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Research Article

Preoperative Assessment of Difficult Laparoscopic Cholecystectomy Using Clinical and Ultrasonographic Predictors

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ABSTRACT

Laparoscopic cholecystectomy (LC) is the gold standard treatment for symptomatic gallstone disease. Despite advances in technique and experience, LC may be technically difficult in a subset of patients, leading to increased operative time, complications, and conversion to open surgery. Preoperative prediction of difficult LC can improve surgical planning and patient counseling. In this study, we will evaluate the role of preoperative clinical and ultrasonographic parameters in predicting difficult laparoscopic cholecystectomy. This prospective observational study was conducted at a tertiary care teaching hospital over a period of 18 months. Eighty-two patients undergoing elective laparoscopic cholecystectomy were included. Preoperative clinical parameters and ultrasonographic findings were recorded and correlated with intraoperative difficulty. Difficult LC was defined based on operative findings, including difficulty in access, adhesiolysis, Calot's triangle dissection, gallbladder dissection, and intraoperative bleeding. Difficult laparoscopic cholecystectomy was encountered in 28 patients (34.15%). Gallbladder wall thickness >3 mm, stone size >20 mm, multiple stones, body mass index (BMI) >30 kg/m², pericholecystic collection, liver span >13 cm, narrow subcostal angle, and xipho-umbilical distance >18 cm showed a statistically significant association with difficult LC (p <0.05). Conversion to open cholecystectomy was required in 11 patients (13.41%). Preoperative assessment using clinical and ultrasonographic parameters is useful in predicting difficult laparoscopic cholecystectomy and the likelihood of conversion to open surgery. This enables better operative planning, optimal resource allocation, and improved patient counseling.

Keywords: Laparoscopic cholecystectomy; Difficult cholecystectomy; Conversion; Ultrasonography.

INTRODUCTION

Gallstone disease is one of the most common gastrointestinal disorders requiring surgical intervention worldwide. Cholecystectomy remains the definitive treatment for symptomatic gallstones, and since its introduction in the late 1980s, laparoscopic cholecystectomy has become the standard of care due to reduced postoperative pain, shorter hospital stay, faster recovery, and superior cosmetic results compared to open cholecystectomy [1,2].

Despite these advantages, laparoscopic cholecystectomy may be technically challenging in certain patients. Dense adhesions, chronic inflammation, distorted anatomy of Calot's triangle, thickened gallbladder wall, and obesity can increase operative difficulty and the risk of complications such as bile duct injury and hemorrhage [3,4]. Conversion to open cholecystectomy, although not a failure, is sometimes necessary to ensure patient safety.

The reported incidence of difficult laparoscopic cholecystectomy ranges from 10% to 40%, with conversion rates varying between 2 and 15% depending on patient population and surgeon experience [5,6].The ability to predict difficult LC preoperatively allows surgeons to plan appropriately, allocate experienced personnel, anticipate longer operative times, and counsel patients regarding the possibility of conversion.

Several studies have evaluated clinical, biochemical, and radiological parameters as predictors of difficult LC, with ultrasonography being the most commonly used imaging modality [7-9]. However, there is no universally accepted predictive model.

The present study was undertaken to assess the role of preoperative clinical and ultrasonographic parameters in predicting difficult laparoscopic cholecystectomy.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery at a tertiary care teaching hospital over a period of 18 months, from March 2015 to September 2016, after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all patients included

in the study. A total of 82 patients undergoing elective laparoscopic cholecystectomy for gallstone disease were enrolled. Patients with chronic calculus cholecystitis, resolved acute cholecystitis, resolved gallstone pancreatitis, and cholelithiasis with choledocholithiasis after endoscopic retrograde cholangiopancreatography were included in the study.

The exclusion criteria were as follows:

- Acute cholecystitis
- Pregnancy
- American Society of Anesthesiologists (ASA) grade III and IV
- Suspected gallbladder malignancy
- Laparoscopic cholecystectomy performed by inexperienced surgeons

Preoperative evaluation included a detailed clinical assessment and ultrasonographic examination. Clinical parameters recorded were age, sex, body mass index, history of previous abdominal surgery, subcostal angle, and xiphoid-umbilical distance. Ultrasonographic parameters assessed included gallbladder wall thickness, size of gallstones, number of stones, presence of pericholecystic collection, and liver span. All ultrasonographic examinations were performed by experienced radiologists using standard abdominal ultrasound protocols.

