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Prediction of Difficulty Level of Laparoscopic Cholecystectomy According to Preoperative Findings

Harun Bayram[1], Barlas Sulu[2], Tülay Diken Allahverdi[2], Kenan Binnetoğlu[2], Doğan Gönüllü[2]

[1]Bingöl State Hospital, Clinic of General Surgery, Bingöl, Turkey
[2]Kafkas University Faculty of Medicine, Department of General Surgery, Kars, Turkey

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ABSTRACT

Objective: Laparoscopic cholecystectomy stands as the established surgical approach for gallbladder diseases. This study seeks to enhance the management of potential complications by anticipating the likelihood of operative complexity and the risk of requiring conversion to an open procedure.

Methods: In this retrospective study, a total of 811 cholecystectomy procedures were undertaken, segregating patients into case and control groups. The case group comprised 24 patients who initiated laparoscopically but ultimately underwent open conversion. Exclusion criteria encompassed direct open procedures, patients below 18 years of age, and cholecystectomies performed concurrently with other surgeries. A control group of 276 patients was chosen, matched for age, gender, and body mass index, to evaluate the influential aspects governing conversion likelihood.

Results: The study demonstrated a conversion rate of 3.09%. The preeminent determinant of conversion was the increased gallbladder wall thickness. Factors exerting influence on conversion included a history of endoscopic retrograde cholangiopancreatography, prior abdominal surgery, elevated C-reactive protein, lactate dehydrogenase, and direct bilirubin levels, instances of cholecystitis and cholangitis attacks, dense adhesions between the gallbladder and close organs, gallbladder hydrops, impacted stones, and a Callot dissection time exceeding 90 minutes. The Sugrue scoring system was also observed as a potentially valuable tool for predicting the likelihood of open conversion.

Conclusion: The capacity to foresee potential complications proactively empowers optimal preoperative preparations. This approach ensures patients are well-informed about the surgery, potential complications, and the prospect of conversion to an open procedure. Moreover, it enables the possibility of conducting the operation within a more experienced medical center when warranted.

Keywords: Laparoscopic cholecystectomy, open cholecystectomy, cholecystectomy complications

ORCID IDs of the authors: H.B. 0000-0002-1682-1693; B.S. 0000-0001-5426-742X; T.D.A. 0000-0001-5808-0873; K.B. 0000-0001-7517-5970; D.G. 0000-0001-7517-5970.

Corresponding Author: Doğan Gönüllü,
E-mail: dogangonullu@yahoo.com

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INTRODUCTION

Laparoscopic cholecystectomy is currently the gold standard treatment for gallstones. Compared to open surgery, the laparoscopic method has several advantages such as early return of bowel functions, less postoperative pain, better cosmetic results, reduced hospital stay, and early return to daily life (1-3). However, in some patients, surgeons end up having to switch from the laparoscopic method to open surgery.

Some patient or gallbladder data may predict the risk of conversion to open surgery. Thus, this situation can be shared with the patient in advance, and the surgeon should be prepared for possible complications. In the literature, many factors such as male gender, age ≥60 years, history of abdominal surgery, hospitalization due to cholecystitis attacks, and increased gallbladder wall thickness on ultrasonography (USG) were expressed as warning signs that the operation would be difficult (4-7).

This study aims to predict whether the operation would be difficult, to predict the risk of conversion to open surgery, and to prevent or reduce possible complications by using the patient's laboratory test results, imaging methods, clinical findings and medical history.

METHODS

Our study was carried out, after it was approved, with the decision of Kafkas University Faculty of Medicine Ethics Committee dated 30.10.2019 and numbered 80576354-050-99/239. In our retrospective study, the 811 cholecystectomies performed at the General Surgery Clinic of Kafkas University Medical Faculty Research and Application Hospital between January 2015 and December 2018 were examined.

