

# CONVERSION TO OPEN CHOLECYSTECTOMY - A SAFE ALTERNATIVE, NOT A FAILURE!

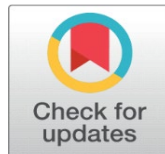
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## ABSTRACT

**Background:** Understanding factors that predict conversion in laparoscopic cholecystectomy (LC) to an open procedure is important as it allows better patient selection, preparation, operating list planning, referral, counseling and lowers the threshold for a safe conversion, thereby minimizing undue prolongation of attempts at laparoscopic completion and inadvertent complications.

**Methods:** Records of 1010 consecutive patients who were taken up for LC, at a tertiary care teaching institute in northern India, were reviewed retrospectively. Preoperative and intraoperative characteristics of patients who underwent a successful LC were compared with those who required conversion to open surgery.

**Results:** The conversion rate was 7.5% (76 patients). The most common reason for conversion was the inability to define the 'Critical view of safety' in 48, (63%) of patients. Other reasons included dense peri-cholecystic 9 (12%) and intra-abdominal 8 (11%) adhesions, suspicion of bile duct injury 4 (5%) or malignancy 3 (4%). Prior upper abdominal surgery, intraoperative finding of a contracted and thick-walled gallbladder (GB), empyema GB, Mirizzi's syndrome, cholecysto-enteric fistula, and a prior endoscopic common bile duct stone clearance were significant predictors of conversion. Xanthogranulomatous cholecystitis was found more commonly (43% vs 5%) in the conversion group.

**Conclusion:** Conversion to an open procedure during LC should always be treated as an integral component of sound judgement to achieve the safest outcome in a particular patient. Due consideration of pre-operative and intra-operative factors predictive of a higher chance of conversion assists pre-operative patient preparation and counseling as well as surgical planning, conduct and mentoring of residents-in-training.

**Keywords:** Cholecystectomy, Cholelithiasis, Gall Bladder, Laparoscopic Cholecystectomy



## 1. INTRODUCTION

Laparoscopic cholecystectomy (LC) is an established gold standard treatment for symptomatic gallstone disease. Experience gained over the last three decades has broadened its clinical utility to acute inflammatory states; e.g., acute cholecystitis, empyema as well as cholecysto-enteric fistula. However, despite the vast experience gained, in a subset of patients a decision to convert this procedure to an open cholecystectomy needs to be considered for various reasons like failure to identify the anatomy in the hepato-cystic triangle, bile duct injury, intraoperative bleeding and suspicion of malignancy. Understanding the factors that predict a higher possibility of a difficult LC leading to a probable conversion to an open procedure is important as it allows better patient selection and preoperative counseling. It also helps in better preparation, from a training point of view, posting the anticipated difficult LC for more experienced surgeons and, lowering the threshold for a safe conversion to prevent and also manage inadvertent complications which may have significant associated morbidity.

## 2. MATERIALS AND METHODS

Records of 1017 patients who were taken up for LC for gall stone disease over a two-year period, in the Department of Surgical Gastroenterology, were retrieved from a prospectively maintained database and reviewed retrospectively. Three patients who underwent LC for gall bladder (GB) polyps and four patients who needed conversion for associated laparoscopic procedures (splenectomy, cystogastrostomy) were excluded from the analysis.

A total of 1010 patients were divided into two groups, one which underwent a successful LC and the other which required conversion to open surgery (CONV). As a policy, patients with acute cholecystitis undergo an elective LC in our department, 4-6 weeks after initial conservative management. Most of the patients with common bile duct (CBD) stones undergo an endoscopic clearance before surgery and the patients in whom endoscopic therapy fails, most often undergo an open procedure in our department. Some selected patients do undergo laparoscopic CBD exploration, and these were also included in the study. Patients with asymmetric GB wall thickening on preoperative imaging, which raises a suspicion of malignancy, undergo an open procedure as a policy. This is because of the very high (one of the highest in the world) incidence of gallbladder cancer in the area [Dutta et al. \(2019\)](#).

