

# Preoperative Predilection of Conversion to Open in Laparoscopic Cholecystectomy

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## Abstract

**Background:** With the new era of laparoscopic surgery within the last three decades, laparoscopic cholecystectomy emerges as the golden standard treatment for gallbladder disease and cholitiasis; laparoscopic treatment not always seems to be successfully completed laparoscopically. Making attempts for completing the procedure it is laparoscopically is challenging some times and conversion occurs. This study is to discuss the conversion main causes try to detect patients at risk factors for conversion in laparoscopic cholecystectomy. **Objectives:** The aim of the study was to predict which patients are having greatest risk factors for possible conversion to open procedure instead of being completed laparoscopically. **Materials and Methods:** This is a cross-sectional study performed retrospectively from October 2007 to January 2019 to detect the patients at risk factors for conversion in patients who started laparoscopically and convert to open approach occurred started by started via. All the procedures were performed by the same operator team surgeon. Surgery was done at AL-Hilla General Teaching Hospital, AL-Sadeque General Teaching Hospital, and in many private hospitals in Babylon Governance. A routine preoperative history, clinical examinations, and US, EX, and laboratory investigations were done for all patients, while abdominal Computerized Axial Tomography (CAT) scan, endoscopic retrograde cholangiopancreatography, and magnetic resonance cholangiopancreatography were done for selected patients if indicated. Many patients have different associated comorbid diseases. There are no selection criteria as all patients have no contraindications for laparoscopic surgery. **Results:** This study included 344 patients; 62 males (18.0%) and 282 females (82.0%). There are different age groups: the mean age is 42.38 (11–85) years for different gallbladder diseases including calculus cholecystitis, acalculus cholecystitis, microlithiasis, cholecystitis causing biliary pancreatitis, and empyema of gallbladder. Data were analyzed retrospectively as the results of surgical procedures outcome which show that only 11 patients (3.2%) whom underwent conversion from a total of 344 patients of the study. **Conclusion:** There are several factors associated with increased risk of conversion, but this study showed that there is no association with age, diabetes mellitus, and abnormal anatomical variations as risk factor for conversion.

**Keywords:** Laparoscopic cholecystectomy, open cholecystectomy, predictive factors for conversion

## INTRODUCTION

The successful initial attempt of laparoscopic cholecystectomy was announced by Philip Mouret in 1987. A new era of laparoscopic surgery was emerged and revolutionized the scope of surgical endoscopy, and endoscopic surgical interventions using a wide variety of surgical conceptions as well as new technical and strategic procedures were invented and replaced the open surgical concept in many surgical departments. There are preoperative variables and factors that can give signals for risk of conversion in certain patients and cases before surgical procedures conducted. This study will emphasize and discuss these patients' risk factors for conversion.

Laparoscopy was initially practiced by gynecologists, rather than by general surgeons. A German physician and Engineer, Kurt Semm in the 1960s, he treated gynecological cases at the

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University of Kiel by laparoscopy in university hospital.<sup>[1]</sup> He described techniques for ovariectomy, adrenalectomy, and myomectomy.<sup>[1]</sup> At 1982, Semm performed an “endoscopic appendectomy.” The German General Surgeon Erich Mühe, inspired by Semm’s success and became interested in cholecystectomy could be performed laparoscopically. In September 12, 1985, during a planned cholecystectomy, he obtained pneumoperitoneum with a Veress needle and introduced the galloscope at the patient’s umbilicus to dissect the gallbladder. After that, Dr. Mühe performed an early version of LC within 2 h.<sup>[2-4]</sup>

Mühe continued to perform cholecystectomies laparoscopically and found himself amazed with the rapid recovery and enjoyed by those undergoing this new approach alternative to open surgery. To start with, he did his first six laparoscopic cholecystectomies using pneumoperitoneum under optical guidance and the remaining 88 cases using gasless laparoscopy; total 94 cases.<sup>[3,5,6]</sup> He chose the gasless laparoscopy method instead of pneumoperitoneum because it can be done faster and by one incision instead of three to four incisions in the cases of pneumoperitoneum cases.

