cholecystectomy, more operative time, and more intraoperative adhesions are higher in male patients than in female patients.⁹ However, other investigations have reported no significant association between gender and operative difficulty, suggesting that disease severity, timing of surgical intervention, and surgeon experience may play a more important role than gender alone.¹⁰ These conflicting findings highlight the need for further investigation to better understand the influence of gender on operative difficulty.

In addition, most available studies have been conducted in Western or other international populations, and evidence from local Pakistani settings remains limited. Variations in healthcare access, disease presentation, and patient demographics may influence surgical outcomes and operative difficulty. Therefore, evaluating the relationship between gender and difficult laparoscopic cholecystectomy within the local population is important for improving surgical risk assessment and management strategies.

The present study was therefore conducted to determine whether gender serves as a predictive pre-operative factor for difficult laparoscopic cholecystectomy among patients undergoing elective surgery in a tertiary care hospital.

Methodology

This cross-sectional Analytical study was carried out in the Department of General Surgery at Jinnah International Hospital, Abbottabad, over a period of eight months starting from April 2025 to December 2025. The approval of the study was taken from the Institutional Review Board (IRB) No. WMC/IRB/2025/224. All patients scheduled to undergo elective laparoscopic cholecystectomy during the study period were screened for eligibility, and those who met the inclusion criteria were invited to participate after providing informed written consent. All patient information was kept strictly confidential, and data were anonymized using unique identification numbers to ensure privacy.

The sample size for the study was calculated using the WHO sample size calculator. The calculation was based on previously reported frequencies of difficult laparoscopic cholecystectomy, which were 50.3% among males and 29.4% among females, with a confidence level of 95% and a study power of 80%. These parameters were used to calculate the minimum required sample size as 140 patients. The enrolling of participants was done through a non-probability consecutive sampling method.

The study included patients aged between 18 and 90 years of either sex who were undergoing elective laparoscopic cholecystectomy due to gallbladder disease such as cholelithiasis and cholecystitis. The patients were not eligible when they refused to participate or undergo surgery; or had previously had a cholecystostomy tube or endoscopic biliary stenting; or known choledocholithiasis that made them in need of other biliary intervention; or a known hepatobiliary malignancy.

The relevant clinical information was recorded on a structured data collection proforma. Age and gender were recorded, and the presence of comorbid illnesses, including hypertension, diabetes mellitus, and hepatitis B or C infection was also recorded. Preoperative diagnosis that resulted in surgery, including cholelithiasis, acute cholecystitis, or biliary pancreatitis, were also noted. All laparoscopic cholecystectomies were conducted on an elective basis by consultant surgeons who had at least five years' experience in laparoscopic surgery. Intraoperative observations were well recorded by the operating surgeon at each procedure. These were the existence of adhesions, anatomy distortion, presence of abnormal vessels/ ducts and the ease or difficulty of the procedure.

In this study, the term difficult laparoscopic cholecystectomy was used to indicate that the patient had dense adhesion, severe inflammation, or that the normal anatomy of the biliary was too distorted to identify the main structures and excise the gallbladder. The consultant surgeon made this evaluation at the end of the procedure. The postoperative outcomes were also observed; this includes the incidence of complication like bile leak or other bad events. Moreover, histopathology results of the gallbladder specimen were examined to identify the presence of acute or chronic inflammatory alterations.

The Statistical Package of Social Sciences (SPSS) version 26.0 was used to enter and analyze all the collected data. Continuous variables like age, were summarized using mean and standard deviation and categorical variables (like gender, comorbidities,

preoperative diagnosis, intraoperative findings and postoperative complications) were summarized as frequencies and percentages. The association between gender and the occurrence of difficult laparoscopic cholecystectomy was analyzed by Chi-square test. Stratified analysis was applied on the basis of age, gender, comorbid conditions, preoperative diagnosis and histopathological findings to control possible confounding factors. The p-value ≤ 0.05 was considered statistically significant.

Results

The study sample involved 140 patients who had undergone elective laparoscopic cholecystectomy. The mean age of the patients was 44.6 ± 12.3 years ranging from 19 to 78 years. A larger portion of the patients (62.9%) were above 40 years of age, with (37.1%) below the age of 40 years. The study sample was composed of females (65.7%), and males (34.3%), respectively. The comorbid conditions included hypertension in 32 patients (22.9%), diabetes mellitus in 26 patients (18.6%), and hepatitis B or C infection in 15 patients (10.7%). Table I presents demographic and clinical features of the study sample.