Preoperative details including patient demographics, comorbid illnesses, prior abdominal surgeries, clinical presentation, duration of symptoms, the preoperative requirement of common bile duct stone clearance with endoscopic retrograde cholangiography (ERC), and preoperative findings of ultrasound (US) abdomen were recorded (as a policy, thick wall is defined as  $\geq 4\text{mm}$  by our sonologists). Intraoperative variables recorded included the gross appearance of GB (distended/contracted), wall thickness (thin/thick), operative diagnosis, and surgery performed. The conversion rate to open surgery was calculated and the reasons for conversions analyzed. The reports of histopathology of both groups were noted. Major postoperative complications requiring invasive interventions/readmissions were recorded.

### • Operative Technique

All surgical procedures were performed either by consultant surgeons or by residents-in-training under the direct supervision of consultants. For the creation of pneumoperitoneum, either Veress needle or open technique (Hasson's method) was

used depending on surgeon preference. After Infra-umbilical, 12mm, port placement, rest of the ports - (12mm epigastric; 5mm midclavicular line; and 5mm anterior axillary line) were placed under vision. Intra-abdominal pressure was kept between 12-15mm Hg. The 'Critical view of safety' as defined by [Strasberg et al. \(1995\)](#) was delineated before clipping structures in the hepatocystic triangle. Monopolar diathermy was used for hemostasis and GB detachment. Harmonic scalpel (Ethicon Endo-Surgery, Cincinnati, OH) was used selectively. The specimen was delivered through epigastric port. Abdominal drains were used selectively. The decision to convert was done after the assessment by a consultant. A right subcostal incision was used for open cholecystectomy.

### • Statistical Analysis

Statistical analysis was performed using SPSS (SPSS 21.0 for Windows; SPSS, Chicago, IL, USA). Continuous variables were expressed as mean  $\pm$  standard deviation and median for variables with normal and non-normal distribution respectively. Categorical variables were expressed as frequencies. For univariate analysis,  $\chi^2$  test or Fisher's exact test was used as appropriate for qualitative data and Student's t-test for quantitative data with normal distribution and Mann-Whitney U test for data without normal distribution. Binary logistic regression method was used for multivariate analysis.  $P < 0.05$  was considered statistically significant.

## 3. RESULTS

There were 1010 patients in whom LC was attempted. There were 373 males and 637 females. The median age was 46 years with an age range of 16 to 90 years. The mean age of the patients who underwent a successful LC was  $45.8 \pm 13.8$  years, whereas that of the patients in the conversion group was  $51.5 \pm 13.3$  years. Other demographic and preoperative characteristics of both groups are shown in [Table 1](#). LC was completed successfully in 934 patients and conversion was required in 76 patients (Conversion rate - 7.52%). The reasons for conversion are summarized in [Table 2](#).

**Table 1**

<b>Table 1 Preoperative Characteristics</b>			
<b>Variables</b>	<b>LC (n = 934)</b>	<b>CONV (n = 76)</b>	<b>P-value*</b>
Age $\geq$ 65 years, n (%)	97 (10.4)	15 (19.7)	<b>0.013</b>
Sex, n (%)			<b>0.000</b>
Male	330 (35.3)	43 (56.6)	
Female	604 (64.7)	33 (43.4)	
Presence of HTN, n (%)	232 (24.8)	27 (35.5)	0.06
Presence of DM, n (%)	158 (16.9)	18 (23.7)	0.16
Presence of cardiac disease, n (%)	69 (7.4)	8 (10.5)	0.36
Presence of COPD, n (%)	35 (3.7)	7 (9.2)	<b>0.04</b>
Presence of CLD, n (%)	13 (1.4)	4 (5.3)	<b>0.04</b>
History of resolved acute cholecystitis, n (%)	80 (8.6)	16 (21.1)	<b>0.002</b>
History of acute pancreatitis (moderate/severe), n (%)	44 (4.7)	5 (6.6)	0.47
Preoperative ERC $\pm$ stenting, n (%)	98 (10.5)	29 (38.2)	<b>0.000</b>
Duration of preoperative symptoms in days (median)	210	240	0.67
Days between ERC and surgery (median)	55	52	0.53
History of prior lower abdominal surgery, n (%)	249 (26.7)	13 (17.1)	0.07

