

# Physio-pathological risk factors from gallbladder affecting the conversion from laparoscopic cholecystectomy to open cholecystectomy

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## Abstract

**Aim:** Laparoscopic cholecystectomy is the first-line treatment method in the surgical treatment of gallbladder pathologies. Predicting conversion from laparoscopic to open cholecystectomy is still an important problem in the world. In our study, we aimed to investigate the gallbladder-derived physiopathological risk factors that affect the conversion from laparoscopic to open cholecystectomy.

**Materials and Methods:** 370 patients who underwent cholecystectomy with the indications of symptomatic gallstone, acute cholecystitis, asymptomatic gallstones and gallbladder polyps were included in the study. Patients' demographic data such as age and sex, and pathological diagnoses, gallbladder wall thickness, and gallbladder volumes were obtained from pathology results. The effects of physiological parameters on conversion to open cholecystectomy were compared.

**Results:** The most common indication for surgery is symptomatic gallstones (227 patients, 74.9%). The first preferred surgical technique is laparoscopic cholecystectomy with 86.5%. The conversion rate was 10.5% (n=39). The rate of conversion to open cholecystectomy was found to be high and a statistically significant difference was observed in patients with high gallbladder wall thickness and large sac volume (p<0.001 for wall thickness, p=0.008 for gallbladder volume)

**Conclusions:** We determined that the wall thickness and volume of the gallbladder had a significant effect on the conversion rate of laparoscopic cholecystectomy to open cholecystectomy. We believe that, patients who can be detected ultrasonographically prior to surgery with increased gallbladder wall thickness, and gallbladder volumes are more likely to conversion to open surgery and that patients should be informed in detail.

**Keywords:** Convert to open; cholecystectomy; gallstones; laparoscopy; risk factors

## INTRODUCTION

After the successful implementation of gallbladder surgery with laparoscopic method in the 1980s, laparoscopic cholecystectomy became a rapidly accepted method in the world. Today, laparoscopic cholecystectomy is accepted as the gold standard treatment method in gall bladder pathologies in developed countries. The main advantages of laparoscopic cholecystectomy are less postoperative pain, faster return to normal physical activities, and better cosmetic results (1).

However, in some cases, conversion to open cholecystectomy may be required according to safe cholecystectomy criteria. A difficult cholecystectomy operation can be estimated by evaluating some parameters related to the patient in the preoperative period. In daily surgery, determination of the risk of convert to open of the

patient before surgery is of great importance in practice. However, consensus could not be achieved on an accepted scoring system in daily practice due to the large number of subjective parameters affecting the conversion to open cholecystectomy (2-4).

In this study, we statistically analyzed the gallbladder related physiological risk factors and demographic data affecting the conversion from laparoscopic cholecystectomy to open cholecystectomy. Especially, we aimed to evaluate whether gallbladder volume has an effect on returning to open procedure by using gallbladder measurements given in pathological examination.

## MATERIALS and METHODS

### Study Groups and Study Plan

This retrospectively planned study included 370 patients who underwent cholecystectomy between the dates of

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January 1, 2014 and December 31, 2018 after obtaining local ethics committee approval. Symptomatic gallstones, acute cholecystitis, asymptomatic gallstones and gallbladder polyps were used as the indications for surgery. The types of surgery of the patients were recorded and 11 patients who underwent open cholecystectomy were excluded from the study. The remaining patients were divided into two groups as laparoscopic cholecystectomy (n = 320) and convert to open (n = 39). Patients' demographic data such as age and sex, and pathological diagnoses, gallbladder wall thickness and gallbladder volumes were obtained from pathology results. The gallbladder wall thickness was calculated based on the highest value given by microscopic examination of the pathology specimen. The gallbladder volume was calculated based on the macroscopic measures of the gallbladder and using the formula  $V = \frac{4}{3} a^2 b \pi$  (a: half of the gallbladder width, b: half of the gallbladder's length). The effects of physio-pathological parameters on the convert to open were compared.

Patients who under the age of 18, had cholecystectomy surgery due to trauma, had open cholecystectomy as the first surgery option and had surgery planned for gallbladder cancer was excluded from the study.

