SCIENTIFIC PAPER JSLS

Factors Influencing the Successful Completion of Laparoscopic Cholecystectomy

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ABSTRACT

Objective: To analyze the preoperative factors contributing to the decision to convert laparoscopic to open cholecystectomy.

Methods: Retrospective identification of 324 consecutive patients undergoing laparoscopic cholecystectomy, with univariate and multivariate analysis of the following parameters: age, gender, obesity, previous abdominal surgery, presentation with acute cholecystitis, pancreatitis or obstructive jaundice, gallbladder wall thickening, gallbladder or common bile duct stones.

Results: Thirty-nine patients (12%) underwent conversion to open cholecystectomy. Patients aged over 65 years were four times more likely to require conversion than patients under 50 years of age. Under 50 years of age, males had equal conversion rates to females, and above this age there was a non-significant increased conversion rate in males. Obese patients had higher conversion rates than non-obese patients (23% versus 9%, $P < 0.003$). Thirty-eight percent of patients with choledocholithiasis required conversion. Age, acute cholecystitis and choledocholithiasis independently predicted conversion. A patient aged less than fifty years with neither acute cholecystitis nor choledocholithiasis had a conversion rate of just 2%, while almost 60% of those over 65 years of age with acute cholecystitis or choledocholithiasis required conversion.

Conclusion: The parameters of age, acute cholecystitis and choledocholithiasis must be considered in the clinical decision making process when planning laparoscopic cholecystectomy.

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DOI: 10.4293/108680809X1258998404560

Key Words: Laparoscopic cholecystectomy, Conversion, Risk factors, Multivariate analysis.

INTRODUCTION

Since Philippe Mouret[1] performed the first laparoscopic cholecystectomy in 1987, it has become the first-line approach to gallbladder disease. The advantages of the laparoscopic procedure include minimal scarring and short postoperative recovery. However, a proportion of cases will require conversion to an open laparotomy. It is important to identify patients at higher risk of conversion preoperatively to allow appropriate patient counseling and planning of resources. Previous studies have identified parameters such as advancing age, male sex, acute cholecystitis, and others, as independent risk factors for conversion **(Table 1)**.[2–6] However, there is no consensus in the results, and some studies have reported on the risk of conversion in institutions that have a high rate of planned open cholecystectomy. Thus, the cohort undergoing laparoscopic cholecystectomy is already highly selected.

The goal of this study was to analyze the factors contributing to the decision to convert from laparoscopic to open cholecystectomy in a less selected population. The analysis was confined to those factors that were available preoperatively, because these data guide the decision to proceed with a laparoscopic or open approach.

METHODS

All patients undergoing cholecystectomy in Mallow General Hospital from January 2004 through December 2006 were retrospectively identified from the hospital's operative records. Data were retrieved by detailed review of the hospital case notes, including radiographic imaging and operative course. The following preoperative parameters were recorded: age, sex, obesity, previous abdominal surgery, presentation with acute cholecystitis, pancreatitis or obstructive jaundice, ultrasonography detection of gallbladder wall thicken-

Table 1.
Studies Reporting Multivariate Analysis of Risk Factors for Conversion From Laparoscopic to Open Cholecystectomy

Author, Year	Risk Factor					
	Age	Obesity	Male	AC*	Previous Surgery	Thick GB* Wall
Rosen, 2002[2]	No	Yes	No	No	No	Yes
Tayeb, 2005[3]	Yes	No	No	No	No	Yes
Brodsky, 2000[4]†	Yes	No	Yes	No	No	No
Kama, 2001[5]	Yes	No	Yes	Yes	Yes (upper)	Yes
Lipman, 2007[6]	No	No	Yes	Yes	No	No
Chandio, 2009[7]‡	Yes	No	No	Yes	No‡	No

*AC = acute cholecystitis; GB = gallbladder.

†All cases had acute cholecystitis.

‡5% of patients with previous surgery had elective open cholecystectomy.

ing or gallbladder stones, and the presence of common bile duct (CBD) stones. We defined a thickened gallbladder wall as being ≥3mm in thickness in the fasting state.