French Surgeon, Mouret shared his practice with a gynecologist and saw firsthand how laparoscopy improved patient satisfaction and led to increased diagnostic capabilities.<sup>[7]</sup>

In March 1987, Mouret was scheduled to perform “laparoscopy, gynecological adhesion lyses, and cholecystectomy” for a 50-year-old woman with vague abdominal pain.<sup>[8]</sup> This woman requested from Mouret to perform the operations of possible pelvic adhesion lyses and cholecystectomy at the same time, which he agreed to do if possible. During his procedure, Mouret explored gallbladder using laparoscope, for the dissection of gallbladder site. He cauterized the cystic artery and clipped the cystic duct with a clip applier.<sup>[8]</sup> The first laparoscopic cholecystectomy done by Mouret last for 2½ h. He left the case feeling both physically and mentally exhausted as he pondered the “weight of medicolegally of invention instead of doing a classic procedure.”<sup>[8]</sup> Dubois performed his first LC in April 1988.<sup>[7]</sup>

To convert from laparoscopy to open cholecystectomy, many factors were evaluated in variable studies; these factors include age, gender, obesity, previous abdominal surgery, ultrasound finding, of gallbladder wall thickness in fasting state, presence of pericholecystic fluid, chronic cholecystitis, liver function test, and intraoperative finding as bleeding, abnormal anatomy of gallbladder including biliary tree, vascular supply, as well as liver conditions, e.g., organomegaly and liver cirrhosis.<sup>[9,10]</sup>

The aim of this study was to recognize these factors that are associated with the need to convert from laparoscopic to open cholecystectomy, helping the surgeon to discuss the possibility of conversion to patients and to allow more efficient scheduling of surgery.

## MATERIALS AND METHODS

### Study design and patients

This is a cross-sectional study conducted retrospectively as

surgical outcome results to detect the patients risk factors’ for conversion in (344) patients who started laparoscopically and completed after conversion (11 patients) to open approach in patients with laparoscopic cholecystectomy.

This study performed retrospectively for a period from October 2007 to January 2019. All the procedures were performed by the same operator team surgeon. Surgery was done at Al-Hilla General Teaching Hospital, Al-Sadeque General Teaching Hospital, and in many private hospitals in Babylon Governance, Iraq.

A routine preoperative history, clinical examinations and Ultrasound (US) examination done for all patients and patients distribution according to study variable as shown in Tables 1-3. Laboratory investigations were done for all patients, while abdominal CAT scan, endoscopic retrograde cholangiopancreatography (ERCP), and magnetic resonance cholangiopancreatography were done for selected patients if indicated. Many patients have different associated comorbid diseases. There are no selection criteria as all patients have no contraindications for laparoscopic surgery.

### Statistical analysis

Statistical analysis was carried out using SPSS version 21 (SPSS, IBM Company, Chicago, IL 60606, USA). Frequencies and percentages were depended for categorical variables. Continuous variables were given as (means ± standard deviation [SD]). For comparison between the means of the two groups, we used the independent sample *t*-test. Fisher’s exact test was used to find the association between two categorical variables. *P* value was accepted as statistically significant if ≤0.05.

### Ethical consideration

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients’ verbal and analytical approval before the sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee.

## RESULTS

From a total of 344 patients, there 282 females and 62 male with different gallbladder diseases including calculus cholecystitis, acalculus cholecystitis, microlithiasis, gallbladder with microlithiasis causing biliary pancreatitis, and empeyma of gallbladder.

There are only 11 patients (3.2%) in whom conversion occurred from a total of 344 patients as the following findings: males 6 (54%), females 5 (45.5), mean age 49.00 ± 11.76 and body mass index (BMI) was 31.09 ± 2.80 [Tables 3 and 4]. Biliary pancreatitis were found in 4 (36%), abnormal anatomy 3 (27.2), acute cholecystitis 4 (36.4%), bleeding 3 (27.2%), chronic cholecystitis 4 (36.4%), diabetes 4 (36%) [Table 4].

According to the results of this cross-sectional study, risk of conversion was increased in male gender more than in female, as well as increase in patients with acute cholecystitis more

than 72 h, patients with chronic cholecystitis, and patients with increasing age more than 49 years.

Also increase with increase with BMI more than 31.09 as shown in Figure 1 in cases of biliary pancreatitis, as well as cases of, intraoperative bleeding 3 patients out of 11 because of obscure anatomy weather due to adhesions, fibrosus as shown in Figure 2.

Patients with chronic cholecystitis they showed high rate of conversion in this study 4 patients out of 11 patients [Table 4]. Regarding ERCP, it has no significant for risk for conversion as well as patients with DM has no relation for conversion.

