



## ORIGINAL ARTICLE

# When Should a Surgeon Think to Convert Laparoscopic Cholecystectomy to Open Surgery? A Retrospective Study

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## Abstract

**Introduction:** Today, it is still a difficult decision for surgeons to convert from laparoscopic cholecystectomy (LC) to Open cholecystectomy (OC). Our aim in this study is to predict the possibility of conversion to OC before the operation by comparing the data of the patients who underwent LC.

**Methods:** Patients were divided into two groups. The first group was the OC group and the second group was the LC group. The data of both groups were compared with various parameters.

**Results:** The conversion rate from LC to OC was 7.2%. The rate of conversion in male patients was 12.8%, and the rate of conversion in female patients was 5.2%. The mean age of the group with OC ( $52.66 \pm 13.77$ ) was statistically higher ( $p=0.019 < 0.05$ ) than the laparoscopy group ( $47.22 \pm 13.04$ ).

**Discussion and Conclusion:** Regarding patients' age, gender, increased alkaline phosphatase, gamma-glutamyl transferase and direct bilirubin values, gallbladder wall thickness, presence of bile sludge and presence or suspicion of choledocholithiasis, preoperative endoscopic retrograde cholangiography history parameters as a risk factor in the group OC, there were statistically significant relation.

**Keywords:** Conversion; laparoscopic cholecystectomy; open cholecystectomy.

With the development of technology over the years, the technology has undergone a rapid development process in the devices and materials used in the field of surgery. Open surgeries are replaced by surgeries performed from smaller incisions as much as possible.

In all medical applications, there is no other procedure that is accepted as quickly and widely as laparoscopic interventions. Laparoscopic interventions have entered the service of applied medicine as opposed to similar practices. The acceptance of laparoscopic cholecystectomy (LC) as the gold standard in gallstones operation and the realization

of this were as little as 5-10 years after the first trials. This is explained by the additional advantages of the technique. Moreover, LC has become rapidly widespread all over the world and has been the most important factor in the development of other endoscopic surgical procedures.

The first form of operation that follows these changes is LC, and it would not be wrong even to call LC the ancestor of laparoscopic and minimally invasive surgery. Over time, the first option in the treatment of cholelithiasis shifted from open cholecystectomy (OC) to LC.

Despite all the advances in technology and surgery, there

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are still conversions to OC. Thus, it has become mandatory to share the possibility of conversion to OC with the patient before surgery. Moreover, it will be life-saving to use some markers to determine the patients who may undergo OC before surgery.

Our aim in this study was to investigate the rates of conversion to OC in patients who have planned LC in our hospital and the preoperative parameters that can be used to evaluate this possibility and to investigate whether there is a difference between the parameters in the approach. In this way, it is to reveal the development in this field in the last ten years.

## Materials and Methods

This study was conducted consecutively with 101 patients with elective LC with cholelithiasis between January 2015 and January 2018 at the Haseki Training and Research Hospital. The data of 50 consecutive patients who underwent OC and LC were retrospectively examined. Patients who underwent surgery and cholecystectomy were excluded from this study for another reason. Patients confirmed that their data can be used during hospitalization. Since our study was retrospective and the data consisted of standard preoperative examinations, ethics committee approval was not obtained for this study.

Patients' files include age, gender, history of diabetes mellitus (DM), history of hypertension (HT), history of chronic obstructive pulmonary disease (COPD), history of acute pancreatitis, history of acute cholecystitis, endoscopic retrograde cholangiography (ERCP) history, history of abdominal surgery, number of stones in gallbladder, size of the largest stone in gallbladder, thickness of gallbladder wall, presence of pericholecystic fluid, presence of sludge in gallbladder, choledocholithiasis, leukocytes in circulating blood count, lactate dehydrogenase (LDH), aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma-glutamyl transferase (GGT), alkaline phosphatase (ALP), amylase, total bilirubin, direct bilirubin and indirect bilirubin values were recorded.