Two patient groups were formed using the patient and control method. Twenty-four patients in whom laparoscopic surgery was converted to open surgery were included as the patient group. According to the exclusion criteria we determined, patients in whom the surgery was started with open surgery, patients under the age of 18 and patients with cholecystectomy performed in conjunction with another operation were not included in the study. A control group was formed by selecting 276 patients in whom the surgery was started and finished laparoscopically according to criteria such as age, gender, and body mass index (BMI).

Age, gender, BMI, presence of additional disease, history of endoscopic retrograde cholangio-pancreatography (ERCP), previous abdominal surgery, previous cholecystitis and cholangitis attack, presence of pericholecystic fluid and gallbladder wall thickness in USG, increase in gallbladder wall thickness, preoperative serum liver enzymes, amylase, lipase, leukocyte count, C-reactive protein (CRP), direct bilirubin (DB) values during the operation were examined in order to determine the factors affecting exposure, gallbladder adhesion, presence of stones in the Hartman region, gallbladder hydrops, gallbladder scleroatrophy, and dissection time of Calot's triangle. In addition, the effectiveness of the Sugrue score was investigated (Table 1). All these parameters were examined to determine the parameter that would make conversion to the open surgery more effective.

Statistical Analysis

Statistical analysis was performed using the SPSS version 22.0 software program for Windows. While descriptive statistics for numerical variables were expressed as mean, standard deviation, median, and minimum-maximum; percentage and frequency values were given for categorical variables. The conformity of the "Calot Dissection Time" variable to the normal distribution was tested with the Shapiro-Wilk test. In this context, the Mann-Whitney U test was used for two-group comparisons. Pearson chi-square and Fisher chi-square tests were used in the analysis of categorical data. Backward regression analysis was used to show the effect of independent variables on the conversion to open surgery and logistic analysis was used to show the variables that were found to be insignificant in the analysis. The results were evaluated within the 95% confidence interval, and the $p<0.05$ value was considered significant.

RESULTS

Eight hundred and eleven cholecystectomies were performed in our clinic between January 2015 and December 2018. Seven hundred and fifty-two of those were completed laparoscopically. In 24 of the other 59 patients, the operation was started laparoscopically and converted to open surgery while in 35 patients, it was directly started with open surgery for various reasons.

In order to reduce our type 2 error rate, we tried to get a high number of controls. Considering the inclusion and exclusion criteria between January 2015 and December 2018, all eligible patients were included in the study. Power analysis was not performed because all patients were included in the study.

There was no statistically significant difference between the age groups (≥60 years or <60 years), gender, BMI (BMI <30 vs. BMI >30) and comorbidity of the patients converted to open surgery (Table 2).

The risk of conversion to open surgery increased statistically in patients with a history of preoperative ERCP (p=0.001), those with previous abdominal surgery (p=0.001), those with a history of cholecystitis attack (p=0.002) and those who had a history of cholangitis attack (p=0.003) compared to those without ERCP, abdominal operation, cholecystitis and cholangitis attack histories (Table 3).

When liver enzymes [aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma glutamyl transferase (GGT), alkaline phosphatase (ALP)] were examined within the scope of the study, no significant difference was found between those in whom laparoscopy was converted to open surgery and those in whom there was no conversion (Table 3).

In addition, there was no significant difference between the leukocyte counts between those in whom laparoscopy was converted to open surgery and those in whom there was no

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conversion (p=0.449), but a statistically significant difference was observed in terms of CRP values (p=0.024) (Table 3).

The rate of conversion to open surgery was found to be higher in patients with high DB levels, and a statistically significant difference was found (p=0.001). A significant correlation was found between the conversion to open surgery and serum lactate dehydrogenase (LDH) levels (p=0.001) (Table 3). When ultrasonographic parameters were compared, no significant correlation was found between those who underwent laparoscopy and those who underwent open surgery in relation to the presence of pericholecystic fluid (p=0.401). A significant correlation was found between these two groups in terms of gallbladder wall thickness (p=0.001) and presence of hydrops (p=0.001) (Table 3). In terms of surgical findings, there was no difference between the two groups in terms of whether the gallbladder was scleroatrophic or not (p=0.053). However, it was determined that the adhesion to the organs around the gallbladder posed a risk of conversion to open surgery (p=0.001). It was determined that the presence of an impacted stone in the Hartman pouch also posed a risk of conversion to surgery (p=0.001). The dissection time of Calot's triangle was found out to be longer in patients who underwent open surgery compared to patients who underwent laparoscopy (p=0.001) (Table 4). In addition, the calculated Sugrue score was found to be significantly higher in patients converted to open surgery (p=0.001) (Table 3).