## DISCUSSION

The successful initial attempt of laparoscopic cholecystectomy was announced by Philip Mouret in 1987. There was a new era of laparoscopic surgery that changes the scope of surgical procedures and endoscopic surgical interventions using a wide variety of conceptions as well as new technical and strategic equipments. New procedures were emerged There are preoperative variable factors that can give signals for risk of conversion in certain patients and specific cases before surgical procedure being conducted. It should be noted that conversion to open from laparoscopy as a procedure should not be regarded as failure of procedure as the patient safety is the main priority of surgical outcome.<sup>[10]</sup>

In this study, the rate of conversions was 3.2% and a successful completion of the laparoscopic procedure was 96.8%, while many literature shows that there is 2%–15% of patients require conversion to open cholecystectomy and the reasons were mentioned in many literature. These high results of conversions were reported in spite of different operative strategies which were invented. The use of new modalities for safe dissection and mobilization of different surgical organs as: harmonic scalpel knife, electrical cattery, and bipolar hemostatic instruments, e.g., LigaSure.<sup>[9-12]</sup>

Regarding age factor, many studies were found to have statistical significant associations with conversion rate, and others report association only with advanced age group.<sup>[13-18]</sup>

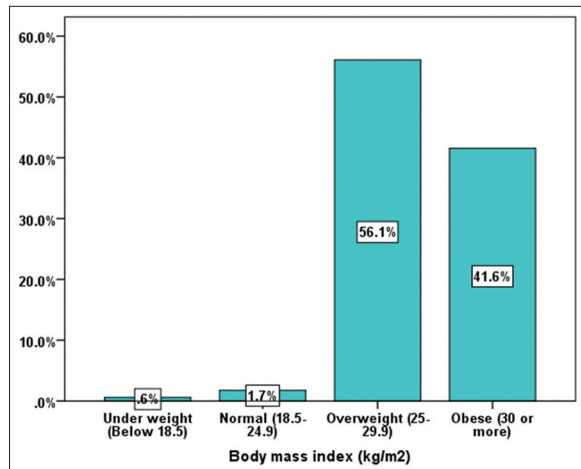


Figure 1: Distribution of patients according body mass index

In this study, we did not report association with age but conversion occurred in some cases, probably due to increasing co morbidity of older patients and systemic complications, so age is an independent risk factor for conversion this finding also same in other published literature.

In the current study, males carry significant risk factor for converting the procedure to open which is comparable with a result of a multicenter of hepatobiliary units, of different nations showed that a same results.<sup>[13]</sup> Of the laparoscopic cases, only 27% are male whereas for open operations, 42% were male. These findings of male sex being identified as a significant risk factor for conversion are consistent with the similar finding from several single institutions<sup>[9,10,16-19]</sup> and also meta-analysis of the literature.<sup>[19]</sup> In this study, we have the same result and statistically approved that male was more common than female in association with converting the procedure to open [Table 4].

Table 1: Patients distribution according to study variables

Study variables	n
Age (years)	42.38±12.03 (11-85)
BMI (kg/m <sup>2</sup> )	28.96±3.07 (15-42)
Gender	
Male	62 (18.0)
Female	282 (82.0)
Total	344 (100.0)

BMI: Body mass index

Table 2: Distribution of patients according to study variables

Study variables	n (%)
Diabetes mellitus	
Yes	81 (23.5)
No	263 (76.5)
Total	344 (100.0)
Biliary pancreatitis	
Yes	34 (9.9)
No	310 (90.1)
Total	344 (100.0)
Abnormal anatomy	
Yes	36 (10.5)
No	308 (89.5)
Total	344 (100.0)
Acute cholecystitis	
Yes	25 (7.3)
No	319 (92.7)
Total	344 (100.0)
Chronic cholecystitis	
Yes	18 (5.2)
No	326 (94.8)
Total	344 (100.0)
Bleeding	
Yes	10 (2.9)
No	334 (97.1)
Total	344 (100.0)

**Table 3: The mean differences of age and body mass index according to outcome**

Study variable	Conversion	n	Mean	SD	t-test	P
Age (years)	Yes	11	49.00	11.76	1.859	0.064
	No	333	42.17	12.00		
BMI (kg/m <sup>2</sup> )	Yes	11	31.09	2.80	2.347	0.019*
	No	333	28.89	3.06		

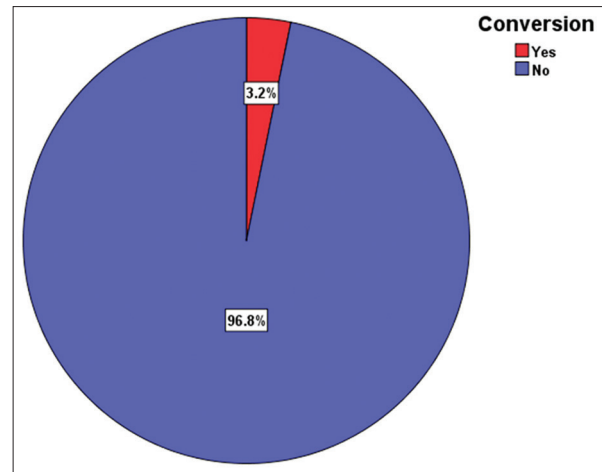
\*P<0.05 was significant. SD: Standard deviation, BMI: Body mass index

