**Predictive Factors Influencing Conversion to Open Surgery in Patients Undergoing Laparoscopic Cholecystectomy For Chronic Calcular Cholecycystitis**

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**Abstract:**

With decreased postoperative pain, earlier oral intake, shorter hospital stay, early resumption of normal activity and improved cosmesis, laparoscopic cholecystectomy (LC) has become a routine surgical procedure in general surgical units for cholelithiasis all over the world. But, substantial proportions of patients in whom LC cannot be successfully carried out are converted to open cholecystectomy (OC) because of technical difficulty or intraoperative complications. The aim of this study was to define the incidence & predictive factors of conversion to open surgery in patients who will undergo a laparoscopic cholecystectomy.

 In the period of January 2011 to October 2011 Laparoscopic cholecystectomy was attempted in 150 patients suffering from symptomatic cholelithiasis. A retrospective analysis of parameters, including patient demographics, laboratory values, radiologic data, and intraoperative findings, was performed. Univariate and multivariate analysis was done to determine those variables predicting conversion. Twelve (8.0%) patients required a conversion. Significant predictors of conversion to open cholecystectomy in univariate analysis were increasing age, male gender, previous upper abdominal or upper and lower abdominal incisions, an elevated white blood cell count, preoperative ultrasound findings of a thickened gallbladder wall >4mm, preoperative endoscopic retrograde cholangiopancreatography (ERCP), high-grade adhesion, and thickened wall of the gallbladder intraoperatively. Multivariate analysis revealed that the significantly independent predictive factors for conversion were age, male gender, total leucocytic count, gallbladder wall thickening reported by the radiologist and adhesion score.

**KEY WORDS:** predictive factors, laparoscopic Cholecystectomy, conversion

**Introduction**

Laparoscopic cholecystectomy has become a routine surgical approach due to decreased postoperative pain, earlier oral intake, shorter hospital stay, early resumption of normal activity and improved cosmesis, (LC). Substantial proportions of patients in whom LC cannot be successfully carried out are converted to open cholecystectomy (OC) because of technical difficulty or intraoperative complications. ***[1]***

Conversion to open surgery may be required during the attempted LC due to inflammation and fibrosis of Calot’s triangle, unclear anatomy, uncontrollable bleeding, and bile duct injury. Conversion is not a complication, but a means of preventing more serious problems ***.[2]***

As experience has been accumulated over time, several other reliable risk factors have been identified to increase the likelihood of conversion. These risk factors can predict the possibility of certain difficulties or conversion in a particular patient, thereby allowing for appropriate planning and management. They should not be considered as a contraindication to laparoscopic cholecystectomy, but they should draw the attention and patience of the laparoscopic surgical team .***[3]***

The importance of factors predisposing to conversion from laparoscopic to open cholecystectomy has been emphasized in numerous studies, Many of these studies showed that acute cholecystitis is one of the most important risk factors for conversion. By excluding the patients with acute cholecystitis, perioperative factors affecting conversion has not previously been evaluated sufficiently in patients who had undergone elective LC for chronic longstanding cholecystitis. A determination of preoperative factors affecting conversion in patients who undergo elective LC for cholelithiasis may give valuable ideas to operating surgeons about patient selection and, according to intraoperative findings, whether the procedure can be completed laparoscopically or not***.[4]***

Determining variables associated with the risk of conversion would be useful for evaluating patients preoperatively, thus avoiding wasteful laparoscopic attempts by proceeding directly to an open operation. Unfortunately, the reported factors indicating a risk for conversion from laparoscopic to open cholecystectomy have been inconsistent. ***[5]***

Identification of the preoperative parameters that are risk factors for possible conversion would be useful for both patients and surgeons. With the availability of such information, patients can be counseled and are able to make the necessary arrangements for their recuperation. The surgeons can better plan their operating schedules***. [6]***

 **Aim of the work**

The objective of this study is to define the incidence & predictive factors of conversion to open surgery in patients who will undergo a laparoscopic cholecystectomy for chronic calcular cholecystitis.