### Statistical Analysis

The analysis of the data was done in SPSS (Statistical Package for Social Science) for Windows 15.0 package program. Continuous variables from the descriptive statistics were shown as mean  $\pm$  standard deviation. Whether there is a difference between groups for continuous variables was evaluated by One-Way ANOVA or Kruskal Wallis variance analysis. Mann-Whitney U multiple variance analysis was used to evaluate which group was different when the p value was statistically significant. Chi-square test was used to compare discrete variables. For all results, p <0.05 value was considered statistically significant.

## RESULTS

General demographic data of 359 patients who underwent cholecystectomy between 01 January 2014 and 31 December 2018 are summarized in Table 1. According to the data obtained, the average age of the patients is  $46.36 \pm 14.53$  years. 78 of the patients who underwent cholecystectomy operation were male (21.7%) and 281 (78.3%) were female. The most common indication for surgery is symptomatic gallstones (269 patients, 74.9%). Indications were determined as acute cholecystitis (18.9%), asymptomatic gallstones (4.2%) and gallbladder polyps (1.9%), respectively. According to the first preferred surgical option, the laparoscopic cholecystectomy rate was 86.5%, the conventional cholecystectomy rate was 3%. The conversion to open rate was found to be 10.5% (n=39). The causes of convert to open were determined as adhesion and bleeding. Conversion to open operation occurred due to adhesions in 35 patients. In 5 of these 35 patients, conversion to open procedure was due to the detection of bile duct injury per operatively. There was no postoperative mortality.

**Table 1. General demographic data of patients**

Demographic data	n=359
Mean age (years)	46.36 $\pm$ 14.53
Gender (Male/Female)	78 (%21.7) / 281 (%78.3)
Mean duration of complaint (months)	5.86 $\pm$ 5.69
<b>Operation Indication</b>	
Symptomatic gallstone	269 (%74.9)
Acute cholecystitis	68 (%18.9)
Asymptomatic gallstones	15 (%4.2)
Gallbladder polyp	7 (%1.9)
<b>Type of surgery</b>	
Laparoscopic cholecystectomy	320 (%86.5)
Convert to open	39 (%10.5)
<b>Reason of convert to open</b>	
Adhesion	35 (%11)
Bleeding	4 (%1)
<b>Pathological diagnoses</b>	
Acute cholecystitis	61 (%17)
Chronic cholecystitis	275 (%76.6)
Gastric metaplasia	12 (%3.3)
Gallbladder polyp	7 (%1.9)
Gallbladder cancer	4 (%1.1)
<b>Duration of hospital stay (days)</b>	1.70 $\pm$ 1.43

Open cholecystectomy was performed in 11 patients and they were excluded from the study. The effects of 359 patients' pathological and demographic data on conversion to open operation were evaluated in Table 2. According to the data obtained, there was no difference between the groups in terms of age and sex. The mean age of the patients whose operation was completed laparoscopically was 46.22, while the mean age of the patients who converted to open procedure was found to be 47.59, and there was no statistically significant difference (p=0.586). Laparoscopic cholecystectomy was performed in 252 male and 68 female patients. Conversion to open cholecystectomy was necessary in 29 male and 10 female patients. Statistically, gender did not have a significant effect on conversion to open procedure (p: 0.328). Pathological evaluation of 61 patients was acute cholecystitis. While laparoscopic cholecystectomy was performed in 51 (83.6%) of these patients, conversion to open cholecystectomy was necessary in 10 (16.4%) of them. The pathology outcome was chronic cholecystitis in 275 patients and the number of laparoscopic completed and laparoscopic incomplete patients was 251 (91.5%) and 24 (8.7%), respectively. All 7 patients with gall bladder polyp were operated laparoscopically. It was observed that the pathological diagnosis did not have a statistically significant effect on conversion to open cholecystectomy (p=0.097).