All patients underwent standard four-port laparoscopic cholecystectomy under general anesthesia using a uniform surgical technique. The operating surgeon recorded intraoperative findings. Difficult laparoscopic cholecystectomy was defined based on intraoperative criteria, including difficulty in access or port placement, excessive adhesions requiring prolonged adhesiolysis, difficulty in identification or dissection of Calot's triangle, difficulty in gallbladder dissection from the liver bed, and significant intraoperative bleeding. Conversion to open cholecystectomy was performed whenever deemed necessary for patient safety.

The sample size was calculated based on the expected proportion of difficult laparoscopic cholecystectomies reported in previous studies, which ranged between 25 and 35%. Assuming a prevalence of difficult laparoscopic cholecystectomy of 30%, with a confidence level of 95% and an absolute precision of 10%, the minimum required sample size was calculated to be 81 patients. Accordingly, 82 patients were included in the study.

Statistical analysis was performed using appropriate statistical software. Categorical variables were expressed as frequencies and percentages. The association between preoperative clinical and ultrasonographic parameters and intraoperative difficulty was analyzed using the Chi-square test. A *p-value* of less than 0.05 was considered statistically significant.

RESULTS

A total of 82 patients undergoing elective laparoscopic cholecystectomy were included in the study. The mean age of the patients was 41 ± 13.6 years (range 18–70 years). There were 56 female patients (68.3%) and 26 male patients (31.7%), with a female-to-male ratio of 2.15:1.

Based on intraoperative findings, laparoscopic cholecystectomy was classified as difficult in 28 patients (34.15%), while 54 patients (65.85%) underwent an easy procedure. Conversion to open cholecystectomy was required in 11 patients, giving a conversion rate of 13.41%.

Demographic and Clinical Parameters

Higher body mass index was significantly associated with a difficult laparoscopic cholecystectomy. Among patients with BMI > 30 kg/m², 14 experienced difficult LC compared to 6 in the easy LC group ($p = 0.01$). Anatomical factors such as a narrow subcostal angle and increased xipho-umbilical distance (>18 cm) were also found to be significant predictors of difficult LC. Previous abdominal surgery did not show a statistically significant association with operative difficulty. The association of clinical parameters with difficult laparoscopic cholecystectomy is summarized in Table 1.

Ultrasonographic Parameters

Gallbladder wall thickness emerged as the most significant ultrasonographic predictor of difficult laparoscopic cholecystectomy. Gallbladder wall thickness > 3 mm was observed in 19 patients in the difficult LC group compared to 7 patients in the easy LC group ($p = 0.001$). Stone size > 20 mm and the presence of multiple gallstones were also significantly associated with operative difficulty. Pericholecystic collection and increased liver span (>13 cm) showed a statistically significant association with difficult LC, indicating underlying inflammation and altered anatomy. The association between ultrasonographic parameters and operative difficulty is shown in Table 2.

Conversion to Open Cholecystectomy

Out of the 28 patients who underwent difficult laparoscopic cholecystectomy, 11 required conversion to open cholecystectomy. The most common intraoperative reasons for conversion were dense adhesions, unclear anatomy of Calot's triangle, excessive bleeding, and difficulty in gallbladder dissection. Conversion was significantly more frequent in patients with gallbladder wall thickness > 3 mm, multiple stones, pericholecystic collection, and BMI > 30 kg/m². Factors associated with conversion to open surgery are detailed in Table 3.

Table 1: Association of clinical parameters with the difficulty of laparoscopic cholecystectomy

Clinical parameter	*Difficult LC (n = 28)*	*Easy LC (n = 54)*	*p-value*
BMI > 30 kg/m²	14	6	0.01
Narrow subcostal angle	18	9	0.002
Xipho-umbilical distance > 18 cm	16	8	0.01
Previous abdominal surgery	6	7	NS

Table 2: Association of ultrasonographic parameters with the difficulty of laparoscopic cholecystectomy