Table 1. Difficulty grading of laparoscopic cholecystectomy (44)

Appearance of the gallbladder	Difficulty level, score
Less than 50% adhesions	1
Gallbladder not visible due to adhesions	3
Maximum	3
Distended/contracted gallbladder	1
Gallbladder cannot be grasped with atraumatic holding forceps	1
Enclaved >1 cm stone in Hartmann's pouch	1
Difficulty in entry	
BMI >30	1
Difficult to enter due to previous surgeries	1
Pus/biliary discharge from the gallbladder	1
Cystic artery/duct dissection >90 min	1

BMI: body mass index, min: minutes

Table 2. Characteristics of the patients

	Case, n (%)	p-value
Age <60 Age >60	12 (6.1%) 12 (11.5%)	p=0.100
Female Male	13 (6.1%) 11 (12.5%)	p=0.064
BMI <30 BMI >30	11 (7.7%) 13 (8.2%)	p=0.878
Comorbid disease (+) Comorbid disease (-)	11 (6.4%) 13 (10.2%)	p=0.221

BMI: body mass index

Table 3. Examined parameters related to the conversion to open surgery

	Case, n (%)	p-value
ERCP (-) ERCP (+)	19 (6.6%) 5 (41.7%)	p=0.001
Previous abdominal surgery (-) Previous abdominal surgery (+)	17 (6.1%) 7 (33.3%)	p=0.001
AST <32 U/L AST >32 U/L	20 (7.5%) 4 (11.4%)	p=0.502
ALT <33 U/L ALT >33 U/L	19 (7.7%) 5 (9.6%)	p=0.637
GGT <36 U/L GGT >36 U/L	16 (7.1%) 8 (10.7%)	p=0.326
ALP <104 U/L ALP >104 U/L	20 (8.1%) 4 (7.5%)	p=1.000
Leukocyte count <10.4 Leukocyte count >10.4	21 (7.7%) 3 (11.5%)	p=0.449
CRP <0.5 CRP <0.5	11 (5.5%) 13 (13%)	p=0.024
DB <0.3 DB >0.3	11 (5.5%) 8 (24.1%)	p=0.001
LDH <225 LDH >225	19 (6.7%) 5 (29.4%)	p=0.001
Amylase <100 Amylase >100	22 (7.7%) 2 (13.3%)	p=0.341
Lipase <60 Lipase >60	22 (7.7%) 2 (13.3%)	p=0.341
Cholecystitis attack (-) Cholecystitis attack (+)	5 (3.2%) 19 (13.1%)	p=0.002
Cholangitis attack (-) Cholangitis attack (+)	20 (6.9%) 4 (44.4%)	p=0.003
Pericholecystic fluid (-) Pericholecystic fluid (+)	21 (7.6%) 3 (13.6%)	p=0.401
Gallbladder wall thickness not increased Increased gallbladder wall thickness	5 (3.1%) 19 (13.9%)	p=0.001
Adhesion (-) Adhesion (+)	01 (0.6%) 23 (17%)	p=0.001
Hydropic gallbladder (-) Hydropic gallbladder (+)	7 (3.3%) 17 (19.5%)	p=0.001
Scleroatrophy (-) Scleroatrophy (+)	22 (7.5%) 2 (40%)	p=0.053
Stone in Hartmann's pouch (-) Stone in Hartmann's pouch (+)	10 (3.9%) 14 (32.6%)	p=0.001
Sugrue score: extreme difficulty Sugrue score: severe difficulty	8 (100%) 13 (33.3%)	p=0.001
Sugrue score: mild difficulty Sugrue score: moderate difficulty	2 (1.9%) 1 (0.7%)	