**Patients and methods**

***Patients and data collection***

Laparoscopic cholecystectomy was attempted in 150 patients suffering from symptomatic cholelithiasis (e.g., one or moreepisodes of colicky pain, epigastric discomfort, nausea, vomiting), done in the period between Jan 2011 to Oct 2011.Exclusion criteria included Patients having acute cholecystitis (if seen 48 hours after the onset of symptoms), gallbladder cancer, or lost data for multivariate analysis.

The incidence of conversion to open cholecystectomy was recorded. Patients who were subjected to conversion were analysed according to the data which was collected prospectively & a detailed tabulation was developed to record information on pre- and intraoperative factors.

Preoperative factors included age, gender, body mass index (BMI), previous abdominal surgery, history of acute cholecystitis, associated medical risk factors (i.e., diabetes mellitus, hypertension, cardiovascular disease, etc.), preoperative measurement of white blood cell (WBC) count and liver function tests, preoperative ultrasound evidence of gallbladder wall thickening, number of gallstones, and preoperative endoscopic retrograde cholangiopancreatography (ERCP).

Data was collected on intraoperative variables include adhesion score of the gallbladder and time of conversion (early or late conversion). Reasons for conversions and any intraoperative complications were recorded for each patient during the procedure. All data was collected prospectively and was analysed retrospectively.

**Results**

 In the period from January 2011 to October 2011 Laparoscopic cholecystectomy was attempted in 150 patients suffering from symptomatic cholelithiasis. Of the 150 patients in this series, 105 were women (70%) and 45 were men (30 %); the mean age of the patients who had successful LC was 53±9.7 years. The mean age of the patients who needed conversion was 62.5±6.8 years; those who needed a conversion were significantly older (**P<0.01**).

Of the 150 included patients, 128 (85.3%) were operated on electively while 22 patients (14.6%) had emergency surgery. Of the elective cases the number of converted patients was 5/128(4%), meanwhile the number of converted cases from patients underwent emergency cholecystectomy was 7/22(31.8%), 5 of which had acute cholecystitis & the remaining 2 patients underwent early LC who had choledocholithiasis and had stones removed during ERCP again it’s statistically significant **p<0.01**.

LC was successfully completed in 138 patients (92%), whereas a conversion to open surgery was required in 12 patients (8.0%). This was more common with advanced age and in males. The reasons for a conversion to open cholecystectomy are summarized in Table 1.

**Table1**. Reasons for Conversion to Open Cholecystectomy

|  |  |
| --- | --- |
| Reasons for Conversion | Conversion(n=12)(8%) |
| 1. Intra-abdominal or perihepatic dense adhesions
 | 5(41.6%) |
| 1. Inability to define anatomy of Calot’s triangle
 | 3(25%) |
| 1. Bleeding
 | 2(16.6%) |
| 1. Injury to the biliary tract
 | 1(8.3%) |
| 1. Bowel injury
 | 1(8.3%) |
|  |  |

Early conversion to open procedure was adopted in “difficult” cases to prevent severe complications. Median length of time for taking this decision was 15 (10–20) min. The mean duration of operation for patients who had successful LC was 50.9±9.1 minutes and that for those who had a conversion to open cholecystectomy was 99±16.7 minutes. Again, this was statistically significant (**P<0.01**). The mean length of stay for patients who had LC was 2.9±5 days and that for patients who had a conversion to open surgery was 6.3±1.2 days. This difference between the two groups was statistically significant (**P=0.02**). There were 17/150 (11.3%) cases of acute cholecystitis, 5 of which underwent conversion to open surgery n:5/17 (29.4%), 2 cases were gangrenous cholecystitis, one case was mucocele of gallbladder, and 2 cases were empyema of the gallbladder. The conversion rate was considerably higher in patients with acute cholecystitis n:5/17(29.4%) than in patients with chronic cholecystitis n:7/133(5.2%). This difference is considered to be statistically significant **p=0.05**.

 Laparotomy was required in 3 patients due to inability to define anatomy of Calot’s triangle.