All patients scheduled for elective cholecystectomy were admitted the day before the procedure and underwent preoperative blood testing and ultrasound of the biliary tract. At the time of this study, interval laparoscopic cholecystectomy was performed 3 weeks to 4 weeks after the patient presented with acute cholecystitis. Patients with choledocholithiasis had magnetic resonance cholangiopancreatography or endoscopic retrograde cholangiopancreatography (ERCP) performed and underwent preoperative endoscopic sphincterotomy (ES). The majority of operations were performed by consultant surgeons with a minimum of 10 years experience in performing laparoscopic cholecystectomy, via a standard 4-port method, achieving pneumoperitoneum using the Veress/Hasson technique for carbon dioxide insufflation.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 17). Mean values were compared using the Student *t* test. Univariate analysis of categorical variables was performed by the chi-square test. Factors that differed between the converted and nonconverted groups with a probability of <0.25 were entered as variables into a multiple logistic regression model, and retained if the probability value was <0.05.

RESULTS

During this period, 335 patients underwent cholecystectomy. The female to male ratio was 5:2 (245 versus 90), and the mean patient age was 51 years (range, 15 to 90).

Elective open cholecystectomy was performed in 11 patients (3%). These patients had a higher mean age (63 years) than the general laparoscopic cholecystectomy cohort had. Five of these patients had undergone previous upper and lower abdominal surgery, one had a known perforated gallbladder, and 2 had failed extraction of CBD stones by ES. The remainder required other abdominal surgery. Thus, 324 patients were scheduled for laparoscopic cholecystectomy. Of this cohort, 39 patients (12%) underwent conversion to open cholecystectomy.

Factors Associated with Conversion

As expected, conversion rates rose with age **(Table 2)**. Patients aged ≥65 years were 4 times more likely to require conversion than patients <50 years of age. A trend was noted towards a higher proportion of male patients requiring conversion than female patients [17% versus 10%, P=not significant **(Table 3)**]. However, in those <50 years, males had equal conversion rates to those of females. Of note, males >50 years were more obese than females were (42% vs 16%, P<0.003). Obese patients had higher conversion rates than nonobese patients had (23% versus 9%, P<0.003).

This difference held true in either sex at any age but was

Table 2.
The Influence of Age on the Risk of Conversion From Laparoscopic to Open Cholecystectomy

Age (Years)	Number of Cases	Percentage Converted
<35	67	4.5
35–49	151	6
50–64	92	16
65–74	48	19
≥75	33	21

most marked in women 50 years to 65 years of age (3-fold increase in odds ratio of conversion), and men >65 years (5-fold increase in odds ratio of conversion). Thus, older male obesity may explain some of the trend towards higher conversion rates in older males.

A clinical diagnosis of acute cholecystitis had been made in more than twice as many converted as nonconverted cases **(Table 3)**. Almost 60% of those >65 years of age with clinical features of acute cholecystitis required conversion **(Table 4)**. Clinical presentation with pancreatitis, cholangitis, and obstructive jaundice was also more common in converted cases. Of the total cholecystectomy cohort, 9 patients had previous upper *and* lower abdominal surgery. Of these, 5 had elective open cholecystectomy. All 4 who had attempted laparoscopic cholecystectomy required conversion. A history of previous upper *or* lower abdominal surgery also predisposed to conversion **(Table 3)**. Of the total cholecystectomy cohort, 32 (9.5%) had known CBD stones. Eleven of these patients were treated by elective open cholecystectomy, while 21 had attempted laparoscopic cholecystectomy following ERCP, with a 38% conversion rate. Converted patients had gallbladder stones identified on preoperative ultrasound more often than nonconverted patients had ($P<0.0001$). There was a trend for more converted patients than nonconverted patients to have a thickened gallbladder wall.