History of prior upper abdominal surgery, <i>n</i> (%)	28 (3.0)	10 (13.2)	<b>0.000</b>
US Findings, <i>n</i> (%)			
Contracted GB	75 (8.0)	47 (61.8)	<b>0.000</b>
Thick walled GB	232 (24.8)	59 (77.6)	<b>0.000</b>
Residual GB	5 (0.5)	4 (5.3)	<b>0.002</b>

\* Significant value is mentioned in bold; CLD, Chronic liver disease; CONV, Conversion to open cholecystectomy; COPD, Chronic obstructive pulmonary disease; DM, Diabetes mellitus; ERC, Endoscopic retrograde cholangiography; GB, Gall bladder; HTN, Hypertension; LC, Laparoscopic cholecystectomy; US, Ultrasound

**Table 2**

Table 2 Reasons for Conversion to Open Cholecystectomy in 76 Patients	
Reason for conversion	<i>n</i> (%)
Conversion 'By Choice'	
Inability to define the CVS because of	48 (63)
Unclear anatomy at Calot's triangle	24 (32)
Frozen Calot's triangle	18 (24)
Mirizzi's syndrome	06 (8)
Dense peri-cholecystic adhesions	09 (12)
Dense intra-abdominal adhesions	08 (11)
Suspicion of malignancy	03 (4)
Contracted GB with cirrhotic liver	01 (1)
Failure to retrieve CBD stones	01 (1)
Conversion 'Perforce'	
Suspicion of bile duct injury	04 (5)
Uncontrollable hemorrhage	01 (1)
Failure to tolerate pneumoperitoneum	01 (1)

CBD, Common bile duct; CVS, Critical view of safety; GB, Gall bladder

The most common reason for conversion was the inability to define the 'Critical view of safety' for various documented reasons, which lead to conversion in almost two-thirds of patients. The rest of the reasons documented were severe peri-cholecystic adhesions/inflammation, dense intra-abdominal adhesions predominantly due to prior upper abdominal surgeries. Conversion due to suspicion of bile duct injury was required in four patients. Only one out of these 4 patients actually had a CBD injury (lateral injury) which was repaired over a T - tube. One patient had uncontrolled bleeding from the cystic artery which was managed after conversion. In an elderly patient with coronary artery disease who had a thick and contracted GB the procedure had to be converted to an open cholecystectomy because the patient could not tolerate prolonged pneumoperitoneum.

On univariate analysis, the preoperative characteristics which were significantly associated with conversion were age  $\geq 65$  years, male gender, presence of chronic obstructive pulmonary disease (COPD) and chronic liver disease (CLD), history of resolved acute cholecystitis, history of CBD stones requiring endoscopic clearance  $\pm$  stenting, history of upper abdominal surgery, ultrasound finding of a thick or contracted GB or a residual GB. Univariate analysis of intraoperative findings as recorded in Table 3, showed a significant association between conversion and thick or contracted GB, a diagnosis of Mirizzi's syndrome, cholecysto-enteric fistula, empyema GB or a previous GB perforation. No patients with mucocele GB (*n* = 29) required conversion. On analysis of histopathology of

both groups, it was noticed that a significant proportion of patients in the conversion group (33 patients, 43%) had xanthogranulomatous cholecystitis (XGC), a variant of chronic cholecystitis commonly found in northern India, which is often associated with the presence of a thick-walled GB and intense peri-cholecystic inflammation. In contrast, the number of patients with XGC in the LC group was only 45 (5%).

**Table 3**

<b>Table 3 Operative Characteristics</b>			
<b>Intraoperative variables</b>	<b>LC (n = 934)</b>	<b>CONV (n = 76)</b>	<b>P-value*</b>
Contracted GB, n (%)	70 (7.5)	52 (68.4)	<b>0.000</b>
Thickened GB wall, n (%)	233 (24.9)	67 (88.2)	<b>0.000</b>
Empyema GB, n (%)	36 (3.9)	13 (17.1)	<b>0.000</b>
Mirizzi's Syndrome, n (%)	0 (0)	10 (13.1)	<b>0.000</b>
Cholecysto-enteric fistula, n (%)	4 (0.4)	12 (15.8)	<b>0.000</b>
Previous GB perforation, n (%)	4 (0.4)	3 (3.9)	<b>0.01</b>

