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Original Research Article

A clinical study to predict difficult laparoscopic cholecystectomy based on clinicoradiological assessment

Nitin M. Parmar, Rajesh D. Patel, Jay Nareshkumar Chandani*

Department of Surgery, B. J. Medical College, Ahmedabad, Gujarat, India

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***Correspondence:**
Dr. Jay Nareshkumar Chandani,
E-mail: drjaynchandani@gmail.com

ABSTRACT

Background: Laparoscopic cholecystectomy is the gold standard for gallstone disease, but operative difficulty varies due to clinical and radiological factors. Predicting difficult cases preoperatively helps improve surgical planning, reduce complications, and guide timely conversion to open surgery.
Methods: This prospective study included 50 patients undergoing laparoscopic cholecystectomy between December 2022 and December 2024. Clinical parameters (age, sex, BMI, comorbidities, prior surgery, history of cholecystitis, ERCP) and radiological findings (gallbladder wall thickness, stone characteristics, gallbladder status, Mirizzi syndrome) were recorded. Intraoperative difficulty was categorized as easy, difficult, or requiring conversion to open surgery, based on predefined criteria.
Results: Difficult laparoscopic cholecystectomy occurred in 38% of cases, with a 12% conversion rate. Key predictors of difficulty included acute cholecystitis (50%), obesity (58%), age >50 years, and prior ERCP (54.5% difficulty, 45% conversion). Mirizzi syndrome showed 100% difficulty and 75% conversion. Contracted gallbladder and thickened wall (>4 mm) were associated with higher difficulty. Male patients had higher conversion rates (22.2%) despite fewer difficult cases. Stone size and number were not reliable predictors.
Conclusions: A combination of clinical and radiological factors can effectively predict difficult laparoscopic cholecystectomy. Acute inflammation, prior ERCP, Mirizzi syndrome, obesity, and advanced age are strong indicators of operative complexity and conversion risk. Preoperative risk stratification enables better planning, improves patient counselling, and enhances surgical safety.

Keywords: Clinical study, Predict, Difficult laparoscopic cholecystectomy, Clinicoradiological assessment, Lap cholecystectomy

INTRODUCTION

Laparoscopic cholecystectomy has been the gold standard for the surgical management of gallbladder diseases, particularly cholelithiasis, since the late 1980s. Compared with open cholecystectomy, it offers clear advantages, including reduced postoperative pain, shorter hospital stays, faster return to normal activities and superior cosmetic results. Currently around 80% of cholecystectomies are performed using laparoscopic approach.[1]

However, despite being minimally invasive, the procedure can become technically challenging in certain situations. Factors such as acute or chronic inflammatory changes, anatomical variations of the biliary tree, a thickened or a contracted gallbladder, gangrenous cholecystitis and dense adhesions can increase operative difficulty. Patient-related factors like obesity, previous upper abdominal surgeries and associated comorbidities further complicate the dissection and raise the risk of bleeding, gallbladder perforation, prolonged operative time and conversion to open surgery.

The conversion rate from laparoscopic to open cholecystectomy-generally reported between 5-30%-serves as an indicator of operative difficulty.[2,3] Conversion is usually required in cases of unclear anatomy, uncontrolled haemorrhage or severe adhesions. Importantly, conversion should not be considered a failure but rather a prudent decision to ensure patient safety when laparoscopic completion is not feasible.

Preoperative imaging plays a vital role in anticipating surgical difficulty. Ultrasound helps identify gallbladder wall thickening, stones and signs of inflammation, while MRCP can delineate biliary anatomy and detect ductal stones or anatomical variations. Proper clinical and radiological correlation enables better surgical planning, early decision-making and improved patient outcomes.

Objectives

Objectives were to identify the clinical and radiological factors that help to predict a difficult laparoscopic cholecystectomy, to evaluate the correlation between preoperative predictions and intraoperative findings and to assess the impact of preoperative prediction on surgical planning, including the decision for conversion to open surgery.

METHODS

In this prospective study, all the patients who requires laparoscopic cholecystectomy for gallstone disease were included. Exclusion criteria were- patients with ASA grade IV or more, significant portal hypertension, acute pancreatitis, uncorrectable coagulopathies and suspected/proven malignancy. 50 patients who underwent laparoscopic cholecystectomy between December-2022 to December-2024 at Civil Hospital, Ahmedabad were included in this study. Details of cases were recorded including history, clinical examination and investigations done.