 Management of intraoperative complications required conversion in 4 patients. In 2 of these patients, the complication was bleeding. One patient bled from the liver bed, one from the right hepatic artery. All bleeding was successfully controlled with laparotomy.

 Major bile duct injury was confirmed in one patient. Strasberg type D injury was detected and repaired by primary suture alone. Bowel injury occurred in one patient & a primary repair was done.

Regarding patients who have co-morbidity, the number of co-morbid patients underwent successful LC are 24/138(17.3%) and who had conversion are: 4/12 (33.3%), the percentage is higher in the converted group but still it does not reach the level of significance p=0.23.

Univariate analysis of the pre- and intraoperative data for statistical significance for conversion is shown in Table (5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Criteria** | **Completed successfully (n=138) N (%)** | **Converted patients (n=12)****N (%)** | **P-value** |
| **Gender** | MaleFemale | 38(27.5)100(72.4) | 7(58.3)5(41.6) | **0.04** |
| **Age (years)** | ≤5050.1–64.9≥65 | 49(35.5)70(50.7)19(13.7) | 1(8.3)6(50)5(41.6) | **0.02** |
| **BMI (kg/m2)** | ≤2525.1–30≥30.1 | 25(18.1)103(74.6)10(7.2) | 010(83.3)2(16.6) | 0.17 |
| **Comorbidity** | YesNO | 24(17.3)114(82.6) | 4(33.3)8(66.6) | 0.23 |
| **Previous abdominal incision** | UpperLowerUpper + Lower | 3(2)25(18)3(2) | 3(25)1(8.3)2(16.6) | **<0.01** |
| **WBC count (mL)** | ≤11,000>11,000 | 124(89.8)14(10.1) | 7(58.3)5(41.6) | **<0.01** |
| **AST (IU/L)** | ≤50>50 | 127(92)11(8) | 9(75)3(25) | 0.09 |
| **ALT (IU/L)** | ≤50>50 | 134(97)4(3) | 11(91.6)1(8.3) | 0.34 |
| **ALP (IU/L)** | ≤200>200 | 132(95.6)6(4.4) | 10(83)2(17) | 0.12 |
| **Total bilirubin (mg/dL)** | ≤1.2>1.2 | 134(97)4(3) | 10(83)2(17) | 0.07 |
| **Wall thickness (mm)** | ≤4>4 | 130(94)8(6) | 5(41.6)7(58.3) | **<0.01** |
| **Number of stones** | SingleMultiple | 43(31.1)95(68.8)  | 4(33.3)8(66.6) | 1.0 |
| **Preoperative ERCP** | YesNo | 11(8)127(92) | 4(33.3)8(66.6) | **0.02** |
| **Gallbladder adhesion score** | Grade 1Grade 2Grade 3Grade 4 | 122(88.4)12(8.7)4(2.8)0 | 3(25)2(16.6)4(33.3)3(25) | **<0.01** |
| **Gallbladder appearance** | NormalHydropicThick wallFriable wallBuried | 113(81.8)8(5.7)8(5.7)4(2.8)5(3.6) | 3(25)3(25)4(33.3)2(16.6)0 | **<0.01** |

For multivariate analysis, variables with significant associations confirmed in univariate analysis were introduced into a forward selective set of logistic regression models predicting each outcome separately, it showed that the significantly independent predictive factors for conversion were age, male gender, total leucocytic count, gallbladder wall thickening reported by the radiologist and adhesion score. The risk for conversion was increased 3.8-fold in patients aged ≥65, males had the risk of conversion increased by 5.5 times. On the other hand, the risk for conversion was increased 4.4-fold for patients with leucocytosis, also it’s increased 10.8-fold if the GB wall thickness is more than 4mm and in patients with adhesion score 4 have the greatest risk, 23-fold than patients with no adhesions at all.

There were, not surprisingly, more complications in the converted group as compared with those who had successful LC.

 Eleven patients n: 11/150 (7.3%) had general complications such as wound infection (4 patients), and intra-abdominal collections (2 patients) of which a male who had a perihepatic rim of hyperechoic shadow not increasing in size that didn’t require reopening and a female who had an accidental bile duct injury discovered post-operatively, underwent hepaticojejunostomy Roux-en-Y and she recovered smoothly.