AST: aspartate aminotransferase, ALT: alanine aminotransferase, GGT: gamma glutamyl transferase, ALP: alkaline phosphatase, CRP: C-reactive protein, DB: direct bilirubin, LDH: lactate dehydrogenase

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In the Backward regression analysis, 13 variables that significantly affected the conversion from laparoscopy to open surgery were included in the model. These variables are shown in Tables 2 and 3. The analysis was continued until the 9th step by adding the non-significant variables, and finally, 13 factors were included in the analysis (ERCP history, previous operation history, CRP, DB, LDH, cholecystitis attack, cholangitis attack, gallbladder wall thickness, gallbladder adhesion, hydrops, stone in Hartman, Sugrue score in those who underwent previous surgery, more than 10 years of previous abdominal operation, Calot's dissection). When patients who did not have previous abdominal surgery were taken as reference, conversion to open surgery was 10,663 times more in those who had previous surgery. When patients with a low DB level were taken as reference, conversion to open surgery was 9,402 times more in those with a high DB level. Considering those with normal gallbladder wall thickness as a reference, conversion to open surgery was 7,323 times more in those with increased gallbladder wall thickness (Table 5). Conversion to open surgery was 12,083 times more in those who had ERCP compared to those who did not.

When we compared patients with moderate/mild Sugrue scores with those with severe scores, it was found that the rate of conversion to open surgery was 379,219 times higher in those with severe Sugrue scores (Table 5). Model explanatory power was 71% at step 9 based on the Nagelkerke R2 value.

DISCUSSION

Open cholecystectomy was first performed by Carl Johann August Langenbuch in 1882 in a 43-year-old male patient who had had gallbladder disease for 16 years (8,9). Laparoscopic cholecystectomy has been used as the gold standard surgical treatment method in gallbladder pathologies since the day it was discovered by Philip Mouret. Although laparoscopic cholecystectomy has indisputable advantages, open cholecystectomy may be needed due to different problems arising during the operation. Some preoperative markers can help predict the difficulty of surgery and the risk of open cholecystectomy. Knowing these risk factors before surgery can help predict the risk of open cholecystectomy and can help the surgeon prepare for the operation and inform the patient about this situation and possible complications beforehand. The patient can be referred to more experienced centers if necessary. Conversion to open cholecystectomy should not be seen as a failure or a complication; on the contrary, it should be considered as the most important way to prevent possible complications.

In the literature, the rate of open cholecystectomy varies between 2-15% (4), but in the study of Gabriel et al. (5), in 61 patients (26.1%) out of 234 patients, the laparoscopic operation was converted to open cholecystectomy. In our study, the rate of conversion to open surgery was determined as 3.09% and it was compatible with the literature. Due to the fact that older patients are exposed to more cholecystitis attacks, it has been reported in many studies that the rate of conversion to open surgery is higher in older patients (6). In our study, we found that advanced age was not a predictive factor in the conversion to open surgery.

Most studies have reported that male gender is a risk factor for difficult gallbladder surgery. This outcome can be explained by finding an unexplained fibrotic Calot triangle during surgery (10) or by the higher number of "untreated attacks" due to fewer doctor visits in male patients according to a hypothesis. In a study conducted by Anuk and Kahramanca (11), it was found that gender was not a risk factor. In our study, we concluded that gender was not a significant factor for difficult cholecystectomies.