**Table 4: Association between outcome and study variables**

Study variables	Conversion		Total	P
	Yes	No		
Gender				
Male	6 (54.5)	56 (16.8)	62 (18.0)	0.006*
Female	5 (45.5)	277 (83.2)	282 (82.0)	
Total	11 (100.0)	333 (100.0)	344 (100.0)	
DM				
Yes	4 (36.4)	77 (23.1)	81 (23.5)	0.295
No	7 (63.6)	256 (76.9)	263 (76.5)	
Total	11 (100.0)	333 (100.0)	344 (100.0)	
Biliary pancreatitis				
Yes	4 (36.4)	30 (9.0)	34 (9.9)	0.016*
No	7 (63.6)	303 (91.0)	310 (91.1)	
Total	11 (100.0)	333 (100.0)	344 (100.0)	
Abnormal anatomy				
Yes	3 (27.2)	33 (9.9)	36 (10.5)	0.097
No	8 (72.8)	300 (90.1)	308 (89.5)	
Total	11 (100.0)	333 (100.0)	344 (100.0)	
Acute cholecystitis				
Yes	4 (36.4)	21 (6.3)	25 (7.3)	0.005*
No	7 (63.6)	312 (93.7)	319 (92.7)	
Total	11 (100.0)	333 (100.0)	344 (100.0)	
Bleeding				
Yes	3 (27.2)	7 (2.1)	10 (2.9)	0.003*
No	8 (72.8)	326 (97.9)	334 (97.1)	
Total	11 (100.0)	333 (100.0)	344 (100.0)	
Chronic cholecystitis				
Yes	4 (36.4)	14 (4.2)	18 (5.2)	0.001*
No	7 (63.6)	319 (95.8)	326 (94.8)	
Total	11 (100.0)	333 (100.0)	344 (100.0)	

\*P<0.05 was significant. Fisher-exact test

One of the main factors for conversion is the gallbladder condition whether acute, chronic, thick wall, associated with jaundice or not, and the complicated cholecystitis. To reach this various parameters, data have been analyzed in different studies include WBC, total serum bilirubin, alkaline phosphates, aspartate transaminase, and alanine transaminase. Leukocytosis is indicative of acute cholecystitis; however, if associated with systemic signs of sepsis, it is indicative of complicated cholecystitis such as empyema, perforation, gangrene while elevated liver enzymes particularly alkaline phosphates are indicative of cholangitis or common bile duct stones and coagulopathy. Which should be corrected whatever the cause being, making surgery possible.



**Figure 2: Distribution of patients according to conversion outcome**

Abdominal US EX had been done in all patients with gall stone disease its reliable, quick, noninvasive tool in diagnosis, but it is highly operator dependence.<sup>[20]</sup> It may give clue and may predict the degree of difficulty that may involve during the procedure. The finding of maximal wall thickness of >4.0 mm in fasting state may indicate fibrotic or contracted gallbladder which is difficult to be grasped during laparoscopy surgery.<sup>[21]</sup>

A meta-analysis study of diagnostic characteristics of US published in 1994 revealed sensitivity and specificity of 94% and 78% respectively.<sup>[19]</sup>

There are little data available to assess diagnosis of acute cholecystitis in chronic cholecystitis as diagnostic value for the severity of inflammation; US signs of severity of inflammation including Murphy's sign, pericholecystic fluid, gallbladder wall thickness, and gallbladder distention<sup>[22,23]</sup> in spite of that the ability of prediction of difficulty of surgery by US remain limited.<sup>[24]</sup> The finding of air within the wall, or air within intraluminal of GB, marked irregularity of the wall of GB are specific features of gangrenous GB; these findings may also be seen in severe cases of disease without gangrene.<sup>[25,26]</sup>

In most of the studies one of the predictors for conversion is acute cholecystitis if presentation more than 3–4 and 5 days the Golden period for cholecystectomy is first 72 hours of condition as well as the sonographic finding: of the wall thickness more than 3 mm in fasting state, presence of pericholecystic fluid in acute cholecystitis.<sup>[27]</sup> In our study there is increased risk of conversion in acute and chronic cholecystitis, and that compatible with other published studies all over the world.<sup>[22-24]</sup>

Procedure of palmers point entry in patients with previous abdominal surgery and suspected adhesions post biliary pancreatitis, to avoid bowel injury that necessitate conversion due to first port entry injuries.<sup>[28]</sup> In our study, there was no port site entry injury to the bowel or other intra-abdominal structures including cases with palmars point entry all passed successfully.