Parameters like wall thickness of gallbladder, number and size of calculi, Mirizzi syndrome, and cystic duct stone were noted on ultrasonography of each patient pre-operatively and compared with intra-operative findings. Intra-operative findings were divided into easy laparoscopic cholecystectomy, difficult laparoscopic cholecystectomy and conversion to open cholecystectomy. Difficult laparoscopic cholecystectomy was judged based on presence of at least one of the following i.e. difficult port entry, difficult grasping gall bladder, difficult dissection of calot's triangle, bleeding, difficult clipping, difficult dissection of gallbladder from liver bed, difficult extraction of gall bladder.

Patient records were collected prospectively. Categorical variables were analysed using the chi-square test, while continuous variables were analysed using the Student's t-test. A $p<0.05$ was considered statistically significant. Data from case records were entered into a Microsoft Excel worksheet and analysed.

RESULTS

Age incidence

The mean age in this study is 45.56 years. The age group of the patients in this study ranged from 16 years to 84 years. The highest incidence is seen in the age group of 31-45 years.

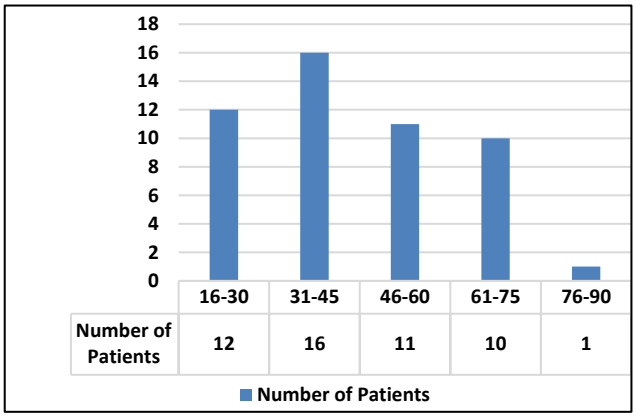

Figure 1: Age distribution of patients according to age-group in years.

Sex distribution

In these 50 cases, 9 were males and 41 were females. The ratio of female-to-male is 4.6:1. The data given below shows that gall stone diseases have higher incidence in females than male.

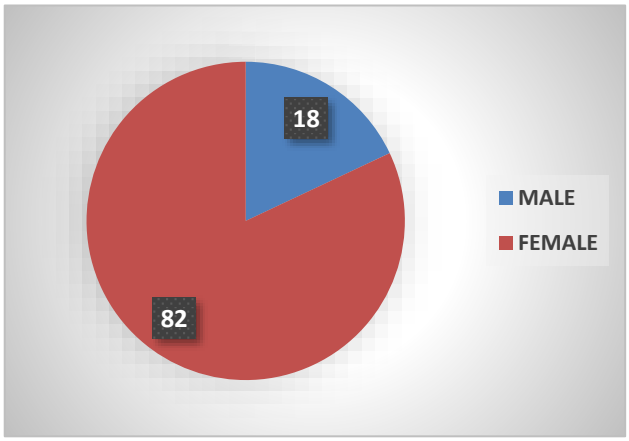

Figure 2: Sex distribution in present study.

Baseline characteristics and co-morbidities

In terms of baseline characteristics and comorbidities, 19 patients (38%) had a body mass index (BMI) over 27 kg/m², qualifying as overweight/obese. A history of hypertension was present in 9 patients (18%), and

diabetes mellitus in 6 patients (12%). Twenty-seven patients (54%) had a history of prior abdominal surgery (such as appendectomy or caesarean section), which could potentially cause intra-abdominal adhesions. Eleven patients (22%) had undergone endoscopic retrograde cholangiopancreatography (ERCP) prior to surgery (for removal of common bile duct stones), indicating a subset with complex biliary stone disease.

Clinical presentation of disease

Patients predominantly presented with typical symptoms of gallstone disease. Right upper quadrant abdominal pain was the most common symptom, reported by 48 out of 50 patients (96%). Nausea and vomiting were experienced by 24 patients (48%), typically during acute attacks. Jaundice was observed in 6 patients (12%), indicating possible common bile duct obstruction or Mirizzi syndrome. Clinical signs of acute cholecystitis (fever, localized peritonitis) were present in 16 patients (32%). Murphy's sign was elicited in 16 patients (32%). Mirizzi syndrome was diagnosed in 4 patients (8%), potentially complicating surgical management.