\*Significant value is mentioned in bold; CONV, Conversion to open cholecystectomy; GB, Gall bladder; LC, Laparoscopic cholecystectomy

In the multivariate analysis using binary logistic regression, factors that were independently predictive of conversion to open cholecystectomy were, history of prior upper abdomen surgery, history of CBD stones requiring endoscopic clearance  $\pm$  stenting, and intraoperative findings of a thickened and contracted GB, presence of cholecysto-enteric fistula and empyema GB. The Odds ratios of these variables with 95% confidence intervals are shown in Table 4. Since Mirizzi's syndrome was 100% predictive of a conversion (zero variance) in univariate analysis, it was not included in the multivariate analysis.

**Table 4**

<b>Table 4 Binary Logistic Regression Model for Risk Factors for Conversion to Open Cholecystectomy</b>			
<b>Variable</b>	<b>Odds Ratio (OR)</b>	<b>95% Confidence Interval for OR</b>	<b>P-value</b>
History of prior upper abdominal surgery	15.51	3.96, 60.65	0.000
Pre-operative ERC	2.08	1.03, 4.23	0.042
<b>Intraoperative Findings</b>			
Contracted GB	8.47	2.62, 27.36	0.000
Thickened GB wall	5.50	1.59, 18.97	0.007
Empyema GB	5.52	2.15, 14.16	0.000
Cholecysto-enteric fistula	5.31	1.51, 18.71	0.009

ERC, Endoscopic Retrograde Cholangiography; GB, Gall bladder

There was no 30-day mortality in either group. There were two bile duct injuries, both of which were detected and managed appropriately during surgery. One of the injuries was sustained during laparoscopic dissection in a case with frozen Calot's triangle, in which there was a lateral CBD wall injury, for which open conversion and repair over T - tube was done. Another injury (type D) was sustained after conversion to open cholecystectomy with a 'fundus first' approach in a case of empyema GB with frozen Calot's triangle. Repair with Roux - en - Y hepaticojejunostomy was done in this case.

The rest of the morbidities requiring invasive intervention are shown in [Table 5](#). In all the patients with bile leak, surgical drains were in situ which were kept in anticipation during surgery due to a difficult cystic duct/ GB stump. Only two patients required endoscopic therapy to hasten closure of the leak. One of the patients with Mirizzi's syndrome type 2 (Csendes classification) [Beltran et al. \(2008\)](#), in whom primary closure of CBD was done over stents placed preoperatively, developed biliary stricture which was managed successfully with endoscopic dilatation.

**Table 5****Table 5 Major Morbidities Requiring Intervention**

Morbidity	Total morbidity		Morbidity requiring intervention		Intervention
	LC (n = 934)	CONV (n = 76)	LC (n = 934)	CONV (n = 76)	
Bowel injury, n (%)	1 (0.11)	1 (1.32)	1 (0.11)	0 (0)	Laparotomy + loop ileostomy
Reactionary bleed, n (%)	2 (0.21)	1 (1.32)	1 (0.11)	1 (1.32)	Laparotomy
Bile leak, n (%)	4 (0.43)	3 (3.95)	1 (0.11)	1 (1.32)	ERC + stenting
Subhepatic abscess, n (%)	2 (0.21)	0 (0)	1 (0.11)	0 (0)	Percutaneous drainage
Port site abscess, n (%)	NA	NA	1 (0.11)	0 (0)	Debridement under anesthesia
Biliary Stricture, n (%)	0 (0)	1 (1.32)	0 (0)	1 (1.32)	Endoscopic dilatation

CONV, Conversion to open cholecystectomy; ERC, Endoscopic retrograde cholangiography; LC, Laparoscopic cholecystectomy; NA, Not Available

#### 4. DISCUSSION

Laparoscopic cholecystectomy is associated with a significantly shorter hospital stay and a shorter convalescence compared with classical open cholecystectomy and is the preferred modality of treating gallstones all over the world [Keus et al. \(2010\)](#).