Table 4. The relationship between the dissection time of Callot's triangle and the rate of conversion to open surgery

Case	Number	Median (min-max)	Mean rank*	p-value
Conversion to open surgery	24	87.5 (35-210)	239.71	0.001
Laparoscopy	276	50 (20-100)	142.74	
	300	50 (20-210)		

min-max: minimum-maximum, *mean rank = average ordinal number

Table 5. Logistic regression analysis of the factors affecting conversion to open surgery

Independent variables		Dependent variables					
		B	SE	Wald	p-value	Odds ratio	%95 CI (lower bound-upper bound)
Previous surgery	(+)	2.209	1.026	4.633	0.031	9.107	1.218-68.078
	(-)	-	-	-	-	-	-
Direct Bilirubin level	>0.3	1.898	0.927	4.188	0.041	6.672	1.083-41.086
	<0.3	-	-	-	-	-	-
Gallbladder wall thickness	increased	2.588	1.238	4.370	0.037	13.308	1.175-150.690
	normal	-	-	-	-	-	-

CI: confidence interval, SE: standard error

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Obesity has been used as an indicator of difficult cholecystectomy operations in the literature for reasons such as causing more inflammation and fibrosis, and thus making dissection difficult, problems with trocar entry due to the thickness of the subcutaneous adipose tissue, and the inability to fully determine the anatomy due to the density of intraperitoneal adipose tissue. In their study, Ammori et al. (12) showed that obese individuals had longer laparoscopic cholecystectomy durations compared to non-obese individuals due to the fatty Calot triangle, fatty right colonic flexure, fatty liver and increased body volume, but there was no difference in the rate of conversion to open surgery. Angrisani et al. (13) could not detect a difference between the rates of open surgery in morbidly obese and non-obese patients (obese 11.4%, non-obese 15.5%); In our study, it was determined that obesity was not a significant risk for difficult cholecystectomy.

Husain et al. (14) suggested in their prospective study with 108 patients that the presence of a history of comorbid disease in general was a predictive factor for conversion to open surgery, and Lipman et al. (15) suggested in their multivariate analysis of 1377 patients that the presence of a history of diabetes mellitus was a predictive factor for conversion to open surgery. In our study, it was determined that the history of additional disease was not a predictive factor for conversion to open surgery. However, in our study, we could state that the additional disease was not a predictive factor, inconsistent with the literature, since we kept the spectrum of additional diseases wide including diabetes mellitus, hypertension, heart failure, coronary artery disease, chronic obstructive respiratory disease and asthma.

In our study, it was observed that the rate of conversion to open surgery in patients who underwent ERCP was 12 times higher than those who did not. In the literature, it was stated that the shorter the time between ERCP and laparoscopic cholecystectomy, the lower the rate of conversion to open surgery (16). If cholecystectomy was performed within the first week after ERCP, it was reported as 13.2%, if it was performed less than forty-two days, 11.4%, and 20.6% if it was performed after forty-three days (16,17). Similarly, de Vries et al. (18) compared the rate of conversion to open surgery in cholecystectomies performed within two weeks after the ERCP procedure with the rate of conversion to open surgery in cholecystectomies performed within 2-6 weeks in their study, and the rate of conversion to open surgery was found to be statistically lower in the first group of patients. In their study, Boerma et al. (19) determined that laparoscopic cholecystectomy could be difficult and the rate of conversion to open surgery could increase 3 times 6 weeks after ERCP.

Many studies in the literature have shown that previous abdominal surgery is effective in the conversion to open surgery (6,20). This rate increases especially in those with a history of upper abdominal surgery (radical gastrectomy, perforated ulcer, vagotomy types, splenectomy, etc.). Adhesions between the liver bed and gallbladder and adjacent organs are common after such surgeries. The entrance to the abdomen will be dangerous due to possible intestinal adhesions, so as a precaution, the trocar should be inserted into the abdomen with the open method in these patients, and unnecessary dissection should be avoided by the surgeon. In our study, we found that patients with a history of previous abdominal surgery had 10 times more conversion to open surgery. Philip Rothman et al. (21) commented in their meta-analysis of 32 prospective studies that especially previous upper abdominal surgeries did not increase the rate of conversion to open surgery. According to the studies of Lee et al. (22), the rate of conversion to open surgery was 20 times higher especially in those who underwent upper abdominal surgery. Similarly, Hu et al. (23) reported in their review study that previous upper abdominal surgery was a serious risk factor, but previous lower abdominal surgery did not affect the rate of conversion to open surgery.