Regarding obesity as a risk factor for conversion, it is estimated in many literature that obese patient is difficult to perform surgery, but there is no increase in rate of conversion<sup>[29]</sup> while in our study, there was a significance risk for conversion due to obesity, BMI more than 31.09 SD 2.80 associated with conversion from laparoscopy to open.

Other operative finding, e.g., if there is no progression of the procedure for more than 20–30 min from the start of dissection in the Calot's triangle and if the procedure is extended for more than 2 h, the risk of perioperative complications is 4 times more than if the surgery completed within 30 to 60 minutes.<sup>[12]</sup>

In laparoscopic cholecystectomies, morbidity and mortality rates are similar to open surgery. However, the rate of bile duct injuries and leaks is higher in laparoscopic approach than in open cholecystectomy.<sup>[21]</sup>

Regarding anomalies of biliary tree or vascular anomalies e.g., caterpillars' of right hepatic artery, short multiple cystic arteries, aberrant cystic artery anterior cystic artery, as well as anomalies of biliary tree configuration, site of final insertion of cystic duct or aberrant right hepatic duct as well as choledocho-cholecystic duct communication, duct of Lushka, intrahepatic gallbladder these are operative finding and rarely can be anticipated preoperatively This area regarded as the most common wide anatomical variations in the GIT configurations whether biliary or vascular variations.<sup>[30]</sup> Abnormal anatomy found in 3 cases out of 11 converted cases but careful dissection and proper selection of intervention time enable completing surgery laproscopically although. Results showed no significant effect as a cause per see for conversion (significant  $P \leq 0.05$ ) [Table 4].

Bleeding considered as a risk factor for conversion occurred mainly due to dense adhesions and fibrosis causing difficult dissection to clear view identification and clearance of cystic duct and obtain critical view of safety uncontrolled bleeding happed with injury to unexpected vessel which can not be controlled safely laproscopically.

In this study, bleeding reported in 3 cases out of the 11 cases of conversion [Table 4], which necessitate conversion but no major biliary tree or major vascular injury was occurred as well as neither morbidity after long follow-up nore mortality.

The critical view of safety was declared as the golden standard practice to see the liver bed through a window performed within Calot's Triangle.<sup>[30,31]</sup>

Regarding biliary pancreatitis, high complication and mortality rates after early cholecystectomy in patients with severe pancreatitis have prompted guidelines recommending delaying cholecystectomy until all signs of inflammation have resolved (i.e., interval cholecystectomy).<sup>[32-34]</sup> Patients with mild biliary pancreatitis early cholecystectomy is advised; these are the current guidelines.<sup>[35-37]</sup>

The British Society of Gastroenterology recommend cholecystectomy within 2 weeks after discharge;

Gastroenterological Association recommend that all patients with mild biliary pancreatitis should undergo cholecystectomy as soon as the patient has recovered from the attack (337).<sup>[36]</sup> In daily practice, cholecystectomy after mild biliary pancreatitis is often postponed for several weeks after hospital discharge (interval around 6 weeks after discharge from hospital admission for mild biliary pancreatitis).<sup>[38]</sup>

A danger of perioperative complications in early cholecystectomy after acute pancreatitis is a reason for the delay in cholecystectomy.<sup>[39]</sup> It is believed that distorted biliary tract anatomy by inflammation and edema may complicate dissection with a higher risk of conversion and surgical complications, such as bile duct injury.<sup>[32,40]</sup>

According to the guidelines, laparoscopic cholecystectomy were done to those patients with history of biliary pancreatitis if they were being clinically and supported by laboratory investigation that pancreatitis was resolved and even that selection were practiced conversion still occurred due to: dense adhesions, cannot visualize proper anatomy and bleeding occurred in 4 patient out of 11 conversion total patient and these goes with same finding similar with other studies all over the ward.<sup>[32,40]</sup>

## CONCLUSION

There are several factors that will increase risk of conversion. Male Gender, presence of acute cholecystitis more than >4–5 days, biliary pancreatitis, BMI more than 31.09, certain US finding (wall thickness more than 3 mm pericholecystic shown by ultrasound examination). No progression of dissection of Calot's triangle intraoperative uncontrolled bleeding which cannot be managed laproscopically, chronic cholecystitis, but study showed there is no association with: diabetes mellitus, as well as abnormal anatomical variations as risk for conversion.

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## Conflicts of interest

There are no conflicts of interest.

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