Table 2. Distribution of factors affecting convert to open

	Lap. Cholecystectomy (n=320)	Convert to open (n=39)	p
Mean age (years)	46.22 ± 14.80	47.59 ± 12.14	0.586
Gender (Male/Female)	68/252	10/29	0.328
Gall bladder wall thickness (mm)	2.80 ± 0.57	2.98 ± 0.90	<0.001
Gallbladder volume (mm <sup>3</sup> )	48.01 ± 32.02	79.46 ± 75.44	0.008
<b>Gall bladder pathology</b>			0.097
Acute cholecystitis	51 (%83.6)	10 (%16.4)	
Chronic cholecystitis	251 (%91.3)	24 (%8.7)	
Gastric metaplasia	9 (%75)	3 (%25)	
Gallbladder polyp	7 (%100)	0	
Gallbladder cancer	2 (%50)	2 (%50)	

In patients with high gallbladder wall thickness and large gall bladder volume, the rate of convert to open surgery return was high and a statistically significant difference was detected (for p <0.001 wall thickness, p = 0.008 for gallbladder volume) (Figure 1).

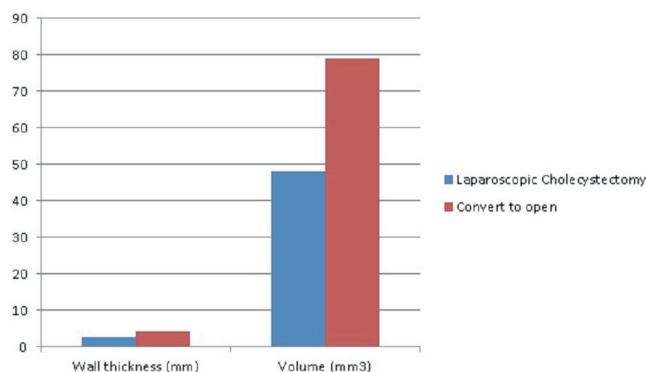


Figure 1. The graphic of factors influencing from laparoscopic cholecystectomy to open surgery

## DISCUSSION

In this study, we investigated the effect of the wall thickness and volume of the gallbladder for conversion from laparoscopic cholecystectomy to open cholecystectomy and found that these parameters had a significant effect on the conversion rate.

Laparoscopic cholecystectomy has become the gold standard surgical treatment method in gallbladder pathologies in the world. However, in some cases, conversion to open cholecystectomy may be required according to safe cholecystectomy criteria. Many studies have been conducted in the literature to predict such situations. Many subjective factors cause conversion to open surgery from laparoscopic cholecystectomy. For this reason, a common consensus could not be established on a scoring system that could be adapted to daily surgical practice (1-4).

In the literature, many parameters including the patient's age, gender, ethnicity, timing of the planned operation, indication of the planned operation, ultrasonographic

findings, location of the stone in the gallbladder, presence of pericolectic fluid, MRCP (magnetic resonance cholangiopancreatography) findings, ERCP (endoscopic retrograde cholangiopancreatography) findings, whether there is a need for ERCP, laboratory values, anthropometric measurements, additional diseases, ASA score, and body mass index (BMI) are evaluated together or separately, and many risk assessment scoring systems are tried to be created (5-11). Patient-independent factors, such as the surgical experience or the operating volume of the hospital, have also been evaluated (12).

Trying to evaluate a large number of variable parameters and subjective factors makes it difficult to create a consensus. These technical challenges have forced the surgeons to search for a way to predict the rate of conversion with high accuracy by simplifying these parameters. Goonawardena et al. (1) found that they were able to achieve approximately 95% similar results compared to the evaluation of all parameters by choosing 5 of the 40 parameters. In addition, they showed that they can calculate the rate of conversion from laparoscopy to open cholecystectomy, more successfully than the surgeon's foresight, with the nomograms that they created by fixing certain parameters. In a review of 13 studies evaluated by Alan Shuin et al. (13), found that only the nomograms created in this study could have methodological usability and value. In addition, before surgery there are also objective parameters, which used by general surgeons, indicate that the possibility of conversion to an open procedure is high. The common point of the studies carried out in this context is the wall thickness of the gallbladder, an effective, objective, and measured easily parameter (14-17). In our study, we found that the rate of conversion to open surgery significantly increased in patients with increased gallbladder wall thickness in pathological evaluation (p=0.001). When we calculate and compare the gallbladder volumes using the formula of  $V = \frac{4}{3} a^2 b \pi$  (a: half of the gallbladder width, b: half of the gallbladder's length) with the macroscopic measures of the gallbladder, we found that the volume of the gallbladder had a significant effect on conversion to open cholecystectomy (p=0.005).