## Statistical Analysis

In this study, mean, rate and standard deviation were used in statistics. The distribution was tested using the Kolmogorov-Smirnov test. T-test was used in the analysis of non-parametric data, and the analysis of the parametric data Mann-Whitney U test was used. In the analysis of proportional data, the chi-square test and Fischer exact test

were used when chi-square conditions were not met. SPSS 19.0 program was used in the analysis.

## Results

In this study, a total of 689 patients who underwent LC between January 2015 and January 2018 were retrospectively analyzed. Among these patients, the total number of cases from laparoscopic to OC was 50, and the control group was formed by taking the first 101 patients who had an LC chronologically backward since January 2018.

Of the cases, 510 were female (74%), and 179 were male (26%). The conversion rate from LC to OC was 7.2%. The rate of conversion in male patients was 12.8%, and the rate of conversion in female patients was 5.2%. The mean age of the group with OC ( $52.66 \pm 13.77$ ) was statistically higher ( $p=0.019 < 0.05$ ) than the laparoscopy group ( $47.22 \pm 13.04$ ). The rate of male patients in the group undergoing OC (M: 46.0%/F: 54.0%) was significantly higher ( $p=0.025 < 0.05$ ) than LC group (M: 27.7%/M: 72.3%) (Table 1).

In the OC group, the number of stones in the gallbladder (9; 18% single, 5% double; 36% multiple) was not significantly different from the laparoscopy group (36; 35.6% single, 10; 9.9% double, 55; 54.5% multiple) ( $p > 0.05$ ) (Table 2).

**Table 1.** Comparison of the patients concerning age and gender

	Open Cholecystectomy Mean $\pm$ SD, n(%)	Laparoscopic Cholecystectomy Mean $\pm$ SD, n(%)	p
Age	52.66 $\pm$ 13.77	47.22 $\pm$ 13.04	0.019
Sex			
Female	27 (54.0)	73 (72.3)	0.025
Male	23 (46.0)	28 (27.7)	

Chi-square test/t-test 95% Confidence Interval.

**Table 2.** Stone properties in the gallbladder of the patients

	Open Cholecystectomy Mean $\pm$ SD, n (%)	Laparoscopic Cholecystectomy Mean $\pm$ SD, n (%)	p
The number of stones in the gallbladder			
Single	9 (18.0)	36 (35.6)	0.074
Double	5 (10.0)	10 (9.9)	
Multiple	36 (72.0)	55 (54.5)	
Size of the largest stone (mm)	12 $\pm$ 8.61	10.26 $\pm$ 9.77	0.137

Chi-square test/Mann-Whitney U test 95% Confidence Interval.

The stone size of the OC group (12.00±8.61) was not significantly different from the laparoscopy group (10.26±9.77) (p>0.05) (Table 2).

There was no significant difference between the history of abdominal operation of the two groups, history of pancreatitis, history of acute cholecystitis, history of COPD, presence of diabetes and presence of hypertension (p>0.05). In the OC group (12.0%), the rate of patients with a history of ERCP was significantly higher (p=0.001 <0.05) higher than the laparoscopy group (Table 3).

The leukocyte count, AST, ALT, total bilirubin, indirect bilirubin and amylase values in the two groups were not statistically different. The mean value of LDH (141.0±111.8) of the group with OC was significantly lower (p=0.048 <0.05) than the LC group (196.2±150.2). The mean value of GGT (126.7±198.4) of the group with OC was significantly higher (p=0.000 <0.05) than the LC group (31.23±92.09).

**Table 3.** Past medical history of the patients

	Open Cholecystectomy n (%)	Laparoscopic Cholecystectomy n (%)	p
History of lower abdomen operation			
No	38 (76.0)	73 (72.3)	0.626
Yes	12 (24.0)	28 (27.7)	
History of upper abdomen operation			
No	49 (98.0)	101 (100)	0.154
Yes	1 (2.0)	0 (0)	
ERCP history			
No	44 (88.0)	101 (100.0)	0.001
Yes	6 (12.0)	0 (0)	
History of pancreatitis			
No	46 (92.0)	93 (92.1)	0.986
Yes	4 (8.0)	8 (7.9)	
History of acute cholecystitis			
No	47 (94.0)	96 (95.1)	0.786
Yes	3 (6.0)	5 (4.9)	
COPD history			
No	49 (98.0)	97 (96.0)	0.666
Yes	1 (2.0)	4 (4.0)	
Presence of diabetes mellitus			
No	43 (86.0)	86 (85.1)	0.899
Yes	7 (14.0)	15 (14.9)	
Presence of Hypertension			
No	35 (70.0)	75 (74.3)	0.580
Yes	15 (30.0)	26 (25.7)	

Chi-square test/Fischer exact 95% Confidence Interval.

