

DETERMINANTS THAT PREDISPOSE TO CONVERSION OF LAPAROSCOPIC CHOLECYSTECTOMY TO OPEN CHOLECYSTECTOMY IN A TERTIARY HEALTH-CARE CENTER IN INDIA

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ABSTRACT

Objectives: The aim of this study was to analyze the patient and disease-related factors of gallstone disease and also to identify pre-operative clinical, laboratory, and ultrasonic predictors that predispose to conversion of laparoscopic to open cholecystectomy.

Methods: The study was prospectively conducted over 1-year duration in a tertiary care center in India. Demographic, hematological, and radiological data were recorded for all participants and compared to assess predictors of conversion from laparoscopic to open cholecystectomy.

Results: A total of 526 patients participated in the study. Thirty-two cases were converted to open with 6.08% conversion rate. The common intraoperative causes of conversion were frozen Calot's triangle, dense adhesions, and empyema gallbladder. The significant predictors of conversion were found to be a previous episode of acute cholecystitis ($p=0.003$), previous upper abdominal surgery ($p=0.001$), total leukocyte count ($p=0.012$) with neutrophils ($p=0.005$), gallbladder wall thickness >5 mm ($p=0.0082$), and presence of pericholecystic fluid ($p=0.0184$).

Conclusion: The above-mentioned determinants can be used to predict the chances of conversion in a patient planned for laparoscopic cholecystectomy so that the patient can be counseled regarding the risk of conversion and informed consent can be obtained, and the surgical team can be adequately prepared.

Keywords: Acute cholecystitis, Complicated gallbladder, Laparoscopic cholecystectomy, Open cholecystectomy, Calot's triangle, Ultrasound abdomen.

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INTRODUCTION

Gallstone diseases represent a significant health problem in India and the world over. Many cases are asymptomatic, but the complications can be life-threatening. Surgery in the form of cholecystectomy is the treatment of choice in most patients, with 92.5% of symptomatic and 76.6% of asymptomatic patients undergoing cholecystectomy within 1 year of diagnosis [1]. With the advent of laparoscopic surgical techniques, the management of gallstone diseases has altered completely and laparoscopic cholecystectomy has become the gold standard operation for both symptomatic and asymptomatic cholelithiasis, and other benign pathologies of the gallbladder [2]. Laparoscopic cholecystectomy has significant advantages over open surgery, being a minimally invasive technique with enhanced recovery, shorter duration of hospital stays, reduced post-operative pain, better cosmetic results, and earlier return to normal activities and work [3]. However, even with these above-mentioned advantages, about 5–10% of cases require a conversion of laparoscopic to open procedure [4]. The often attributed disease-related intraoperative causes for conversion are Inflammation (35%), adhesions (28%), and anatomic difficulty (22%) which are secondary to acute or chronic inflammation [5]. Other less common causes for conversion include intraperitoneal bleeding, suspected common bile duct injury, anatomic variations, inability to insufflate pneumoperitoneum, injury to other organs, and equipment failure [6]. There are certain parts of the surgery where the decision to convert to open is frequently made, depending on the anatomic parts explored and the extent of the disease process. The most common conversion points are (i) after visualization of the peritoneal cavity but before dissection of the cystic structures; (ii) after dissection of

the cystic structures; and (iii) after initial laparoscopy [7]. Certain pre-operative determinants can be used to predict the conversion of planned laparoscopic procedure into an open operation. These include clinical factors such as age, male gender, previous upper abdominal or upper plus lower abdominal incisions, diabetes mellitus, and laboratory values such as an elevated white blood cells with high neutrophil count, elevated liver function tests such as high aspartate transaminase, alkaline phosphatase, and total bilirubin levels [8]. Preoperatively, an ultrasound of the abdomen reveals many findings such as pericholecystic exudative fluid collection, difficulty in identifying anatomical structures due to severe inflammation, and a gallbladder wall thickness of more than 5 mm which can predict higher odds of conversion in the patient [9]. The above criteria assist the surgeon for risk stratification and to appropriately inform each patient's unique risk of conversion to open, before the laparoscopic surgery. The decision to convert to open operation should not be considered a complication, but rather a valuable choice to avoid complications or additional injury to the patient.