Variable	Category	(n)	(%)
Age (years)	Mean $\pm$ SD	44.6 ± 12.3	
Age Group	≤ 40 years	52	37.1
	>40 years	88	62.9
Gender	Male	48	34.3
	Female	92	65.7
Hypertension	Yes	32	22.9
	No	108	77.1
Diabetes Mellitus	Yes	26	18.6
	No	114	81.4
Hepatitis B/C	Yes	15	10.7
	No	125	89.3

Regarding preoperative diagnosis, cholelithiasis was the most frequent sign of surgery in 88 cases (62.9%), then acute cholecystitis in 36 cases (25.7%), and then biliary pancreatitis was identified in 16 cases (11.4%). The intraoperative observations revealed that 56 of the patients had adhesions (40.0%), and 30 patients had distended biliary anatomy (21.4%). A total of 15 patients (10.7%) experienced abnormal vessels or ducts. The histopathological analysis of the gallbladder specimens indicated that chronic cholecystitis was observed in 94 (67.1%) and acute inflammatory changes in 46 (32.9%) patients. Table II gives an overview of these operative and pathological findings.

Difficult laparoscopic cholecystectomy (DLC) was noted in 58 patients (41.4%), and 82 cases (58.6%) were done without any major challenge. Postoperative complications were rare; only 6 patients (4.3%)

experienced bile leakage and 134 patients (95.7%) did not experience any bile leakage. These results are demonstrated in (Table III).

Variable	Category	(n)	(%)
Preoperative Diagnosis	Cholelithiasis	88	62.9
	Acute Cholecystitis	36	25.7
	Biliary Pancreatitis	16	11.4
Adhesions	Present	56	40.0
	Absent	84	60.0
Distorted Anatomy	Present	30	21.4
	Absent	110	78.6
Anomalous Vessels/Ducts	Present	15	10.7
	Absent	125	89.3
Histopathology	Acute Cholecystitis	46	32.9
	Chronic Cholecystitis	94	67.1

Variable	Category	(n)	(%)
Difficulty of Surgery	Difficult LC	58	41.4
	Not Difficult LC	82	58.6
Bile Leak	Yes	6	4.3
	No	134	95.7

Stratified analysis was conducted to assess how age, gender, preoperative diagnosis, and adhesions relate to the prevalence of difficult laparoscopic cholecystectomy using Chi-square test. The frequency of difficult laparoscopic cholecystectomy was more common in male patients (54.2%) than in female patients (34.8%), and the relationship was significant (p-value = 0.028). The proportion of difficult surgeries reported in patients aged over 40 years (47.7%) was noted higher than that reported in patients aged ≤ 40 years (30.8%), but these differences were not observed to be statistically significant (p-value = 0.067). With respect to preoperative diagnosis, patients who presented acute cholecystitis showed a higher percentage of difficult laparoscopic cholecystectomy (55.6%) than patients who had cholelithiasis (36.4%), and biliary pancreatitis (37.5%); although, the difference was not statistically significant (p-value = 0.091). There was a significant association between adhesions presence and surgical difficulty. The incidence rate of difficult laparoscopy cholecystectomy was found to be very high among patients with adhesions (67.9%) and very low among patients without adhesions (23.8%) and it was highly significant (p-value < 0.001). Table 4 shows the stratified analysis.

Tab IV: Stratified Analysis of Factors Associated with Difficult Laparoscopic Cholecystectomy.

Variable	Category	Difficult LC n (%)	Not Difficult LC n (%)	P-value
Age Group	≤40 years	16 (30.8)	36 (69.2)	0.067
	>40 years	42 (47.7)	46 (52.3)	
Gender	Male	26 (54.2)	22 (45.8)	0.028
	Female	32 (34.8)	60 (65.2)	
Preoperative Diagnosis	Cholelithiasis	32 (36.4)	56 (63.6)	0.091
	Acute Cholecystitis	20 (55.6)	16 (44.4)	
	Biliary Pancreatitis	6 (37.5)	10 (62.5)	
Adhesions	Present	38 (67.9)	18 (32.1)	<0.001
	Absent	20 (23.8)	64 (76.2)	

Discussion

Laparoscopic cholecystectomy (LC) is considered as gold standard treatment for symptomatic gallstone disease. Due to its many benefits like minimized postoperative pain, shorter hospitalization, and prompt recovery in comparison to open surgery. Although these advantages exist, the procedure can sometimes be complicated technically because of reasons like inflammation, adhesions or distorted anatomy within Calot triangle. It is thus important to identify predictors of difficult laparoscopic cholecystectomy (DLC) prior to planning the gallstone surgery. Which will help to enhance the surgical outcome, and to reduce complication occurrence. A number of studies have tried to determine clinical and intraoperative factors which can be used to predict difficulty in laparoscopic cholecystectomy.¹¹⁻¹³