Multivariate Analysis

Age, sex, acute cholecystitis, biliary colic, gallbladder wall thickening, cholelithiasis, obesity, previous surgery, and chololithiasis were entered as variables into a multiple logistic regression model **(Table 5)**. Only age, acute cholecystitis, and choledocholithiasis were independently associated with conversion. Obesity was not an independent predictor of conversion in this study, because obese patients more often presented with acute cholecystitis than nonobese patients did ($P<0.002$).

Intraoperative Indications for Conversion

The most common reason for conversion was a diseased gallbladder. This included inability to define anatomy in 14 patients, a contracted or fibrotic gallbladder with foreshortening of the cystic duct, and dense adhesions of the gallbladder to either the duodenum or the CBD. Eight patients had gallbladder empyema or gangrene, and all were converted to an open procedure. In 3 patients, intraoperative cholangiography revealed large CBD stones, which were thought to be difficult to treat by postoperative ES. These patients underwent conversion to open CBD exploration with placement of a T-tube. One patient had an incidental gallbladder tumor, leading to conversion for staging purposes. Laparotomy was required for the management of intraoperative complications in 6 patients, injuries being as follows: cystic duct injury, bile duct injury (major), breach of small bowel mesentery, perforated jejunum, perforated gallbladder, and bleeding. All injuries were diagnosed intraoperatively and had a satisfactory clinical outcome.

Table 3.
Comparison of Preoperative Clinical Parameters Between Laparoscopic Cholecystectomy Cases That Required Conversion and Those That Were Successful

Clinical Parameter	Converted (N = 39)	Successful (N = 285)	P Value
Mean age	61	49	<0.0002
Obesity	16 (41%)	55 (19%)	<0.003
Acute cholecystitis	26 (67%)	84 (29%)	<0.0001
Previous abdominal surgery	13 (33%)	41 (14%)	<0.003
Gallbladder stones	35 (90%)	154 (54%)	<0.0001
Common bile duct stones	8 (21%)	13 (5%)	<0.001

Table 4.
Interplay of Age, Acute Cholecystitis, and Choledocholithiasis in Predicting Conversion From Laparoscopic to Open Cholecystectomy

Clinical Parameter*	Number of Patients	Percentage Converted
Age <50 years, no AC or CBD stones	94	2
Age 50 and AC	54	39
Age 50 and CBD stone	17	41
Age 65 and AC	19	58
Age 65 and CBD stone	9	56

*AC = acute cholecystitis; CBD = common bile duct.

Table 5.
Multivariate Analysis of the Risk Factors for Conversion From Laparoscopic to Open Cholecystectomy

Clinical Parameter	Beta Value	P Value
Age	0.21	<0.0002
Acute cholecystitis	0.19	<0.003
Choledocholithiasis	0.15	<0.005
Obesity	0.12	<0.08
Previous abdominal surgery	0.04	<0.5
Biliary colic	0.05	<0.43
Male sex	0.04	<0.5
Gallbladder stones	0.03	<0.57
Thick gallbladder wall	0.05	<0.4

DISCUSSION

Laparoscopic cholecystectomy is considered the treatment of choice for gallbladder disease. It confers definite advantages over the open procedure. Conversion of a laparoscopic cholecystectomy to an open procedure does not indicate failure but can have implications for resource management and patient satisfaction. Thus, preoperative identification of those at higher than normal risk of conversion is important.

Our conversion rate of 12% lies within the reported range of 3% to 14%.[2,3,6–11] It reflects our low rate of elective open cholecystectomy (at just 3%, versus the 25% reported in a nationwide US study),[9] and the high prevalence of acute cholecystitis (34%) in our cohort. If a patient was <50 years old and had neither acute cholecystitis nor choledocholithiasis, the conversion rate was just 2%. Our practice of attempting laparoscopic cholecystectomy in most cases means that the laparoscopic cohort, unlike other studies, is not highly selected.

