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Pre-operative prediction of difficult laparoscopic cholecystectomy from clinical, hematological and radiological parameters

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ABSTRACT

Background: The aim of study was to formulate a scoring system to predict difficult laparoscopic cholecystectomy (LC) pre-operatively; depending on the specific parameters of an individual patient.

Methods: We have included 100 patients who underwent LC from July 2010 to December 2012. Conversion to open cholecystectomy in relation with age, sex, attack of acute cholecystitis, fever, abdominal tenderness, serum amylase and LDH level, status of GB and GB wall thickness, number of stone, leukocyte count and CBD diameter were assessed.

Results: The most important reason for conversion was adhesions at Calot's triangle (60%), followed by contracted gall bladder (15%). The other reasons of conversion were empyema of the gall bladder (15%), stone at Hartmann's pouch (10%), bleeding during dissection (5%).

Conclusions: This study will surely help the surgical fraternity in the future to plan the particular patients for appropriate mode of surgery, pre-operative preparation, patient counselling and most importantly to predict the score for the difficult interval Laparoscopic Cholecystectomy.

Keywords: Laparoscopic cholecystectomy, Open cholecystectomy

INTRODUCTION

The diseases of gall bladder are known since antiquity. Cholelithiasis is the captain of gallbladder diseases. Cholecystectomy performed using a midline or right upper quadrant incision has been the preferred therapy for gallstone diseases since shortly after its description in 1882 by Carl John August Langenbuch. The risk of death from major complications resulting from this operation are low and open cholecystectomy was regarded as the 'gold standard' for patients with cholelithiasis. ^{2,3}

A method to remove the gallbladder using laparoscopic guidance was described and has been adopted by surgeons at an unprecedented rate. The advent of laparoscopic cholecystectomy (LC) has been a significant

milestone not only in treatment of gallstone disease, but in the evolution of surgical treatment toward minimal access surgery; the aim of which is intended to minimize the trauma of access without compromising the exposure of the surgical field.

For surgeons it would be helpful to establish criteria that would assess the risk of conversion to open procedure, preoperatively. This would be useful for informing patient and a more experienced surgical team could be assembled when risk for conversion appears significant.

Aims and objectives

 To look at the various factors and conditions that would help a surgeon to predict a 'Difficult Laparoscopic Cholecystectomy'.

- Pre-operative prediction of a Difficult Laparoscopic Cholecystectomy, which helps 'patient counselling'.
- To help the surgeon to prepare himself better for the intra-operative risk and the technical difficulties expected to be encountered.
- To formulate a scoring system to predict difficult Laparoscopic Cholecystectomy pre-operatively; depending on the specific parameters of an individual patient.

METHODS

In our study, we included 100 patients who underwent LC from July 2010 to December 2012 in our university

hospital in Vadodara, at Sir Sayaji General Hospital. Patients with history of jaundice, cholangitis, raised alkaline phosphatase or dilated common bile duct (CBD) were evaluated further by MRCP and patients with CBD stones were excluded. All cases were operated by experienced senior surgeons. All patients were evaluated in terms of clinical, hematological, biochemical and ultrasonography parameters (Table 1).

The present study was carried out on total of 100 patients. All patients were subjected to thorough clinical examination with relevant laboratory and imaging investigations.

Table 1: Clinical, hematological, biochemical and ultrasonography parameters.

Clinical parameters	Haematological parameters	Sonographic parameters	
Age	TLC	Gall bladder (contracted, normal or distended)	
Sex	Serum Amylase	GB wall thickness(mm)	
Duration from last attack		No. of stones Device also systime demo(V/N)	
No. of attacks		No. of stones Pericholecysticedema(Y/N)	
P/H/O Acute Cholecystitis	Serum LDH		
H/O Fever at the time of attack		CBD diameter(mm)	
Tenderness			

Only good risk patients who meet the following criteria, were selected:

- Symptoms consistent with biliary colic.
- Documented gallstones on ultrasonography.
- No evidence of common bile duct stones or disease.
- Absence of acute cholecystitis (last attack of acute cholecystitis more than 6 weeks back)
- No major bleeding disorder.
- No previous upper abdominal surgery.

Laparoscopic cholecystectomy operative procedure

All the patients are given one gram Ceftriaxone and one ampule of ondansetron preoperatively. Patients are given general anaesthesia with endotracheal intubation and muscle relaxation for controlled ventilation. A major laparotomy set is kept immediately available if needed. Nasogastric tube is inserted to decompress stomach. The patient is positioned supine on the operative table with both the arms apart by side of the table.