**Table 4.** Patients' laboratory results

	Open Cholecystectomy Mean±SD	Laparoscopic Cholecystectomy Mean±SD	p
Leukocyte count (/μL)	8.00±2.29	7.24±2.17	0.051
AST (U/L)	39.38±47.88	55.08±133.74	0.184
ALT (U/L)	55.46±76.53	70.81±145.27	0.582
LDH (U/L)	141.06±111.84	196.28±150.27	0.048
GGT (U/L)	126.71±198.48	31.23±92.09	0.000
ALP (U/L)	141.38±122.63	96.74±68.17	0.003
Total Bilirubin (mg/dL)	1.12±1.40	0.66±0.44	0.073
Direct Bilirubin (mg/dL)	0.59±0.98	0.29±0.31	0.027
Indirect Bilirubin (mg/dL)	0.55±0.49	0.41±0.20	0.156
Amylase (U/L)	84.36±74.18	63.87±24.85	0.290

Mann-Whitney U test/t-test 95% Confidence Interval.

The mean value of ALP (141.3±122.6) of the group with OC was significantly higher (p=0.003 <0.05) than the LC group (96.7±68.1). The direct bilirubin mean value (0.59±0.98) of the group with OC was significantly higher (p=0.027 <0.05) than the LC group (0.29±0.31) (Table 4).

In the OC group (18.0%), the rate of patients with the presence of sludge in the gallbladder was significantly higher (p=0.001 =0.05) than in the LC group. In the OC group (22.0%), the rate of gallbladder wall thickness increased was significantly higher than in the LC group (6.9%) (p=0.007 <0.05). In the OC group (12.0%), the rate of patients with choledocholithiasis was significantly higher (p=0.002 (0.05)

**Table 5.** Ultrasonography characteristics of the patients

	Open Cholecystectomy n (%)	Laparoscopic Cholecystectomy n (%)	p
Sludge			
No	41 (82.0)	98 (97.0)	0.001
Yes	9 (18.0)	3 (3.0)	
Gallbladder wall thickness			
Normal	39 (78.0)	94 (93.1)	0.007
Increased	11 (22.0)	7 (6.9)	
Choledocholithiasis			
No	44 (88.0)	100 (99.0)	0.002
Yes	6 (12.0)	1 (1.0)	
Presence of pericholecystic fluid			
No	48 (96.0)	100 (99.0)	0.212
Yes	2 (4.0)	1 (1.0)	

Chi-square test/Fischer exact 95% Confidence Interval.

than the LC group (1.0%). There was no significant difference between the rates of patients with the presence of pericholecystic fluid in the two groups ( $p>0.05$ ) (Table 5).

## Discussion

Today, 10-15% of the adult population in developed countries has gallstones [1]. The complication rate requiring surgery, such as acute cholecystitis, in these individuals is between 1-2% [2]. LC is the treatment to be chosen in the treatment of symptomatic gallstones disease and related complications. Compared to OC, LC's morbidity and mortality rates are lower [3]. Their superiority to the OC, less painless, better cosmetic results, shortening of hospital stay and rapid conversion to postoperative normal life have been known for years [4,5]. However, in some patients where LC cannot be safely performed due to technical difficulties or intraoperative complications, switching to OC may sometimes be mandatory [6-8].

The rate of conversion from LC to OC was reported as 2.6% to 7.7% in recent studies [9-12]. In our study, we determined the rate of conversion to OC as 7.2% in accordance with the literature.