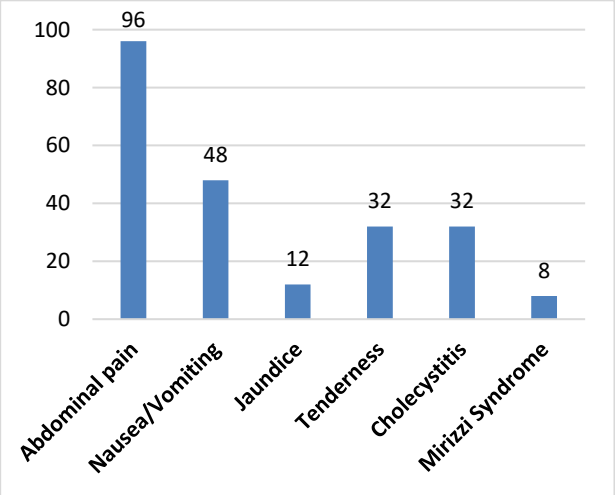

Figure 3: Clinical presentations of patients in present study.

Radiological findings

All patients underwent preoperative abdominal ultrasound (and some had additional imaging like MRCP as indicated) to evaluate gallbladder pathology. Imaging findings provided several insights:

Gallstone characteristics

The majority of patients (43 cases, 86%) had multiple stones, while 7 patients (14%) had a single gallstone. Stone size ranged from 3.5 mm to 26 mm, with a mean of ~9.9 mm. Although many had moderate-to-large stones, stone size did not reliably predict surgical difficulty, as inflammation played a larger role.

Gallbladder wall and inflammatory signs

Features of cholecystitis were common, with 16 patients (32%) showing ultrasound signs of acute inflammation, including wall thickening (>4 mm) and pericholecystic fluid. These changes often led to fibrotic adhesions around Calot's triangle.

Gallbladder morphology

On ultrasound, 44 patients (88%) had a distended gallbladder and 6 patients (12%) had a contracted gallbladder. Distension can aid grasping and dissection but may indicate acute inflammation if severe, while contraction often reflects chronic fibrosis, making dissection more challenging.

Impacted stones

One patient (2%) had a stone impacted in the cystic duct, and 4 patients (8%) had Mirizzi syndrome with a stone at the gallbladder neck causing bile duct dilation. These high-risk findings can distort anatomy and lead to dense adhesions to the common bile duct.

Liver condition

Ten patients (20%) had concomitant fatty liver changes noted on ultrasound. None had liver cirrhosis. Fatty liver itself is not a direct risk for laparoscopic cholecystectomy difficulty, though it may reflect metabolic syndrome (overweight) which can make surgery trickier.

Biliary tree

All jaundiced patients had common bile duct imaging; 11 cases had stones managed with preoperative ERCP. Overall, 32% had thickened, inflamed gallbladders and 8% had Mirizzi syndrome, indicating a higher likelihood of difficult laparoscopic cholecystectomy.

Intraoperative difficulty and conversion rates

A "difficult laparoscopic cholecystectomy" was defined by challenges like difficult port entry, obscure Calot's anatomy, bleeding, or need for conversion. Of 50 cases, 19 (38%) were difficult and 31 (62%) were completed without major issues. Six cases (12%) required conversion to open surgery, aligning with the reported 5–15% range but slightly higher due to case complexity.

Gender and difficulty

Among females, 17 of 41 (41.5%) had a difficult laparoscopic cholecystectomy, compared to 2 of 9 (22.2%) males. Thus, a higher proportion of females faced intraoperative difficulty, likely due to more acute or complex disease. While males had fewer difficult laparoscopic cholecystectomy, when difficulty occurred, it more often led to conversion.