Ultrasonographic parameter	*Difficult LC (n = 28)*	*Easy LC (n = 54)*	*p-value*
Gallbladder wall thickness > 3 mm	19	7	0.001
Stone size > 20 mm	17	8	0.001
Multiple stones	21	11	0.002
Pericholecystic collection	9	3	0.01
Liver span > 13 cm	15	9	0.02

Table 3: Factors associated with conversion to open cholecystectomy

Parameter	*Converted (n = 11)*	*Not converted (n = 71)*	*p-value*
GB wall thickness > 3 mm	9	17	0.001
Multiple stones	8	24	0.01
Pericholecystic collection	6	6	0.02
BMI > 30 kg/m²	5	15	0.04

DISCUSSION

Laparoscopic cholecystectomy is the standard surgical procedure for the management of symptomatic gallstone disease; however, operative difficulty remains an important concern due to the potential for complications and conversion to open surgery. The ability to predict difficult laparoscopic cholecystectomy preoperatively allows better operative planning, allocation of experienced surgical teams, and appropriate patient counseling. In the present study, difficult laparoscopic cholecystectomy was encountered in 34.15% of patients, with a conversion rate of 13.41%, which is comparable to rates reported in previous studies [5,6].

Gallbladder wall thickness was the most significant ultrasonographic predictor of difficult laparoscopic cholecystectomy in this study. Patients with gallbladder wall thickness greater than 3 mm had a significantly higher incidence of operative difficulty and conversion to open surgery. Chronic inflammation leads to fibrosis and loss of tissue planes, resulting in difficult dissection and poor visualization of Calot's triangle. Similar findings have been reported by Randhawa and Pujahari, who identified gallbladder wall thickness as the strongest predictor of difficult laparoscopic cholecystectomy [7]. Gupta *et al*. also demonstrated a significant association between increased gallbladder wall thickness and operative difficulty [8].

Stone-related factors, such as stone size greater than 20 mm and the presence of multiple stones, were significantly associated with difficult laparoscopic cholecystectomy in the present study. Large stones and multiple calculi contribute to gallbladder distension, impaired grasping, and difficulty in retraction, thereby increasing operative complexity. These findings are in agreement with those of Vivek *et al*. and Kama *et al*., who reported stone characteristics as important predictors of operative difficulty and conversion [9,6].

Pericholecystic collection was found to be significantly associated with difficult laparoscopic cholecystectomy and conversion to open surgery. This finding reflects ongoing or previous inflammatory processes leading to adhesions and altered anatomy. Increased liver span was also associated with operative difficulty, likely due to restricted operative space and difficulty in liver retraction. Similar associations between inflammatory changes and difficult laparoscopic cholecystectomy have been described in earlier studies [10].

Among clinical parameters, obesity emerged as a significant predictor of difficult laparoscopic cholecystectomy. Increased body mass index is associated with a thicker abdominal wall, increased intra-abdominal fat, and limited working space, all of which contribute to prolonged operative time and technical difficulty. Several studies have reported obesity as an independent risk factor for difficult laparoscopic cholecystectomy and conversion [11,12]. In addition, anatomical factors such as a narrow subcostal angle and increased xipho-umbilical distance were significantly associated with operative difficulty in the present study. These parameters limit instrument maneuverability and visualization, thereby increasing technical challenges during surgery.

The conversion rate of 13.41% observed in this study is within the range reported in the literature. Conversion to open cholecystectomy was most commonly due to dense adhesions, unclear anatomy of Calot's triangle, and excessive bleeding. Early conversion should be regarded as a judicious surgical decision rather than a failure, as it helps prevent major complications such as bile duct injury, as emphasized by Strasberg and Way *et al*. [3,12].

The findings of this study highlight the importance of comprehensive preoperative assessment using simple clinical and ultrasonographic parameters. Identification of patients at higher risk for difficult laparoscopic cholecystectomy allows surgeons to anticipate challenges, plan operative strategy, counsel patients appropriately, and reduce morbidity. Although the study is limited by a relatively small sample size and single-center design, the results are consistent with existing literature and support the routine use of preoperative predictors in clinical practice.

CONCLUSION

Preoperative evaluation using easily assessable clinical and ultrasonographic parameters is valuable in predicting difficult laparoscopic cholecystectomy. Identification of high-risk patients allows better operative planning, patient counseling, and timely conversion to open surgery, thereby enhancing patient safety.

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