In their meta-analysis, Philip Rothman et al. (24) discussed the importance of leukocytosis in conversion to open surgery in 15 of 32 prospective studies. In 5 of these studies, it was stated that leukocytosis was an important risk factor for conversion to open surgery. In others, it was concluded that the increase in white cell count was not a significant risk factor for conversion to open surgery. Our findings suggested that increased white cell count was not associated with conversion to open surgery.

It has been observed that high liver enzymes (AST, ALT, GGT, ALP) do not constitute an important risk factor for conversion to open surgery in most of the studies in the literature (6,25-27). In our study, it was determined that high liver enzymes did not pose a significant risk for conversion to open surgery.

When Shapiro et al. (28) retrospectively analyzed 46 patients who were operated for acute cholecystitis, they found that elevated amylase lipase level was not a predictive parameter, but they stated that high LDH level was an important predictive factor in the conversion to open surgery. In our study, while the level of amylase lipase was not predictive of conversion to open surgery, the level of LDH was predictive of conversion to open surgery.

Wevers et al. (29) reported that CRP level above 165 mg/dL was predictive of conversion to open surgery. Jessica Mok et al. (30) found the mean CRP level of laparoscopic cholecystectomies which were converted to open surgery to be 286.2 mg/dL, the mean CRP level of difficult cholecystectomies to be 67.4 mg/dL, and the mean CRP level of completed laparoscopic cholecystectomies to be 7.05 mg/dL, and as a result it was considered that preoperative CRP level above 220 mg/dL was a predictive factor in the conversion to open surgery. Increased CRP level is a parameter that reveals the severity of inflammation. It is an important indicator of cholecystitis and is one of the most important causes of conversion to open surgery in inflammatory conditions. Gupta et al. found the mean CRP level to be 22.2±18.2 mg/dL in patients undergoing simple laparoscopic cholecystectomy, 56.5±32 mg/dL in patients undergoing difficult cholecystectomy, and 83.6±22.4 mg/dL in patients with conversion to open cholecystectomy. They concluded that high preoperative CRP level was an important predictive factor for difficult cholecystectomy and conversion to

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open surgery (31). In our study, we found that the CRP level was predictive for the conversion to open surgery.

In our study, it was observed that the rate of conversion to open surgery as 9 times higher in those with a high DB level. In the literature, similar to our study, it has been revealed in various publications that there is a relationship between high serum bilirubin level and conversion to open surgery (10,15). Beliaev and Booth (32) reported that the elevation of DB and ALP levels was directly related to the conversion to open surgery, and the risk of conversion to open surgery in such patients increased 3 times.

Having a history of cholecystitis and cholangitis attacks may be a preoperative determinant of difficult gallbladder surgeries by making it difficult to reveal Calot's triangle with intense inflammation, widespread adhesions, and increased vascularity. Sudhir and Pruthvi (33) compared preoperative and intraoperative grading systems for difficult laparoscopic procedures in their prospective randomized study. In that study, they observed that patients with a history of hospitalization due to cholecystitis had a higher rate of conversion to open surgery (33). According to Nidoni et al. (34), it was reported that those who had more than two cholecystitis attacks experienced approximately 6 times more conversion to open surgery than those who did not. In our study, similar to the literature, a significant relationship was found between the history of cholecystitis and cholangitis, and the rate of conversion to open surgery.

Like Bunkar et al. (35), Lipman et al. (15) also identified pericholecystic fluid on USG as a predictive factor in conversion to open surgery, as stated in many studies in the literature. Randhawa and Pujahari (7) stated that pericholecystic fluid was a non-significant finding in the estimation of difficult gallbladder surgeries, similar to our study.

Bunkar et al. (35) developed a clinical, sonographic and history-based scoring system in a prospective study conducted with 100 patients over the course of 2 years. In this study, they determined that the gallbladder wall thickness of 4 mm and above in ultrasonography was a sign of difficult cholecystectomy operations (35). In our study, we observed that the gallbladder wall thickness of 4 mm and above was 7 times more associated with conversion to open surgery. The data in the literature support our study, and a significant relationship between gallbladder wall thickness and conversion to open surgery has been demonstrated (6,7).