Previous studies have reported that age >60 years,[3–5] or 65 years,[12] is an independent risk factor for conversion. We found the greatest increment in the rate of conversion to be at 50 years of age. We didn't find a large increase in conversion rates above the age of 75, unlike Bratzler et al,[13] who found the rate of conversion to be twice as high in those ≥75 years old than those 65 years to 74 years of age. Of note, our rate of planned open cholecystectomy was not higher in patients aged 75 years and older (in fact, no patient in this age group had a planned open procedure). However, it is possible that older, frailer patients were managed conservatively if their preoperative risk of conversion was considered very high, because they would not tolerate the metabolic challenges of a lengthy operation. This would then artificially lower the conversion rate in the oldest cohort.

Some previous studies have reported that obesity is an independent risk factor for conversion from laparoscopic to open cholecystectomy,[2,12,14] but others have not found this.[5,6,15] In our study, it was found that obese patients had much higher conversion rates than nonobese patients had, particularly in older and male patients. However, obesity was not an independent predictor of conversion, because obese patients were more likely to have presented with acute cholecystitis.

Previous abdominal surgery has been reported as an independent risk factor for conversion.[5] However, many patients with previous extensive abdominal surgery will not have attempted laparoscopic cholecystectomy in the first place, so studies reporting on the effects of previous surgery may have limited the effect of such surgery. We attempted laparoscopic cholecystectomy in 95% of patients with previous abdominal surgery. This included 4 patients with previous extensive abdominal surgery, with all 4 requiring conversion. We also found that any previous abdominal surgery predisposed to conversion, al-

though this was not an independent risk factor for conversion and may be confounded by age.

The role of male sex in predisposing to conversion is controversial. Only 2 studies have found it to independently predict conversion.[5,6] In our study, a minor sex difference was only apparent over the age of 50, and this difference may reflect the fact that males >50 were greatly more often obese than females were. Similarly, Botaitis et al[16] reported that male patients had more severe cholecystitis than female patients had.

In this study, clinical acute cholecystitis predisposed to conversion independently of other risk factors. This is a well-recognized predictor of conversion.[5,6,12,14,15] The challenge is to reliably identify acute cholecystitis clinically, because studies have shown that there is a poor correlation between the clinical and pathologic diagnosis of acute cholecystitis.[6] We similarly found that the histological diagnosis of acute cholecystitis was made in only 27% of those with clinical acute cholecystitis (and 4% of those without clinical cholecystitis), but this may reflect the policy of interval cholecystectomy. Of note, the conversion rate was 10-fold higher in those with a histological diagnosis of acute cholecystitis. Surrogate markers of AC include pericholecystic free fluid, and gallbladder wall thickening. Many studies have found gallbladder wall thickening to be an independent risk factor for conversion.[2,3,5,15] We found only a trend towards more thickening of the gallbladder in converted patients in this study, but it was a retrospective study based on review of previous ultrasound reports rather than specific scrutiny of films for markers of inflammation. The second issue in laparoscopic cholecystectomy for acute cholecystitis is the timing of surgery. We performed interval cholecystectomy at the time of this study, but recent literature suggests that prompt laparoscopic cholecystectomy in the acute phase does not have higher conversion rates than interval surgery.[17–22]

Previous studies have not reported choledocholithiasis to be a risk factor for conversion, but this may be because such cases have had elective open cholecystectomy. We found that 38% of patients with choledocholithiasis required conversion and that choledocholithiasis was an independent risk factor for conversion. Sarli et al[23] reported a conversion rate of 8.3% for choledocholithiasis treated by ERCP and interval laparoscopic cholecystectomy. Some groups advocate laparoscopic CBD exploration,[24] or intraoperative combined laparoscopic/endoscopic removal of CBD stones,[25] rather than preoperative ES.

CONCLUSION

Thus to summarize, this study found that advanced age, presentation with acute cholecystitis, and choledocholithiasis are independent risk factors for conversion from laparoscopic to open cholecystectomy. Only 2% of those <50 years of age with neither acute cholecystitis nor choledocholithiasis required conversion. In contrast, almost 60% of those >65 years of age who had a clinical presentation suggesting acute cholecystitis or with choledocholithiasis required conversion. Thus, these 3 factors should inform the clinical decision-making process when planning laparoscopic cholecystectomy and when counseling patients preoperatively.

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