Laparoscopic cholecystectomy comprises of four steps:

- Creation of pneumo-peritoneum and insertion of all
- Separation of all adhesions to gallbladder and the surrounding liver, with the exposure of peritoneal fold in which the cystic duct and cystic artery are situated.

- Dissection and skeletonization of the cystic duct and cystic artery and occlusion and division of these structures
- Excision and extraction of gallbladder and closure of incision.

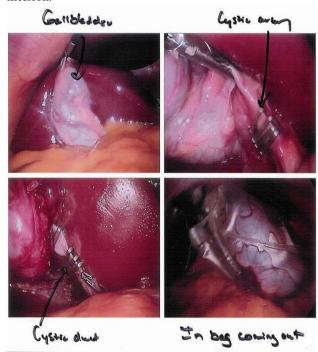


Figure 1: Photograph showing procedure of cholecystectomy.



Figure 2: Laparoscopic view of clipping cystic duct and artery.

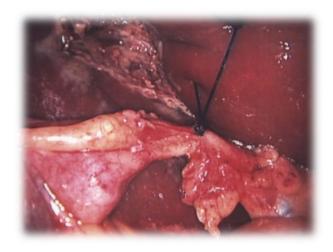


Figure 3: Laparoscopically tying cystic duct with thread.

Careful note is made of anaesthesia time, operative time, operative technique, any technical difficulties. Intraoperative complications are analysed. Any conversion to open Cholecystectomy and its reasons are noted.

RESULTS

We included 100 patients of gall stones who underwent laparoscopic Cholecystectomy and 7 required conversion. So this study was effectively carried out on 100 patients with an overall conversion rate of 7%. The mean age of patients was 43.29±15.187 years. The mean age in nonconverted cases was not statistically different from the conversion group (p>0.05).

The conversion rate in male gender (6.5%) was also not significantly different from that in females (7.2%, p=0.885).

Of the 100 patients, 80 patients had history of episodes of acute cholecystitis and the rest had history of dyspeptic symptoms. Patients with history of more number of acute

attacks had a significantly higher conversion rate (P <0.0001).

Total duration of symptoms and duration between surgery and last attack was not significantly different in the conversion and the non-conversion group, but it was found that the conversion rate was higher in patients with >5 attacks. The number of attacks was a statistically significant factor (p=0.557).

Conversion rate was not significantly higher in patients with history of fever at the time presentation (p=0.525).

Levels of serum LDH (p=0.695) and serum amylase (p=0.338) were also evaluated, but these were not statistically significant.

With evaluation of patients by ultrasonographic parameters, 29 patients had contracted gall bladder and 71 patients had non-contracted gall bladder. In the contracted gallbladder group, 2 patients underwent conversion while in the non-contracted gallbladder group 5patients underwent conversion. The difference between the two groups was not statistically significant (p=0.97).

A total of 85 patients had normal gallbladder wall thickness with a conversion rate of 2% as compared to 33.33% with thick gall bladder wall (p<0.05). The minimum wall thickness beyond which the risk of conversion increased statistically was 5 mm.

A single stone was present in 33 patients, while 67 patients had more than one stone. Conversion rate in each group was 7.5% and 6.1% respectively; with a p-value of 0.796. Patients who had at least one stone greater than 10mm in diameter were not having statistically significant difference in conversion rate as compared to those with stone sizes less than 10mm.

There were 12 patients with raised TLC. 3 patients with normal values underwent conversion as compared to 4 patients with raised counts. The mean TLC in the conversion group was 11271.43±3220.61, ranging from 6,400 to 16,000/cmm. The mean of the counts in the non-conversion group was 7670±2417.31, ranging from 4,200 to 13,800/cmm. TLC were found to be statistically significant for risk of conversion (p<0.0001).

Pericholecystic edema was present in 6 patients and absent in 94 patients and out of them 1 and 6 patients underwent conversion which is statistically not significant (p=0.33).

CBD diameter was normal in 98 patients and increased in 2 patients and out of them 7 and 0 patients underwent conversion which is statistically not significant (P=0.695).

Univariate analysis showed that fever at the time of attack, number of stones, number of attacks, previous

history of acute Cholecystitis, presence of tenderness in the right hypochondrium, gall bladder wall thickness on USG and raised TLCs were statistically significant for risk of conversion (Table 2).

Table 2: Logistic regression of univariate significant variables.