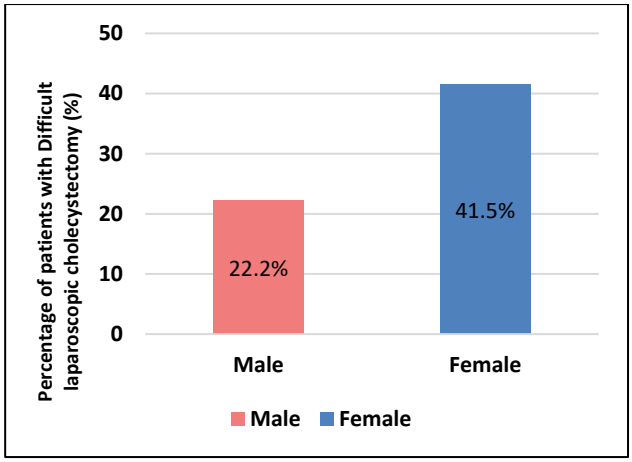

Figure 4: Percentage of patients with difficult laparoscopic cholecystectomy by sex.

Gender and conversion

Male patients had a higher conversion rate: 2 of 9 (22.2%) males versus 4 of 41 (9.8%) females. Although fewer males were operated on, their conversion rate was double that of females, suggesting more severe or less manageable disease in males. Many difficult female cases were completed laparoscopically without conversion.

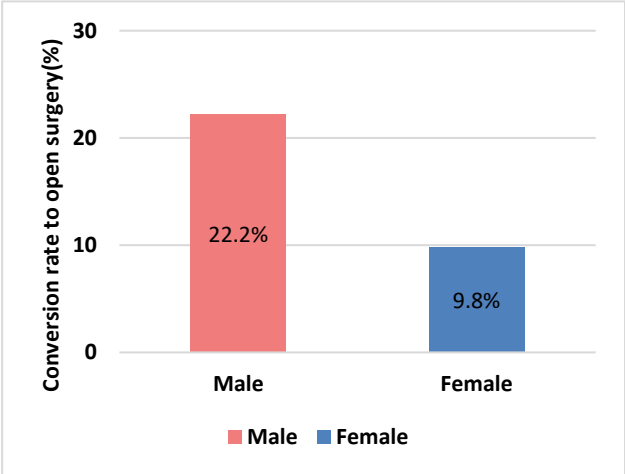

Figure 5: Conversion to open cholecystectomy by sex.

Nature of intraoperative difficulties

Among the 19 difficult cases (including the 6 conversions), the specific intraoperative problems encountered were recorded:

Each difficult case often had more than one of these issues concurrently. The 6 converted cases were generally those with multiple severe issues (e.g. dense adhesions with uncontrolled bleeding or indistinct anatomy). For the converted cases, the typical reasons were either inability to clearly identify anatomy due to inflammation (to avoid bile duct injury, conversion was done) or bleeding obscuring the field. Notably, out of the 6 conversions, 4 patients (66%) had presented with obstructive jaundice and 5 patients (83%) had undergone prior ERCP-indicating that those with complicated biliary histories were at high risk. Three (50%) of the conversions had Mirizzi syndrome.

Table 1: Nature of intraoperative difficulties.

Difficulties	N	Percentage (%)
Bleeding	11	22
Difficulty in gallbladder extraction	8	16
Difficulty in calot's triangle dissection	7	14
Difficulty in clipping structures	7	14
Difficulty in port entry	6	12
Difficulty in gallbladder grasping	6	12
Difficulty in dissecting gallbladder from liver bed	6	12

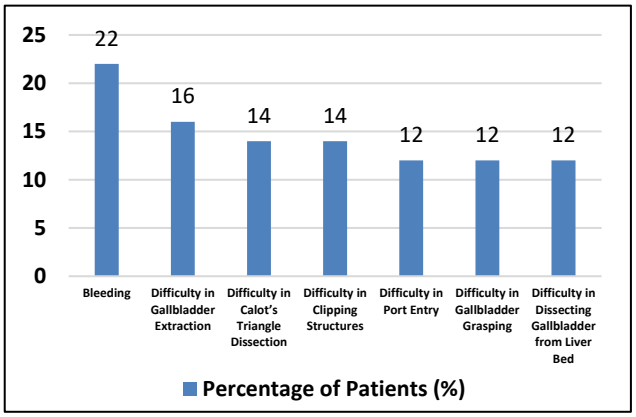

Figure 6: Difficulties in present surgery.

Correlation of clinico-radiological factors with surgical difficulty

Figure below summarizes the proportion of cases that were difficult in the presence vs absence of key risk factors.