Bile duct injuries (BDI), however, are more frequent during LC (0.4-0.6%) than during open cholecystectomy (0.1-0.2%) [Kapoor \(2020\)](#); they are also, usually, more complex in being more proximal and closer to the biliary confluence and are more often associated with vascular injuries [Chaudhary et al. \(2001\)](#) and can happen even in the hands of experienced and well-trained surgeons [Kapoor \(2020\)](#). The occurrence of a BDI with or without a vascular injury, can lead to severe morbidity as well as mortality, in addition to increasing the economic burden for the patient as well as the health care system. Though most of the cholecystectomies may be straightforward (and well within the surgical range of a trainee surgeon), a certain subset of difficult cholecystectomies can challenge even the most experienced surgeon. It is important to be aware of this wide range of complexity in cholecystectomy and a knowledge of pre-operative and intra-operative harbingers of "difficult" cholecystectomy is paramount for a safe cholecystectomy. Even though the increasing technical expertise over the last two decades has led to a decreasing trend in the rate of conversion to open cholecystectomy, converting to an open procedure is one of the "safe bail out" techniques that may be required, and should be resorted to, in an individual patient [Gupta & Jain \(2019\)](#).

The rate of conversion in recent large series comprising of diverse indications for cholecystectomy has been in the range of 1.03 – 15.2% [Ambe et al. \(2016\)](#), [Al Masri et al. \(2018\)](#), [Sutcliffe et al. \(2016\)](#), [Ballal et al. \(2009\)](#), reflecting, probably,



the wide spectrum of gallstone disease and variable percentage of a subset of patients with gallstones in whom the severity and/or duration of inflammation and the subsequent alteration of anatomy precludes a safe LC. The conversion rate in the current study was 7.52% which was within the range documented in the literature. Since the experience comes from a surgical gastroenterology unit in a tertiary care referral and teaching center there may be a higher proportion of complicated gallstone disease - reflecting the referral bias.

Many studies have documented various reasons for conversion of LC to an open procedure, which include male gender, old age, acute cholecystitis, emergency admission, severity of the disease, difficulties in the Calot's triangle, intra-abdominal adhesions, thickened GB wall, and a history of upper abdominal surgery [Al Masri et al. \(2018\)](#), [Sutcliffe et al. \(2016\)](#), [Ballal et al. \(2009\)](#), [Philip Rothman et al. \(2016\)](#). In an earlier publication from the department, we had suggested classifying conversions into conversions 'by choice' and conversions 'perforce' to differentiate conversions by choice in face of difficult anatomy/pathology from conversions following a complication [Kapoor et al. \(1995\)](#).

In our study, the predominant factor leading to conversion was the inability to define the 'Critical view of safety' in 48 (63%) patients due to unclear anatomy, inflammation, and fibrosis of Calot's triangle or the presence of Mirizzi's syndrome. Long-standing inflammation of the GB leads to fibrosis of its wall and of peri-cholecystic tissues, and sometimes to fistulization of the wall of GB into the adjacent bile duct or hollow viscus - a situation where attempts to remove the GB in toto would certainly injure the bile duct.

Mirizzi's syndrome is typically associated with an obliterated Calot's triangle anatomy and is historically best managed with an open procedure. Many of these patients require a sub-total cholecystectomy, cholecystocholedochoplasty, or even Roux-en-Y hepaticojejunostomy which may be difficult laparoscopically. More recently, reports of laparoscopic management of this condition are available, albeit with a high conversion rate [Chen et al. \(2018\)](#). In our series, all the patients with Mirizzi's syndrome underwent a conversion [5 out of these 10 patients underwent a subtotal cholecystectomy (The additional procedures along with cholecystectomy which the patients in this group underwent are - CBD Exploration + Primary repair of fistula - 1, cholecystocholedochoplasty - 1, Colonic + CBD fistula repair - 1, Roux-en-Y hepaticojejunostomy - 1)]. The presence of cholecysto-enteric fistula similar to Mirizzi's syndrome may be associated with a difficulty in the delineation of Calot's triangle anatomy, making a laparoscopic approach challenging. However, with increasing surgical expertise and instrumentation, a safe cholecystectomy may be performed, especially in high volume centers [Chowbey et al. \(2006\)](#). In this study, laparoscopic cholecystectomy was completed successfully in 4 out of 16 patients (25%) with cholecysto-enteric fistulae.