Variables	β Coefficient S.E. Wald P value	C E	Wold	Dyolyo	Odd's Ratio	95% CI	
variables		P value	Oud's Katio	Lower	Upper		
Gender	0.145	1.976	0.005	0.941	1.157	0.024	55.594
Attacks	0.710	0.556	1.630	0.202	2.034	0.684	6.047
h/o Acute	-3.737	3.365	1.233	0.267	0.024	0.000	17.451
Fever	4.293	3.362	1.630	0.202	73.18	0.101	52263.98
Tenderness	1.160	2.975	0.152	0.697	3.191	0.009	1087.631
TLC	0.000	0.000	2.104	0.147	1.000	1.000	1.001
LDH	-1.915	2.719	0.496	0.481	0.147	0.001	30.401
Amylase	-0.469	3.019	0.024	0.877	0.626	0.002	232.410
GB	-1.411	2.390	0.348	0.555	0.244	0.002	26.413
Wall thickness	1.589	0.703	5.107	0.024	4.899	1.235	19.441
Edema	1.768	8.190	0.047	0.829	5.862	0.000	5.491E7
CBD	17.284	26986.51	0.000	0.999	3.20E7	0.000	-
No. stones	-0.929	2.323	0.160	0.689	0.395	0.004	37.476
Constant	-29.752	26986.51	0.000	0.999	0.000	-	-

Table 3: Final matrix showing significant variables on logistic regression.

Variables	B Coefficient S.E. Wald P value	P value	Odd's	95% CI			
variables	D Coefficient	S.L.	Wald	P value	ratio	Lower	Upper
No. of attacks	0.528	0.304	3.017	0.082	1.696	0.934	3.076
Total Leucocyte count	0.000	0.000	2.808	0.094	1.000	1.000	1.001
GB Wall thickness on USG	1.062	0.447	5.633	0.018	2.891	1.203	6.948
Constant	-10.987	3.160	12.088	0.001	0.000		

Table 4: Risk score for conversion from laparoscopic to open cholecystectomy.

Parameter	Frequency	Coefficients
Number of attacks	<3	0
Number of attacks	≥3	5
Total leukocyte count	4000 - 11,000	0
	>11,000	1
GB wall thickness	<5mm	0
GB wall thickness	≥5mm	10
Constant		-10

Stepwise logistic regression to find the independent risk factors showed only wall thickness (p=0.02) to be statistically significant, then stepwise logistic regression was performed deleting one non-significant variable at a time and final logistic regression matrix showed that only number of attacks, TLC counts and wall thickness were statistically significant (Table 3).

Scoring systems for conversion prediction

The β -coefficients of the variables found significant on logistic regression were considered for a scoring system. The coefficients were rounded and multiplied by 10 for

easy calculation. These coefficients and a constant formed the risk score for conversion from laparoscopic to open Cholecystectomy (Table 4).

The sum of the coefficients and the constant gives the final score of the patient and can take a value between -10 and 6. Increasing scores are associated with significantly increased conversions rate.

The mean risk score in non-converted patients was about -8.43, while in the converted patients it was about 2.0. The range of scores in converted patients was from -4 to 6 and in the non-conversion group the range was from -

10 to 6. Evaluating the significance of this scoring system with prediction of conversion, it was noticed that the test

was highly significant for prediction of conversion (Table 5 and 6).

Table 5: Comparison of risk scores in conversion and non-conversion group.

Score	Total (100)	Converted (7)	Non-converted (93)
Mean±SD	-7.70±4.72	2.0±3.78	-8.43 ±3.92
Range	-10 to 6	-4 to 6	-10 to 6

Table 6: Logistic regression model summary.

Omnibus test of model coefficients	Chi-square=24.79, df=3 , p<0.001
Hosmer Lemeshow test	P=0.839 (test of goodness of fit for model)
Nagelkerke R ²	0.552 (range between 0 to 1)
Cox & Snell R ²	0.22 (range between 0 to 0.75)
Classification accuracy	93%

Table 7: Comparison of previous studies with our study, regarding positive parameters of prediction.

Study parameters	Fried et al ⁹⁴	Nachnani et al ¹⁰⁴	Our study
Age	+		
Male gender	+	+	
Obesity	+	+	
Total leukocyte count			+
History of acute cholecystitis	+	+	
No. of attacks of acute cholecystitis			+
History of acute pancreatitis		+	
Gall bladder wall thickness	+	+	+
History of previous surgery		+	

The most important reason for conversion was adhesions at Calot's triangle (60%), followed by contracted gall bladder (15%). The other reasons of conversion were empyema of the gall bladder (15%), stone at Hartmann's pouch (10%), bleeding during dissection (5%).

These values suggest that the study we have conducted and the parameters selected are statistically significant and affect the outcome of laparoscopic cholecystectomy. And the score of prediction that we are getting is also significant according to different statistical methods used, as shown above.