In this study, difficult laparoscopic cholecystectomy was noted in (41.4%) of patients. This rate is in the range of frequencies reported by previous studies, but the incidence is widely reported with variation depending on the criteria applied to determine operative difficulty. According to Gupta et al., higher rate of difficult laparoscopic cholecystectomy can be due to inflammatory variations, adhesions, or anatomic deformity.¹¹ Similarly, Randhawa and Pujahari had constructed a scoring system to forecast difficult laparoscopic cholecystectomy and highlighted that various preoperative and intraoperative parameters cause complexity during surgical procedures.¹² The disparity in the previously reported frequencies could be due to variations in patient selection, severity of the disease, and experience of the surgeon.

The majority of the study participants in the present study were female patients (65.7%), a finding that is in line with the established epidemiology of gallstone disease. Hormonal factors make females more prone to gallstones, especially estrogen, which leads to cholesterol super saturation of bile. Despite several studies showing that male patients are more likely to have a difficult laparoscopic cholecystectomy, gallstone disease is more common in females.^{13,14} In this current study, difficult LC was considerably more common among male patients (54.2%) than among female

patients (34.8%), and the relationship was statistically significant (p-value = 0.028). Lee et al. have also reported similar results, stating that male gender was significantly associated with an increased risk of conversion or operative difficulty, potentially because of late presentation and more inflammatory alterations in the male patients.¹⁵

Age is another factor that has been commonly linked with operative difficulty during laparoscopic cholecystectomy. In this current research, patients over 40 years of age had a higher percentage of difficult procedures than young patients, but the association was not found to be statistically significant. Previous studies have indicated that increased age might also be a factor contributing to operative difficulty due to recurrent inflammatory processes resulting in fibrosis and adhesions of the gallbladder and surrounding tissue.¹⁶ Likewise, Ibrahim et al. indicated that chronic inflammatory changes and alterations in anatomy were more likely to result in difficult laparoscopic cholecystectomy among older patients.¹⁷

The association of preoperative diagnosis with operative difficulty was another significant finding of this current study. In patients with acute cholecystitis, the incidence of difficult laparoscopic cholecystectomy (55.6%) was higher than in patients with uncomplicated cholelithiasis (36.4%). This association was not found to be statistically significant but it is in line with other studies which have indicated that acute inflammation can blur the anatomy of Calots triangle making dissection technically more challenging. Nidoni et al. pointed out that one of the leading causes of difficult laparoscopic operations is inflammatory gallbladder disease due to the edema, adhesion and thickening of the gallbladder wall.¹⁸

Another very important finding of this current study was that there is highly significant association of difficult laparoscopic cholecystectomy with intraoperative adhesions. Difficult laparoscopic cholecystectomy was observed in (67.9%) of patients who had adhesions versus (23.8%) patients who did not have adhesions, which was highly significant (p < 0.001). It is known that adhesions cover anatomical

landmarks and put bile duct at risk of injury during dissection. Adhesions surrounding the gallbladder and the triangle of Calot have also been found as one of the major predictor of difficult laparoscopic cholecystectomy and conversion to open surgery.¹⁹ Vivek et al. also found that dense adhesions were associated with prolonged operation time and technical difficulty in laparoscopic cholecystectomy.²⁰

In the current study, postoperative complications were relatively rare with only (4.3%) of the patients experiencing a leakage of bile. This low complication rate means that laparoscopic cholecystectomy is a safe procedure even in a situation where a difficulty in the operation arises especially when carried out by skilled surgeons. Low complication rates have also been previously observed when proper surgical methods and proper intraoperative judgment were used.¹⁴

The overall results of this study indicate that the male gender and the presence of intraoperative adhesions are strong predictors of difficult laparoscopic cholecystectomy. Also older age and acute inflammatory conditions might also be contributing factors to surgical complexity. Identification of such factors can assist the

surgeons to predict technical difficulties, plan an operation, and eventually achieve better patient outcomes in laparoscopic gallbladder surgery.

Conclusion

A significant rate of difficult laparoscopic cholecystectomy was observed in this study among the patients undergoing elective surgery for gallbladder disease. The results showed that male gender and presence of intraoperative adhesions had a significant positive relationship with surgical difficulty, whereas older age and acute cholecystitis exhibited a tendency towards difficult surgical procedure but did not show a statistically significant relationship. Early detection of such risk factors can help the surgeons to properly plan surgical operations, predict the issues that may arise during the operation, and minimize the chances of developing complications. It is crucial to state that careful intraoperative evaluation and compliance with the principles of safe surgery are the keys to positive results in laparoscopic cholecystectomy.

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