Many studies have shown male sex as an important risk factor in the conversion to OC [11,12]. Etiology is not clear in this union. Gallstone disease may be more serious in men. Inflammation and tight adhesions are often known as the cause of exposure in men. In our study, the proportion of male patients in the group passed to OC was significantly higher than the LC group.

Advanced age has been accepted as a risk factor in the conversion to OC [12]. The higher number of cholecystitis attacks in elderly patients and the longer duration of the history of gallstones can be cited as the cause. In our study, the mean age of the OC group was significantly higher than the LC group.

The increased leukocyte count indicates inflammation associated with more acute disease and is usually associated with acute cholecystic. In our study, there was no significant difference between the number of leukocytes in the OC and LC groups.

In our study, we investigated whether there is a correlation between total bilirubin, direct and indirect bilirubin values and exposure. The OC group's direct bilirubin average ( $0.59\pm 0.98$ ) was significantly higher than in the LC group. Total bilirubin and indirect bilirubin values were not statistically different. Total bilirubin values were examined in the

literature and were cited as predictive factors in the conversion from LC to OC [13]. Tayeb et al. [14] examined direct bilirubin and indirect bilirubin values in a study and found that the conversion to OC was not statistically significant.

In our study, AST, ALT and amylase values were compared between OC and LC groups and there was no significant difference. Kumar et al. [15] and Lipman et al. [16] also found that amylase values were not statistically significant for conversion to LC.

Elevated ALP values have been reported in many studies as a risk factor in returning from LC to OC [17,18]. In our study, the ALP means of the OC group was significantly higher than the laparoscopy group. In some studies, elevated ALP values were not as significant as risk factors in the conversion to OC [14].

There are a limited number of studies on GGT in the literature on the conversion from LC to OC. In a more recent study, GGT was included in liver function tests, and the conversion to OC was significantly higher in patients with abnormalities in liver function tests [15]. In our study, the GGT average of the OC group was significantly higher than the LC group.

LDH is a parameter that is not examined much; Kumar et al. [16] showed that serum LDH levels do not have statistically predictive meaning. However, in our study, the LDH mean of the OC group was significantly lower than that of the laparoscopy group.

In our study, patients were also examined for additional diseases, such as HT, DM and COPD. It has been observed that none of these diseases have statistically predictive meaning in the conversion to OC. Dominguez et al. [17] reported that hypertension is a risk factor. In the same study, DM did not statistically mean anything. Also, Young et al. [18] examined DM, cardiovascular and respiratory additional diseases and found that the conversion to OC was not statistically significant. Lipman et al. [19] found DM as an independent predictive factor in the conversion to OC.

We examined the history of acute pancreatitis and acute cholecystitis separately in our study, we did not identify them as significant risk factors in the conversion to OC. In studies, the history of acute pancreatitis was not identified as a risk factor in the conversion from LC to OC [20]. Publications reporting the history of acute cholecystitis as a risk factor are available [15,19].

In our study, patients were examined in the direction of a history of lower and upper abdomen operations, and we

found that the risk factor in the conversion to OC was not statistically significant. In many studies, it has been reported that a history of the upper abdominal operation increases the risk of conversion from LC to OC [8,12,21]. It has been noted in many publications that the history of lower abdomen operation is not statistically significant as a risk factor in the conversion from LC to O [19].

In our study, preoperative findings, such as gallbladder wall thickness, presence of pericholecystic fluid, presence of bile sludge, single, double, multiple of stones in the gallbladder, size of the largest stone in the gallbladder and presence and suspicion of choledocholithiasis ultrasonographic findings, were evaluated. In the literature, there is almost a consensus about a high correlation between the thickness of the gallbladder wall measured ultrasonographically and the conversion from LC to OC [22].

In our study, the gallbladder wall thickness increased (>4 mm) or classified as normal. In our study, we found that the increased thickness of the gallbladder wall was statistically significant in the conversion from LC to OC. We found no correlation between the presence of pericholecystic fluid and the conversion to OC. There are studies in the literature that are consistent with our findings and also studies that have reached the opposite conclusion [15,18,20].