In their study conducted in 450 patients, Awan et al. (36) stated that the most important reason for conversion to open surgery was intense adhesion. They argued that due to the healing of acute cholecystitis with scar and fibrosis, dense fibrotic adhesions between the omentum and gallbladder and dense fibrotic adhesions between the ductus cysticus and the main bile ducts made it difficult to reveal the anatomy of the Calot's triangle, leading to the inability to perform a "safe cholecystectomy" and leading to conversion to open surgery. In a study in which 6147 patients were examined by Singh and Ohri (37), it was stated that intense adhesion in the Calot triangle was the most important reason for conversion to open surgery. In our case series, in 0.6% of the patients without dense adhesions, the operation was converted to open surgery, while in 17% of the patients with dense adhesions, it was converted to open surgery. A statistically significant correlation was found between the presence of adhesion and the rate of conversion to open surgery.

Chand et al. (38) and Sudhir and Pruthvi (33) reported in their study that there was a significant relationship between gallbladder hydrops and conversion to open surgery. Cho et al. (39), showed in their study that the volume of the gallbladder >50 cm^3, difficulty in traction and manipulation with graspers due to thickened (edematous) and fragile gallbladder wall during an acute cholecystitis attack, and are difficult, and that pouring of the liquid and stone contents of the gallbladder into the environment, prolonging operation time could cause conversion to open surgery. In our study, a significant relationship was found between gallbladder hydrops and the rate of conversion to open surgery, and the rate of conversion to open surgery was found to be 19.5% in patients with hydrops, which was consistent with the average literature data, but it could not be evaluated as an independent variable in the regression analysis.

Z'graggen et al. (40) reported that the presence of scleroatrophic cholecystitis and the presence of stones in the main biliary tract during an acute cholecystitis attack greatly increased the rate of conversion to open surgery. It is known that the scleroatrophic appearance of the gallbladder macroscopically in laparoscopy is due to many previous episodes of acute cholecystitis. In our study, we observed that, contrary to many studies in the literature, scleroatrophic gallbladder was not effective in the conversion to open surgery.

Although the presence of an impacted stone in Hartmann's pouch was found to be unrelated to conversion to open surgery by Randhawa and Pujahari (7), in many studies in the literature, similar to our study, conversion to open surgery was found to be more common in patients who developed Mirizzi syndrome associated with an impacted stone in Hartmann's pouch (41-43).

Lal et al. (41) found in a prospective study consisting entirely of elective operations that total surgery time over 90 minutes, Calot dissection time over 20 minutes, and bile or stones in the bile coming out of the gallbladder significantly increased the risk of conversion to open surgery. In our study, we found that there was a significant relationship between the conversion to open surgery and the Calot dissection time being 90 minutes or more.

Sugrue et al. (44) developed an operative scoring model with surgical findings in their study. While most of the previous studies were conducted with preoperative findings, the scoring made by Sugrue et al. (44) was formed with operative findings. In our study, our patients were evaluated with the scoring made by Sugrue et al. (44).

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Study Limitations

The limitation of our study was that our study was a single-center retrospective study and the conversion to open surgery group included a small number of patients in our study.

CONCLUSION

In our patients, a history of ERCP, previous abdominal surgery, elevated CRP, LDH and DB levels, history of previous cholangitis or cholecystitis attack, increased gallbladder wall thickness, adhesion of the gallbladder to adjacent organs, presence of hydropic gallbladder and impaction of the stone on the Hartmann's pouch caused the operation to be difficult and was found to increase the risk of conversion to open surgery.

ERCP, previous abdominal operation history, high DB level and thick gallbladder wall were considered as independent variables.

The scoring system developed by Sugrue was proven to be reliable in our patients. This scoring system can be further improved with new studies and a consensus can be achieved in all clinics.

Ethics Committee Approval: Our study was carried out, after it was approved, with the decision of Kafkas University Faculty of Medicine Ethics Committee dated 30.10.2019 and numbered 80576354-050-99/239.

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