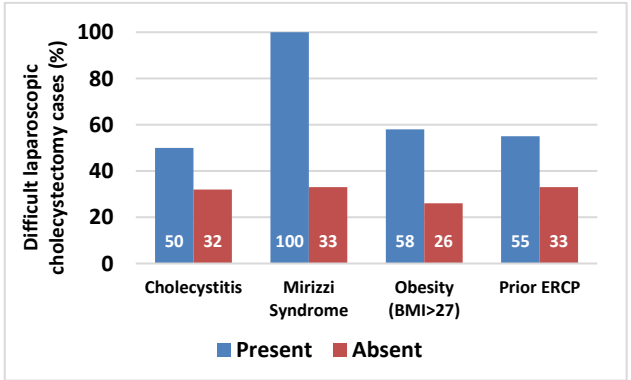

Figure 7: Difficulty rate (%) by key risk factors.

Acute cholecystitis

Among 16 patients with acute cholecystitis (diagnosed clinically and by ultrasound), 8 patients (50%) had a difficult laparoscopic cholecystectomy, compared to 11 patients out of 34 patients (32%) in those without acute inflammation. Conversion rates were similar in both groups (12.5% versus 11.8%), suggesting that while acute inflammation made surgery more challenging, most cases were still completed laparoscopically. Early surgery (within 72 hours) is recommended to reduce complications, though severe inflammation still increases technical difficulty.

Impacted stone/Mirizzi syndrome

All 4 patients with Mirizzi syndrome had difficult surgeries (100%), and 3 of 4 (75%) required conversion to open, confirming Mirizzi as a major predictor of operative difficulty due to severe inflammation and anatomical distortion. The one laparoscopic completion was extremely challenging. Separately, one patient with an impacted cystic duct stone had an uncomplicated laparoscopic cholecystectomy, but the sample is too small for firm conclusions.

Multiple vs single stones

Among patients, those with multiple calculi (n=43) and single stones (n=7) had similar difficulty rates (37% vs 43%). However, all conversions occurred in the multiple-stone group (14%), with none in the single-stone group. While multiple stones often correlated with diffuse inflammation and higher conversion, stone number alone was not a strong predictor of difficulty; the degree of gallbladder inflammation or obstruction mattered more.

Stone size

We did not find a clear link between stone size and surgical difficulty, with an average stone size of ~10 mm in both groups.

Gallbladder contracted vs distended

Among 6 patients with a contracted gallbladder, 3 patients (50%) had difficult surgeries and 2 patients (33%) required conversion. In comparison, among 44 patients with a distended gallbladder, 16 patients (36%) had difficult surgeries and 4 patients (9%) required conversion to open surgeries. This suggests contracted gallbladders may have a higher conversion risk (33% versus 9%), likely due to fibrosis, though small numbers limit firm conclusions.

Obesity (High BMI)

Obesity (BMI >27) was present in 19 patients. Difficult laparoscopic cholecystectomy occurred in 58% of obese patients versus 26% in non-obese, indicating obesity roughly doubled intraoperative difficulty. However, conversion was lower in obese patients (5% vs 16%), possibly due to confounding high-risk factors in non-obese conversions and surgeons' persistence laparoscopically. Overall, obesity increased surgical difficulty but did not translate into a higher conversion rate in our sample.

Previous abdominal surgery

Among 27 patients with prior surgical history, 6 had difficult port entry, mostly linked to adhesions. However, overall difficulty rates were similar (37% with prior surgery vs 39% without), and conversion rates were not significantly different (7.4% vs 17%).

Many prior surgeries were lower abdominal, less likely affecting gallbladder access.

History of ERCP (Choledocholithiasis)

A history of ERCP was a strong predictor of difficulty. Among 11 patients (22%) with prior ERCP, 54.5% had difficult laparoscopic cholecystectomy, and 5 (45%) required conversion, compared to only 2.6% conversion in patients without ERCP (1/39).

This represents an almost 20-fold higher risk of conversion. Prior ERCP often indicated severe pathology like cholangitis or pancreatitis, leading to inflamed or fibrotic gallbladders and cystic duct inflammation.

Patient age

The average age of patients with difficult surgery was 47.1 years versus 44.6 years in non-difficult cases. Those needing conversion were older (mean 57 years) compared to those completed laparoscopically (mean forty four years).

Five of six conversions occurred in patients over 50. Patients over 50 had a 45% difficult rate and 25% conversion rate, compared to 33% and 3% respectively in those under 50. Older age correlated with more advanced disease and higher conversion, supporting its role as a risk factor.