In addition, the age of patients is considered as an important parameter on converting to open cholecystectomy. In a study conducted by Lujan et al. (18), the laparoscopic cholecystectomies performed to patients over 65 years of age had significantly lower morbidities than the open procedure. Tube cholecystostomy can achieve 90% success in the treatment of acute attacks and may be an alternative to surgical intervention, especially in patients with high operation morbidity. El Gendi et al. (19) showed that, patients who underwent a delayed cholecystectomy by placing a tube cholecystostomy, the difficulty of the operation and the rate of conversion to open cholecystectomy decreased significantly. They performed an early cholecystectomy in one group and a cholecystectomy 6 weeks after tube cholecystostomy in the other group by dividing 150 patients into two groups. Although cholecystitis resolved rapidly in both groups, the tube cholecystostomy group had a lower conversion rate to open procedure (2.7% vs. 24%), shorter surgery time (38 to 89 minutes), less blood loss, shorter hospital stay (11 to 52 hours), fewer postoperative complications (2.7% to 27%) and less bile leaks (0% to 10.7%). In particular, this study shows us the importance of determining the treatment modality by detecting difficult cholecystectomies in the preoperative period with high risk of conversion. In their study, Lipman et al. (20) found that the rate of converting to open procedure increased in patients over 65 years of age. However, in our study, we did not find any significant difference between patients who had been converted to open cholecystectomy from laparoscopic cholecystectomy, based on the age of the patients.

When we evaluate the parameters that affect the risk of converting to open cholecystectomy in the literature, we can see that there are contradictory findings. For example, there are many studies in the literature showing that male gender is an important risk factor for conversion to open cholecystectomy (14,21). Russell et al. (22) found that male sex increases the risk of returning to open cholecystectomy. In contrast, in a study by Randhawa et al. (23) in India, reported that male gender did not cause a significant increase on conversion rate. In our demographic evaluation, we did not find any significant gender differences between patients who were converted to open cholecystectomy and completed laparoscopically ( $p = 0.328$ ).

In a study by Zehetner et al. (12), they showed that there was no significant difference between high-volume and low-volume hospitals in terms of conversion rates. Based on this study, we can say that surgeons have gained a lot of experience in laparoscopic cholecystectomy operation over the past years. Laparoscopic cholecystectomy is the most common laparoscopic procedure in the world. During the surgical training, animal laboratories, cadaver laboratories and simulation devices are used. Zehetner et al. (12) defined laparoscopic cholecystectomy as a procedure that has a low learning curve and is

acceptable to the surgeon during learning and developing laparoscopic skills. However, they emphasize the necessity of identifying high-risk patients and being operated by experienced surgeons. This shows us the importance of planning laparoscopic cholecystectomies by determining the degree of difficulty before the operation.

## CONCLUSION

In conclusion, in this retrospective study, we found that the increase in gallbladder wall thickness and volume was effective on the rate of conversion from laparoscopic cholecystectomy to open cholecystectomy, while age, sex and gallbladder pathology had no effect. Although we found that the age and gender did not affect the rate of conversion to open cholecystectomy, the effects of these parameters cannot be denied according to the data in the literature. Today, ultrasound and abdominal tomography are the most commonly used imaging methods in diagnosing gallstones and acute cholecystitis in the preoperative period. In the evaluation of these tests, the volume of the gallbladder is not routinely calculated. The gallbladder volume can be easily calculated in both imaging methods. As a result, we think that routine delivery of the gallbladder volume to the clinician may be helpful in predicting the conversion to the open procedure. We believe that patients who can be detected ultrasonographically prior to surgery with increased gallbladder wall thickness and gallbladder volumes are more likely to return to open surgery and those patients should be informed in detail.