METHODS

We conducted a prospective and observational study in a tertiary care center in Southern India over a period of 1 year. Eligible patients planned for laparoscopic cholecystectomy are included and their details are recorded through a standardized questionnaire. The clinical and ultrasonographic findings are evaluated. Exclusion criteria included patients planned for open cholecystectomy, patient age <18 years. After Ethical Committee clearance, patient accrual was initiated. Consenting patients were included in the study population. Demographic data were recorded. The cases

that undergo conversion of laparoscopic to open cholecystectomy were evaluated separately and the data were collected and analyzed to identify the factors for conversion of laparoscopic to open cholecystectomy.

Statistical analysis

The data were collected and analyzed to identify statistically significant factors. The unpaired sample t-test was used to identify the difference between the bivariate samples in independent groups. For the analysis of categorical data, the Chi-square test was used. In the above statistical tools, the probability value of $p < 0.05$ is considered as the significant level.

RESULTS

A total of 526 cases were incorporated in the study population of which 329 were female and 197 were male. There was no statistical

Table 1: Previous episode of acute cholecystitis

Previous acute cholecystitis	Groups		Total
	Lap	Open	
Previous acute cholecystitis Absent			
Count	459	25	484
%	92.9	78.1	92.0
Present			
Count	35	7	42
%	7.1	21.9	8.0

Table 2: Previous surgery in the upper abdomen

Previous surgery in the upper abdomen	Groups		Total
	Lap	Open	
Previous surgery in the upper abdomen Absent			
Count	477	27	504
%	96.6	84.4	95.8
Present			
Count	17	5	22
%	3.4	15.6	4.2

Table 3: Presence of diabetes mellitus

Diabetes mellitus	Groups		Total
	Lap	Open	
Diabetes mellitus Absent			
Count	355	19	374
%	71.9	59.4	71.1
Present			
Count	139	13	152
%	28.1	40.6	28.9

Table 4: Total leukocyte counts and neutrophils

Total leukocyte counts and neutrophils	Levene's test for equality of variances		t-test for equality of means						
	F	Sig.	t	df (degrees of freedom)	Sig. (2-tailed)	Mean difference	Standard error difference	95% confidence interval of the difference	
								Lower	Upper
Total leukocyte counts									
Equal variances not assumed	8.756	0.003	2.646	32.147	0.012	1993.2002	753.2248	459.2066	3527.1939
Neutrophil									
Equal variances assumed	1.545	0.215	2.851	479	0.005	6.5447	2.2955	2.0343	11.0551

significance between the genders when conversion to open was considered.

Of 484 cases without any previous history of acute cholecystitis, only 25 cases underwent conversion. Among 42 patients who had a previous episode of acute cholecystitis, seven were converted to open. p value calculated by the Pearson Chi-square test is 0.003 and is statistically significant ($p = 0.003$) (Table 1).

Of 504 cases without any upper abdominal surgery, 27 cases were converted, whereas in 22 patients with previous surgery in the upper abdomen, five were converted to open procedure ($p = 0.001$) (Table 2).

Of 374 patients without diabetes mellitus, 19 patients were converted, and in 152 diabetic patients, 13 patients underwent conversion to open. p value calculated by Pearson Chi-square test is 0.131, and diabetes shows no statistical significance in conversion in this study (Table 3).

The values of total leukocyte count and neutrophils were calculated and analyzed by unpaired t-test for equality of means and p value for total leukocyte count was 0.012 and for neutrophils was 0.005. Hence, a total leukocyte count of more than 11,000 and a neutrophil count of more than 80% showed high significance for conversion to open surgery (Table 4).

Data of each individual component of the liver function tests such as aspartate aminotransaminase, alanine aminotransaminase, alkaline phosphatase, amylase, lipase, total, and direct bilirubin were collected and analyzed with t-test for equality of means and were shown to have no statistical significance with regard to conversion of laparoscopic to open cholecystectomy

Considering the ultra sonographic finding of gallbladder wall thickness, of 122 patients with more than or equal to 5 mm, 14 were converted. In 404 patients with < 5 mm, only 18 underwent conversion. p value calculated by the Pearson Chi-square test was 0.0082, which was statistically highly significant ($p = 0.0082$) (Table 5).