In summary, our correlation analysis indicates that several preoperative clinico-radiological factors had strong associations with operative difficulty: particularly acute cholecystitis, Mirizzi syndrome (impacted stone), high BMI, and history of ERCP (complicated gallstone disease) all markedly increased the chance of a difficult surgery.

Mirizzi syndrome and prior ERCP (often reflecting common bile duct stones, jaundice and pancreatitis) were especially linked to conversion to open surgery.

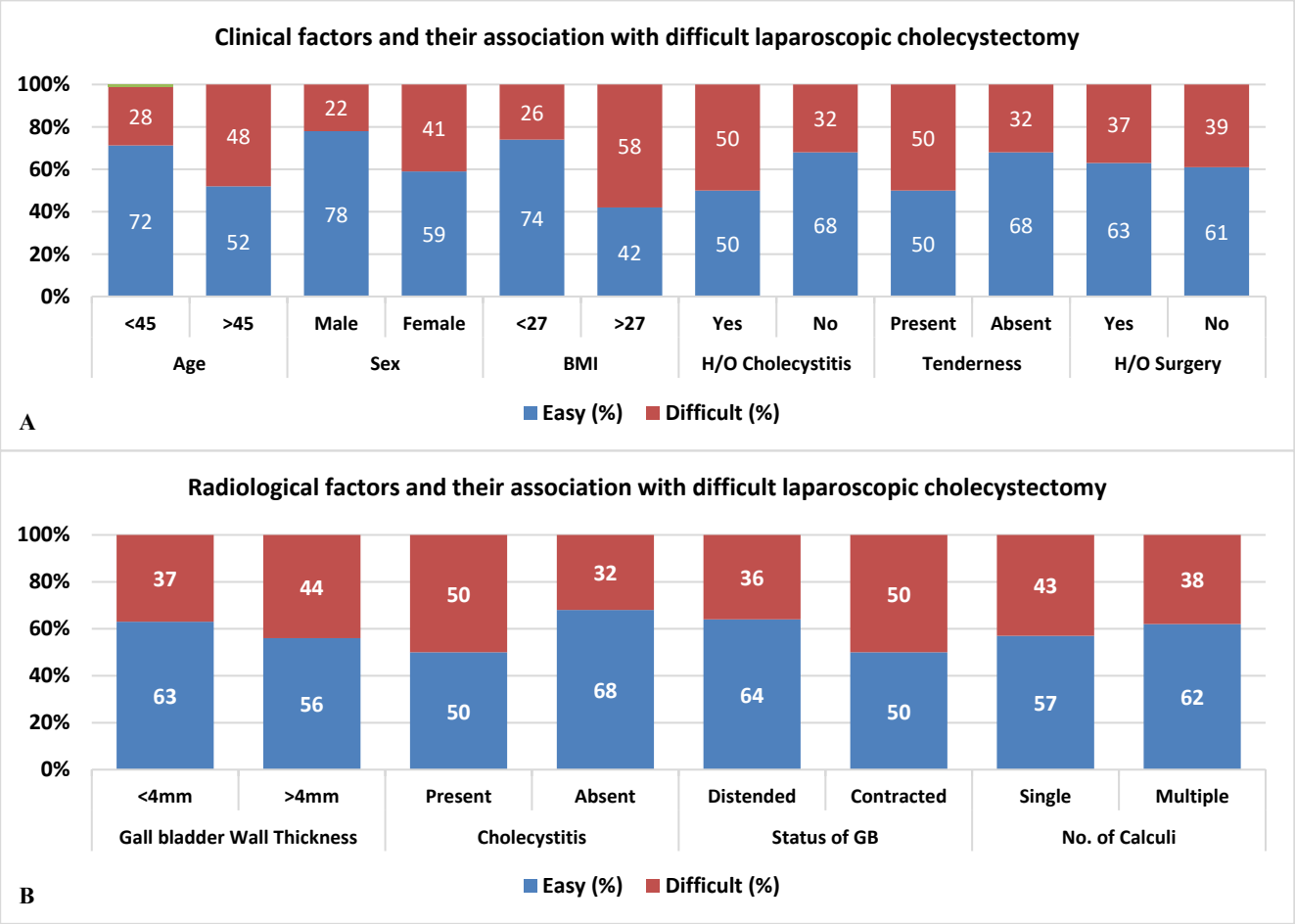

Figure 8 (A and B): Clinical and radiological factors and their association with difficult laparoscopic cholecystectomy.