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## REFERENCES

1. Goonawardena J, Gunnarsson R, de Costa A. Predicting conversion from laparoscopic to open cholecystectomy presented as a probability nomogram based on preoperative patient risk factors. *Am J Surg* 2015;210:492-500.
2. Rosen M, Brody F, Ponsky J. Predictive factors for conversion of laparoscopic cholecystectomy. *Am J Surg*. 2002;184:254-8.
3. Lipman JM, Claridge JA, Haridas M, et al. Preoperative findings predict conversion from laparoscopic to open cholecystectomy. *Surgery* 2007;142:556-63.
4. Ballal M, David G, Willmott S, Corless DJ, Deakin M, Slavin JP. Conversion after laparoscopic cholecystectomy in England. *Surg Endosc* 2009;23:2338-44.
5. Ishizaki Y, Miwa K, Yoshimoto J, Sugo H, Kawasaki S. Conversion of elective laparoscopic to open cholecystectomy between 1993 and 2004. *Br J Surg* 2006;93:987-91.
6. Kama NA, Kologlu M, Doganay M, Reis E, Atli M, Dolapci M. A risk score for conversion from laparoscopic to open cholecystectomy. *Am J Surg* 2001;181:520-5.

7. Sippey M, Grzybowski M, Manwaring ML, et al. Acute cholecystitis: risk factors for conversion to an open procedure. *J Surg Res* 2015;199:357-61.
8. Vivek MA, Augustine AJ, Rao R. A comprehensive predictive scoring method for difficult laparoscopic cholecystectomy. *J Minim Access Surg* 2014;10:62-7.
9. Stanistic V, Andjelkovic I, Vlaovic D, et al. Feasibility of applying data mining techniques for predicting technical difficulties during laparoscopic cholecystectomy based on routine patient work-up in a small community hospital. *Hepatogastroenterology* 2013;60:1561-8.
10. Kaafarani HM, Smith TS, Neumayer L, et al. Trends, outcomes, and predictors of open and conversion to open cholecystectomy in Veterans Health Administration hospitals. *Am J Surg* 2010;200:32-40.
11. Randhawa JS, Pujahari AK. Preoperative prediction of difficult lap chole: a scoring method. *Indian J Surg* 2009;71:198-201.
12. Zehetner J, Leidl S, Wuttke ME, et al. Conversion in Laparoscopic Cholecystectomy in Low Versus High-volume Hospitals Is there a Difference? *Surg Laparosc Endosc Percutan Tech* 2010;20:173-6.
13. Hu ASY, Menon R, Gunnarsson R, et al. Risk factors for conversion of laparoscopic cholecystectomy to open surgery - A systematic literature review of 30 studies. *Am J Surg* 2017;214:920-30.
14. Gholipour C, Fakhree MB, Shalchi RA, et al. Prediction of conversion of laparoscopic cholecystectomy to open surgery with artificial neural networks. *BMC Surg*. 2009;9:13.
15. Zhang WJ, Li JM, Wu GZ, et al. Risk factors affecting conversion in patients undergoing laparoscopic cholecystectomy. *ANZ J Surg* 2008;78:973-6.
16. Yajima H, Kanai H, Son K, et al. Reasons and risk factors for intraoperative conversion from laparoscopic to open cholecystectomy. *Surg Today* 2014;44:80-3.
17. Sultan AM, El Nakeeb A, Elshehawy T, et al. Risk factors for conversion during laparoscopic cholecystectomy: retrospective analysis of ten years' experience at a single tertiary referral centre. *Dig Surg*. 2013;30:51-5.
18. Lujan JA, Sanchez-Bueno F, Parrilla P, et al. Laparoscopic vs. open cholecystectomy in patients aged 65 and older. *Surg Laparosc Endosc*. 1998;8:208-10.
19. El-Gendi A, El-Shafei M, Emara D. Emergency Versus Delayed Cholecystectomy After Percutaneous Transhepatic Gallbladder Drainage in Grade II Acute Cholecystitis Patients. *J Gastrointest Surg* 2017;21:284.
20. Lipman JM, Claridge JA, Haridas M, et al. Preoperative findings predict conversion from laparoscopic to open cholecystectomy. *Surgery* 2007;142:556-63.
21. Kaafarani HM, Smith TS, Neumayer L, et al. Trends, outcomes, and predictors of open and conversion to open cholecystectomy in Veterans Health Administration hospitals. *Am J Surg* 2010;200:32-40.
22. Russell JC, Walsh SJ, Fourquet LR, et al. Symptomatic cholelithiasis: a different disease in men? *Ann Surg* 1998;277:195-200
23. Randhawa JS, Pujahari AK. Preoperative prediction of difficult lap chole: a scoring method. *Indian J Surg* 2009;71:198-201.