**Discussion**

Laparoscopic cholecystectomy has been well received by surgeons and patients since its introduction in 1985, ***[7]*** due to its perceived lower incidence of post-operative pain, morbidity and shorter length of hospital stay. Surgical trainees in the westernized world are taught LC earlier and practice LC more often compared to open cholecystectomy ***.[8]***

However, the incidence of bile duct injury remained higher in LC compared to open cholecystectomy***.[9]*** It is important to realize that the need for conversion to laparotomy is neither a failure nor a complication, but an attempt to avoid complication and ensure patient safety. ***[10]***

The presented rate of LC requiring conversion to open surgery in this study is 8 percent, this is comparable with other studies which reported conversion rates between 4.8 and 8%***.[11]*** For elective LC, a conversion rate of 2-15% has been reported ***[12]***, to which our own figure of n:5/128(4%) is comparable. In the setting of acute gallbladder disease, conversion rates from 5.6 to 32% have been reported ***[13]*** and our own figure compares well n: 5/17 (29.4%).

Currently, there are many studies investigating factors affecting conversion during LC in the medical literature. Ercan et al (2010) found that a history of previous upper abdominal or upper plus lower abdominal surgery, preoperative ERCP, high-grade adhesion, and scleroatrophic gallbladder were independent risk factors of conversion to open surgery. Age, male gender, hypertension, preoperative albumin, low hematocrit (<38%), leucocytosis, hyponatremia, elevated INR, and emergency status of procedure were independent predictors of a decision to convert from LC to OC (all *P* <0.01). ***[14]***

Older patients are probably at a greater risk of conversion due to recurrent attacks of cholecystitis and complicated biliary tract disease, which has previously been shown by several studies ***.[15]***

 The difference between males and females in relation to the disease processes, and male gender as risk factor for the outcome from surgery for gallstone disease has been a particular topic of interest. Several authors have reported that males were significantly older and had a more delayed presentation of symptomatic cholelithiasis. ***[16]***

 This point is further supported by the findings of Yol who observed that the inflammatory processes and fibrosis in acute cholecystitis was more severe in male patients .***[17]*** As for the results from LC, male gender has been shown by several other authors to be associated with adverse outcomes***.[6 ,11, 18]*** Our own findings showed that male patients have longer operating time than female patients (57±20.8 vs 53.8±14) and length of hospital stay(3±1.5 vs 3.3±5.7), increased incidence of conversion{7/45(15.5%) vs 5/105(4.7%)} and morbidity{13/45(28.8%) vs 15/105(14.2%)} that concur with the previous studies, also the effect of male gender was significant predictor for conversion when other factors were adjusted for in multivariate analysis.

In the setting of acute gallbladder disease, conversion rates from 5.6 to 32% have been reported ***[13]*** and our own figure compares well n: 5/17 (29.4%),2 of them were gangrenous, 2 were pyocele & one mucocele. The consequence of each of them is a formation of dense chronic adhesions, especially in the region of Calot’s triangle, which make the blunt dissection difficult and unsafe. These changes influence the conversion and complication rates to a great degree. Several studies have showed that the conversion to open cholecystectomy could be minimised by doing a subtotal or partial cholecystectomy. ***[2]***

 In this study the rate of conversion in emergency cases was higher than that in elective cases {7/22 (31.8%) vs 5/128(4%)} with a **p value <0.01.**

 In this study, the incidence of post-operative complications (intra-abdominal collections, wound infections, etc.) was also significantly increased for patients who underwent emergency LC. N:5/22(22.7%) vs the incidence of complications in patients underwent elective surgery n:6/128(4.6%) with a **p value=0.01** Furthermore, both operative time and the post-operative length of stay were longer for acute LC (62.1±28 vs 53.8±14.1 and 4±1.6 vs 3.1±5.1 respectively). The increased incidence of morbidity should not preclude the use of early LC for acute gallbladder disease, as this has been shown to be safer than delayed surgery in a recent Cochrane review***.[19]***