DISCUSSION

This prospective analysis of 50 patients highlights how clinical and radiological factors influence the difficulty of laparoscopic cholecystectomy.

Females dominated the sample, reflecting gallstone prevalence. Higher incidence of gallstone in females has been suggested due to the effect of oestrogen and progesterone on biliary cholesterol level and gallbladder motility.[4,5]

The higher proportion of females (42%) had difficult surgeries compared to males (22%). However, males had a higher conversion rate (22% vs. 10%), consistent with literature linking male sex to tougher, fibrotic disease and delayed care. Thus, male gender remains an important preoperative risk factor.[6-9]

Some studies have reported old age as a significant risk factor for difficult laparoscopic cholecystectomy.[10-12] Patients over 50 had a 45% difficult rate and 25% conversion rate, compared to 33% and 3% respectively in those under 50. Older age correlated with more advanced disease and higher conversion.

Clinical presentation strongly correlated with difficulty. One-third presented with acute cholecystitis and 12% with jaundice, both associated with harder surgeries. Prior acute episodes and jaundice (indicating CBD stones or Mirizzi syndrome) predicted tougher dissections, underlining the importance of early surgery during the first admission to avoid fibrosis.[13-15]

Radiological findings further refined risk prediction. Gallbladder wall thickening (>3-4 mm) and a diagnosis of acute cholecystitis correlated with higher difficulty (50% difficult cases). Impacted stones at the neck (seen in Mirizzi syndrome) had a particularly poor prognosis, with a 75% conversion rate, consistent with the known high-risk nature of Mirizzi syndrome.

Stone number and gallbladder distension patterns showed mixed effects. Conversion happened more in multiple stone cases, though neither stone size nor number alone strongly predicted difficulty. Contracted or massively distended gallbladders both posed challenges.

Obesity added to operative strain by reducing exposure and increasing bleeding risks, though experienced laparoscopic management helped avoid conversions.

Some studies have found high BMI as significant independent predictor of difficult laparoscopic cholecystectomy.[16-18] Prior ERCP was a major warning sign: nearly half of these patients needed conversion, suggesting a strong association between prior complicated gallstone disease and surgical difficulty.

Our conversion rate (12%) was higher than in elective laparoscopic cholecystectomy series (3-7%), but acceptable given the complicated case mix (32% acute, 8% Mirizzi). Notably, no patient suffered bile duct injury, highlighting that timely conversion ensured safety.

Prior abdominal surgery did not significantly affect difficulty unless upper abdominal surgery was involved, reinforcing that scar location matters more than mere presence.[19,20]

In summary, no single factor perfectly predicts difficulty, but a combination does. Older males, acute cholecystitis, thick-walled gallbladders, impacted stones, obesity, prior ERCP, and Mirizzi syndrome were major red flags. A detailed clinical and radiological review preoperatively enables better surgical planning, patient counselling, and resource allocation, thereby improving outcomes. Our findings align with published data, validating current risk assessment practices.

This study has several limitations. A single-centre design limits the generalizability of findings. The number of patients with certain high-risk conditions, such as Mirizzi syndrome, were low, reducing the statistical strength of subgroup analyses. Intraoperative difficulties were assessed subjectively, introducing potential observer bias. Additionally, surgeon experience and long-term postoperative outcomes were not evaluated, which may influence operative difficulty and overall results.

CONCLUSION

In this study, we found that approximately 38% of laparoscopic cholecystectomies were difficult and 12% required conversion to open surgery. By correlating clinical and radiological data, we demonstrated that certain parameters are highly predictive of a difficult course.

Clinically, patients with a history of acute cholecystitis, jaundice or pancreatitis (indicating complicated gallstone disease), advanced age, and male gender tended to have more problematic surgeries. Radiologically, an inflamed thick-walled gallbladder, presence of pericholecystic fluid, a contracted fibrotic gallbladder, or an impacted stone in the neck (Mirizzi syndrome) were harbingers of difficult dissection and higher likelihood of conversion.

The present study supports the use of a structured preoperative assessment approach to stratify patients according to risk, thereby aiding in better surgical planning, appropriate allocation of surgical expertise, and improved patient counselling. This contributes to enhanced intraoperative decision-making, reduction in complications, and overall improvement in surgical outcomes.

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