Acute cholecystitis also leads to inflammatory edema of the tissues in Calot's triangle, especially when patients present later than 48-72 hours of onset. This study does not include patients with acute cholecystitis managed with early cholecystectomy, however, 50 patients were found to have an empyema of the GB at a delayed elective surgery with peri-cholecystic acute inflammatory changes. 13 (26%) of these patients did require conversion. Other studies also document a higher conversion rate in empyema GB [Ambe et al. \(2016\)](#), [Malik et al. \(2007\)](#). Elective LC can be performed in a previously conservatively managed GB perforation due to acute cholecystitis, however, there is a higher likelihood of conversion due to dense peri-cholecystic adhesions. Current evidence suggests that a delayed LC can be performed in these patients with an acceptable conversion rate

[Lo et al. \(2012\)](#). There were seven patients of GB perforations (Neimeier's Type I and II) [Niemeier \(1934\)](#) in this study, who were managed conservatively initially (1 patient in each group underwent a percutaneous cholecystostomy). Three of these patients required conversion (43%). The conversion rate, however, was not statistically significant, most likely due to a small sample size.

A thick-walled and contracted GB is known to predict difficulty in LC [Sutcliffe et al. \(2016\)](#), [Philip Rothman et al. \(2016\)](#), [Ercan et al. \(2010\)](#). The GB wall is difficult to hold and the sclerotic tissues around it make makes the dissection of the hepatocystic triangle difficult. Apart from acute cholecystitis, a thickened GB wall is seen in long-standing gall stone disease, malignancy, and a particular type of GB wall inflammation called xanthogranulomatous cholecystitis (XGC). XGC is much more common in India than the rest of the world [Hale et al. \(2014\)](#). There was an incidence of 7.7% of XGC in this study and a significantly higher percentage - 43% (33 patients) of these underwent a conversion. A conversion of 16 - 53% has been reported in other series [Qasaimeh et al. \(2015\)](#). This high incidence of XGC could also explain the relatively higher conversion rate seen in this study.

Prior open upper abdominal surgery is reported to be associated with prolonged operative time, increased length of stay, and overall complications during a subsequent laparoscopic surgery [Seetahal et al. \(2015\)](#). Prior studies have demonstrated a significantly higher LC conversion rate in this group of patients [Al Masri et al. \(2018\)](#), [Ercan et al. \(2010\)](#) as seen in this study.

History of CBD stones removed endoscopically was significantly associated with an increased chance of conversion in our study, which has been shown in other studies as well [Ercan et al. \(2010\)](#), [Friis et al. \(2018\)](#). Repeated passage of gall stones into bile duct via cystic duct may induce inflammation and thus fibrosis in the Calot's triangle. Moreover, many patients also undergo simultaneous CBD stenting which may predispose to repeated attacks of cholecystitis if cholecystectomy is delayed and stents may induce significant peri-choledochal inflammation. An increase in the time duration between undergoing endoscopic stone clearance and surgery has been associated with the risk of conversion, with a 14% conversion rate when cholecystectomy was delayed more than 6 weeks [Friis et al. \(2018\)](#). A total of 127 patients (13%) underwent ERC and stone clearance before surgery in this series and the median number of days between ERC and surgery was 54 days. This also might have contributed to the relatively increased conversion rate noted in the current study.

This study also showed that a prior history of acute biliary pancreatitis (moderately severe/ severe; as per Atlanta classification) [Banks et al. \(2013\)](#) does not increase the incidence of conversion, as shown in previous studies [Sutcliffe et al. \(2016\)](#).

Residual GB after prior subtotal cholecystectomy can be managed laparoscopically [Chowbey et al. \(2015\)](#), however, it needs technical expertise. The present study showed an insignificantly increased conversion rate in patients with residual GB.