We did not detect statistical significance between the single, double and multiple gallstones and the conversion to OC. In many studies, there was no statistical correlation between the number of stones and the conversion to OC [22]. Gambling et al., [16] in their study, classified gallstones as single and multiple and stated that patients with single gallstones in the conversion to OC had a better chance of returning to OC. In the same study, there was no correlation between gallstone size and conversion to OC. In our study, we did not detect statistical significance between gallstone sizes in LC and OC groups.

The presence of bile sludge has not been examined as a risk factor in the conversion from LC to OC. In our study, we found the presence of bile sludge with stones statistically significant in the conversion to OC.

In many studies, choledocholithiasis was found to be a risk factor in conversion to OC in LC [18,20]. In our study, we found that the presence of choledocholithiasis was statistically significant in the conversion from LC to OC.

According to some authors, there is a relationship between the conversion to OC and ERCP before surgery [23]. Dominguez et al. [17] showed that ERCP history was found

as an independent high-risk factor in the conversion to OC. Similar to these results in our study, we found that the preoperative ERCP story was a risk factor in the conversion to OC.

In a review edited by Rothman et al. [24] thicker gallbladder wall than 4-5 mm, a contracted gallbladder, age above 60 or 65, male gender and acute cholecystitis were factors risk for the conversion of LC to open surgery.

Gene Hu et al. [25] also considered similar risk factors, such as male gender and old age, as significant. In Rashad et al.'s [26] study, most common cause of conversion was tried adhesions followed by obscure anatomy at Calot's triangle. Other common causes were bleeding, even leakage, visceral injuries and instrument failure.

Bouassida et al. and Utsumi et al. showed that the independent risk factors for conversion to open surgery included male sex, diabetes mellitus, total bilirubin level and TG13 grade. TG13 (Tokyo classification 2013) grade was found to be the most powerful predictive factor for conversion as it had the highest OR [27,28].

In a study of Beksac et al., [29] among 1335 laparoscopically started cases, 104 (7.7%) were converted to open surgery. They showed that alkaline phosphatase (ALP) levels to be significant risk factors. By using a receiver operating characteristic curve, we found that the risk significantly increases after 55 years of age and an ALP over 80 IU/L.

In Coffin et al.'s [30] study, independent predictors of conversion to OC included male gender and age  $\geq 65$ . In a study of Al Masri et al., [31] the variables that were found to be most predictive of conversion were male gender, advanced age, prior history of laparotomy, especially in the setting of a prior wound, a history of COPD and anemia (Hb <9 g/dl). The most common reasons for conversion were perceived as difficult anatomy or obscured view secondary to severe adhesions or significant inflammation.

As a limitation to our study, the number of OC cases in our study may be higher. Hence, the ranges of years examined can be increased, or multicentric examination can be carried out.

## Conclusion

In this study, we investigated the preoperative values of the patient who could be used in preoperative evaluation of the possibility of conversion from LC to OC. Patient's age, gender, ALP, GGT and direct bilirubin values, increased gallbladder wall thickness, presence of bile sludge and

presence or suspicion of choledocholithiasis, preoperative ERCP history parameters as risk factors in the group passed to OC we found it statistically significant. However, leukocyte count, AST, ALT, amylase, total bilirubin, indirect bilirubin, LDH values, pericholecystic fluid presence, number of stones in gallbladder, size of the largest stone in the gallbladder, history of lower abdomen operation, upper abdomen operation history, history of acute pancreatitis and acute cholecystitis and the presence of additional disease was not significant.

Although there are different criteria for determining the risk of conversion from LC to OC, a more easy-to-use, effective and objective scoring system is needed. Thus, in a wide series of prospective work, the question we believe that a reliable scoring system can be reached by increasing the parameters.

**Ethics Committee Approval:** Since our study was a retrospective study ethics committee approval was not obtained for this study.

**Peer-review:** Externally peer-reviewed.

**Authorship Contributions:** Concept: E.F.; Design: E.F., S.P.B.; Data Collection or Processing: E.F., S.P.B.; Analysis or Interpretation: S.P.B.; Literature Search: S.P.B.; Writing: S.P.B.

**Conflict of Interest:** None declared.

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