The other ultrasonographic finding analyzed was the presence of pericholecystic exudative fluid. Of 173 patients with pericholecystic fluid, 17 underwent conversion and of 353 patients without pericholecystic fluid only 15 were converted. This was statistically significant with p value calculated by Pearson Chi-square test being 0.0184 ($p = 0.184$) (Table 6).

DISCUSSION

The demographic details in our study, with respect to gender distribution, show that among the cases 62.5% are female and 37.5% are male. This is in concurrence with the expected disease prevalence of cholelithiasis and corresponds to the study by Novacek [10].

In the group requiring conversion to open surgery, 43.8% were female and 56.3% were male. Although the conversion is higher in males, it was not found to be statistically significant, contrary to the study by Rothman et al. [11].

Table 5: Gallbladder wall thickness

Gallbladder wall thickness	Groups		Total
	Lap	Open	
Gallbladder wall thickness			
≥5 mm			
Count	108	14	122
%	21.9	43.8	23.2
<5 mm			
Count	386	18	404
%	78.1	56.3	76.8

Table 6: Presence of pericholecystic fluid

Pericholecystic fluid	Groups		Total
	Lap	Open	
Pericholecystic fluid			
Present			
Count	156	17	173
%	31.6	53.1	32.9
Absent			
Count	338	15	353
%	68.4	46.9	67.1

Considering the patients with a previous history of acute cholecystitis episodes in our study, 16.67% underwent conversion to open surgery, as compared to 5.16% of patients without previous episodes. The difference was found to be statistically significant ($p=0.003$) and concurs with the study conducted by Warchałowski *et al.* [12].

The history of previous upper abdominal surgery was found to be a statistically significant factor for conversion with 22.7% of cases being converted in comparison to 5.35% for patients without surgical history ($p=0.001$). These findings are similar to those of Masri *et al.* [13].

About 29% of our sample were diabetic patients, and in them, 8.55% were converted to open. In non-diabetic cases, 5.08% underwent conversion to open. Although the conversion is higher in diabetic patients, the results showed no statistical significance ($p=0.131$). These findings contradict with those of Terho *et al.*, who found that diabetes mellitus is one of the predisposing factors for conversion to open cholecystectomy [14].

Nidoni *et al.* found that the total leukocyte count $>11,000$ is a predictor for conversion to open, which is in concordance with our findings ($p=0.012$) [15].

Liver function tests have been used as independent predictors of conversion by Beksac *et al.* [16] and Ercan *et al.* [8]; however, in the present study, none of the components of liver function tests had any significance in conversion.

Sonologically detected GB wall thickness was an independent predictor for conversion with patients whose wall thickness was <5 mm wall thickness was converted less frequently than those with thickness more than 5 mm, and the difference was statistically significant (4.45% vs. 11.4%; $p=0.0082$). Similar results were derived by Kania in their study [17].

Further, the presence of pericholecystic fluid collection was another criterion in ultrasound which was found to be a statistically significant predictor (4.24% vs. 9.82%; $p=0.0184$).

The study by Lee *et al.* showed similar findings [18].

CONCLUSION

The study corroborates the common intraoperative causes of conversion of laparoscopic to open cholecystectomy to be frozen Calot's triangle,

dense adhesions, and empyema gallbladder, all causes secondary to acute or chronic inflammation – cholecystitis.

With the above data and statistical analysis, we conclude that the following determinants are associated with a significantly higher risk for conversion of laparoscopic to open cholecystectomy: History of previous episode of acute cholecystitis, history of previous upper abdominal surgeries, total leukocyte count, and neutrophil ratio, ultrasonographic findings such as gallbladder wall thickness more than or equal to 5 mm and presence of pericholecystic fluid. These determinants can be utilized by the surgeon for assessing the chances of conversion preoperatively, to obtain informed consent from the patient explaining their unique chances of conversion based on these factors, and for adequate pre-operative planning of the surgery.

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AUTHORS' CONTRIBUTION

Karthikhaeyan TR and Ankit Kumar Sharma – Concept, Data Compilation, Analysis, and Manuscript. Keerthi Visagan, Rajasenthil, Vasantha Ragavan - Concept, Data Collection, Analysis.

CONFLICTS OF INTERESTS

Nil.

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