A few other variables that have been reported to be predictive of increased rate of conversion in cholecystectomy include male sex, elderly age [Al Masri et al. \(2018\)](#), [Sutcliffe et al. \(2016\)](#), [Ballal et al. \(2009\)](#), [Philip Rothman et al. \(2016\)](#), chronic liver disease [Puggioni & Wong \(2003\)](#), and chronic obstructive pulmonary disease [Al Masri et al. \(2018\)](#). In this study, these variables were not found significant in the multivariate analysis.

The rate of biliary injury in this series was 0.2% which compares favorably with that reported in several large series, 0.08 - 0.5% [Halbert et al. \(2016\)](#), [Barrett et al.](#)



(2018), Fong et al. (2018), Kohn et al. (2018), and partially reflects our low threshold for conversion (choose to convert before you are forced to convert!). Conversion to an open procedure, in a difficult cholecystectomy, however, should not be considered a panacea, especially in the context of biliary injury. This is exemplified in our series in which one of the patients sustained a major bile duct injury even after conversion, while the performance of a 'fundus first' cholecystectomy in an inflamed and frozen triangle of Calot. Such an approach, which is often used by surgeons, has been reported to cause 'extreme' vasculo-biliary injury Strasberg & Gouma (2012). In the future, this may become even more relevant because surgeons in the laparoscopic era are likely to be less experienced in the conduct of open cholecystectomy than LC, and conversion is usually done in presence of difficult anatomy when technical expertise and judgement are required for doing an open cholecystectomy safely.

Another factor that has been shown to increase the morbidity of LC is prolonged surgery (>2 hours) Sutcliffe et al. (2016), Zdichavsky et al. (2012). Persisting in the laparoscopic approach, disregarding the lack of clarity at the CVS, especially by a surgeon untrained in advanced laparoscopic skills, is associated with an increased rate of complications in LC. A quick decision is warranted in this scenario to seek help from an experienced surgeon or conversion to an open procedure for its safe completion.

Assessment of these significant variables during the evaluation of a patient requiring LC and a subsequent emphasis at the time of surgery is paramount in promoting the "Culture of Safety in Cholecystectomy" (COSIC) philosophy, especially during surgical training Strasberg (2013). Conversion, however, in these difficult circumstances, is not a bailout procedure in isolation. It is safe and effective only when accompanied with other tenets referred to as "ABCD of safe LC", thus, preventing the hazardous biliary/vascular injuries, which sometimes, can complicate LC Gupta & Jain (2019). The aim should always be a safe procedure rather than the completion of LC at all costs. In this study, 28% (21 patients) of patients in the CONV group underwent a subtotal cholecystectomy even after an open conversion.

The type of gall bladder disease seen in northern Indian territory, especially in a tertiary care center, probably is different from that seen elsewhere, with a particularly higher incidence of XGC and carcinoma GB. The current study, being a relatively large series from a northern Indian tertiary referral center, signifies its role in understanding the spectrum of patients undergoing LC. The relatively high conversion rate in this study might be explained by the quantum of complicated GB disease seen at our center exemplified by a high incidence of, elderly population, patients needing LC >6 weeks after ERC, and patients with XGC.

There are certain limitations to the study. This is a retrospective study which makes it at high risk for a lack of appropriate data of all the variables assessed. However, the data was retrieved from a prospectively maintained database, and only the variables whose data was maintained upfront were assessed. The study does not assess acute cholecystitis as a variable, which has been shown as an important predictor of conversion Sutcliffe et al. (2016), Ballal et al. (2009), Philip Rothman et al. (2016).

## 5. CONCLUSION

A subset of patients undergoing LC, are likely to require conversion to an open procedure for the safe completion of cholecystectomy. Factors that should forewarn

the operating surgeon of a higher likelihood of an open conversion include a history of upper abdominal surgery, a thickened and contracted GB, cholecysto-enteric fistula, empyema GB, Mirizzi's syndrome and a prior history of CBD stones clearance through ERC. The presence of these should be taken into consideration during pre-operative patient counseling, pre-operative preparation (including the allocation of an experienced surgeon) as well as during surgery. Conversion to an open procedure during LC should neither be considered a failure nor a complication, rather it should always be treated as an integral component of sound judgement and a safety bailout measure to achieve the safest outcome in a particular patient.

## CONFLICT OF INTERESTS

None.

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None.

## REFERENCES

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