DISCUSSION

In view of Laparoscopic Cholecystectomy being the gold standard treatment of symptomatic cholelithiasis, preoperative prediction of the risk of conversion is an important aspect of planning laparoscopic surgery. The 'risk scoring for conversion from laparoscopic to open Cholecystectomy' (RSCLO) was developed by Kama et al⁴. The successful efficacy of this system has been proved.⁵

In most of the studies on patients with advanced age (>65 years), an increase in complication and conversion rate is

reported and age is recognized as a risk factor for conversion.^{4,6-12} We and some other authors did not notice age to be associated with conversion rate.^{13,14} This varied opinion could be attributed probably to surgeons' experience and expertise.

Male sex was considered an independent risk in many series. ¹⁶⁻¹⁹ However, Liu et al did not notice sex to be associated with conversion. In our series, male sex and parity was not a risk factor for conversion. ⁶ In the literature, we found no study assessing parity as a risk factor for conversion.

In this study, there was significantly more risk of conversion in patients with previous history of acute cholecystitis (p<0.001). The same has been observed in other studies as well (Table 7). ¹⁸⁻²⁰

Association of total duration of symptoms with conversion has also been evaluated. Alponat et al²⁰ did not notice association of conversion with duration of symptoms in both univariate and multivariate analysis. Duration of symptoms is also not found to be associated with risk of conversion in our series as all the patients taken for Laparoscopic Cholecystectomy were taken after interval of 6 weeks.

Sanabria et al, found in their study of 628 patients that patients with multiple attacks (ten or more) were significantly associated with conversion, but in our study, we found significance with a number of attacks more than three.⁸

Schrenk et al, reported in a study of 300 patients assessing 24 variables for conversion that patients with history of Acute Cholecystitis within the last 3 weeks were at increased risk of conversion.²¹

Brodsky et al, reported that patients undergoing laparoscopic cholecystectomy after 96 hours of an attack of acute cholecystitis were more likely to undergo conversion. ¹⁰ In this series, we took a longer period (after 45 days) for assessment of this risk factor and we found it insignificant.

Fever has not been identified as a risk factor for conversion in our series and by many workers in their studies. 10,20,21 Some found it to be significant. 6,4

Tenderness has also been reported as a risk factor for conversion by some authors.²⁰ It is found insignificant in this study.

Many authors have identified raised WBC as a risk factor for predicting conversion. 4,22,23 In our study, there was significantly more risk of conversion in patients having TLC >11000/cmm. This can be probably attributed to persisting acute inflammation with edema of the gall bladder making surgery difficult.

Many others have identified a contracted gall bladder as a potential factor for conversion. A,16,21 Schrenk et al, identified shrunken gall bladder as an independent risk factor for conversion along with other variables. In a study of 738 patients, Jansen et al found contracted gall bladder to be statistically significant for risk of conversion. But in our study, we did not find it significant.

Gall bladder wall thickness has been identified as a risk factor for conversion in almost all the studies. The critical thickness of gall bladder associated with conversion varies from study to study. It was 3 mm, 4 mm, and 6 mm in different studies.^{7,4,9,17,24} In present series, it was 5 mm.

Most of the authors did not find any statistical significance with number of stones and risk of conversion. We found the same inference in our study. Many authors found no statistical significance between size of stones and conversion. At We also found the same, but Jansen et al found that stone size >20mm was associated with increased risk of conversion explaining that large stones are likely to get impacted at Hartmann's pouch, thereby making dissection difficult. A predictive index has been equated in various studies. In a study of 1,676 patients, Fried et al calculated the predictive index

for conversion.⁷ The probability of conversion was predicted.

Tayeb et al presents the multivariate model of risk factors independently associated with conversion. ²⁵ Patients with ultrasonographic signs of inflammation (gall bladder wall thickness >3 mm, edematous wall, peri-cholecystic fluid, and ultrasonographic Murphy's sign) were 8.5 times more likely to be converted to OC compared to the patients who underwent successful LC after adjusting all other variables in the model. Age >60 years was also identified as a risk factor for conversion.

Recent series state that presence of previous upper abdominal surgery with AC and obesity had a substantial effect on conversion, compared with the reference group. LC is safe in patients with AC, previous abdominal surgery, or obesity. However, the presence of inflammation alone or in combination with obesity and/or previous (especially upper) abdominal surgery is the main factor that influences the adverse outcomes of LC.

CONCLUSION

This study will surely help the surgical fraternity in the future to plan the particular patients for appropriate mode of surgery, pre-operative preparation, patient counselling and most importantly to predict the score for the difficult interval laparoscopic cholecystectomy.

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