In this study, there’s a higher incidence of conversion in patients with a history of ERCP due to choledocholithiasis against those who didn’t do ERCP in their life {4/15 (26.6%) vs 8/135 (6%)} and this is statistically significant **p=0.02.** Sarli et al. reported a conversion rate of 8.3%, when ERCP had been performed previously and a conversion rate of 3.4% after standard LC. ***[20]*** Similarly, Ammori et al. showed that previous ERCP predicted a more difficult cholecystectomy. ***[21]***

Our findings of higher conversion rates among the upper incision group n:3/6(50%) and the upper plus lower group n:2/5(40%) compared with the lower incision group n:1/26(3.8%) and a rate of n:6/113(5.3%) among those who had not previously undergone surgery is slightly higher than the findings reported by Karayiannakis et al, .***[22]*** In their study, which included a total of 1638 patients who underwent laparoscopic cholecystectomy, patients with previous upper abdominal operations had a conversion rate of 19%, compared with a rate of 3.3% among patients with previous lower abdominal operations (McBurney incisions excluded), and a rate of 5.4% among patients who had no history of previous abdominal operations. These rates are consistent with the conversion rates of approximately 5% which have been found in several other series. ***[8,15]***

In this study, it was found that a thickened GB wall is associated with the highest conversion rates n:4/12(33.3%) followed by the hydropic GB n:3/12 (25%) then lastly the friable wall 2/12(16.6%) & we found normal GB in 3 converted cases. This is statistically significant in comparison with those who didn’t need conversion **p<0.01.**

Intra-abdominal adhesion scores were assigned according to criteria similar to those defined by (Blauer and Collins , 1988)***[23]:*** **grade 1**, no adhesion; **grade 2**, flimsy adhesions, which allows for easy dissection; **grade 3**, chronic pericholecystitis and pericholecystic fibrosis, which makes dissection difficult, but allows for visualization of the anatomy; and **grade 4**, thickened gallbladder wall and anatomic distortion due to intense adhesions around the gallbladder with the duodenum and colon, which do not permit a safe dissection.

In this study, it’s clear that conversion rates are higher in patients with grade 3 & grade 4 adhesions. Grade 2 adhesions are found in 14 patients, 2 of which underwent conversion (14.2%), grade 3 adhesions are found in 8 patients, 4 of which underwent conversion (50%), all patients with grade 4 (3 patients) necessitate conversion to open surgery (100%) and This is a statistically significant **p<0.01.** Also the effect of adhesion score was significant when other factors were adjusted for in multivariate analysis.

Cucinotta et al. found that LC is safe in patients with cirrhosis, ***[24].*** We found no difficulties in carrying out LC in 4 of our patients with cirrhosis, with one patient converted to open surgery due to incontrollable bleeding from the liver bed.

 The final multivariate model demonstrated that advanced age (>65 years), male gender, high-grade adhesion (grade 4), leucocytosis and USG evidence of thickened GB wall >4mm were independently associated with conversion.

 In this study we analyzed what pre- and perioperative factors affect conversion in patients who underwent LC whether it’s elective for chronic calcular cholecystitis or emergency surgery for acute cholecystitis. The main reasons for the conversion were intra-abdominal or perihepatic dense adhesions leading to difficulty in the exposure and dissection of Calot’s triangle (5 cases), inability to identify a clear anatomy due to inflammation obscuring the operative field (3 cases). The other important reasons for the conversion was intraoperative complications, Uncontrollable bleeding (2 cases), one case of bile duct injury & one case of bowel injury.

***Conclusion***

 Elderly, male gender, leucocytosis, a history of previous upper abdominal surgery, preoperative ERCP, USC evidence of thickened GB wall >4mm, high-grade adhesion, and thickened wall of the gallbladder intraoperatively were predictive factors of conversion to open surgery. LC was successfully completed in 138 patients (92%), whereas a conversion to open surgery was required in 12 patients (8.0%). Patient selection is very important for efficient, safe training in LC. Pathways could be suggested, enabling the surgeon to precisely decide during LC when to convert to open surgery.

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