Original Article

Preoperative Predictors of Level of Difficulty of Laparoscopic Cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the gold standard treatment for symptomatic gallbladder stone disease. This is due to its safety, reliability, cost-effectiveness, negligible mortality, shorter duration of hospitalization (early return to work), better cosmesis, minimal wound complications, and temporary paralytic ileus. In spite of these, conversion to open cholecystectomy which is sometimes required in difficult cases could be challenging. **Aims and Objectives:** The aim of the present study is to aid the prediction of difficult cases undergoing LC, thereby better selection of patients with the least conversion rates. **Materials and Methods:** This prospective study was conducted on 100 consecutive patients with cholecystitis, over a 2-year period from January 1, 2017, to December 31, 2018, having undergone LC. Various preoperative parameters, including age, sex, previous attacks of cholecystitis, deranged liver functions, and ultrasonographic findings, were analyzed for their effects for predicting the level of difficulty during LC. **Results:** Twenty-five percent of the cases were correctly predicted as difficult in the age group of >65 years. Cholecystitis was more common (79%) in females, but difficulties were encountered more frequently while performing LC in males. Abnormal serum hepatic and pancreatic enzyme profiles were associated with difficulties during surgery as about 83.3% of the patients predicted as moderately difficult peroperatively had deranged liver functions. The preoperative ultrasonography findings were helpful for predicting the degree of difficulty involved in the procedure. About 33.3% of the patients that had pericholecystic fluid on ultrasound preoperatively were correctly predicted to have moderately difficult surgeries. The Chi-square test and *P* value were used to determine statistical significance. **Conclusions:** Females, the absence of previous repeated attacks of cholecystitis and hospitalizations, no upper abdominal surgery in the past, normal liver function tests, normal amylase levels, nondistended and uncontracted gallbladder, absence of pericholecystic collection, afebrile, and single stone are positive preoperative predictors of safe LC in symptomatic gallbladder stone disease.

KEYWORDS: *Acute cholecystitis, laparoscopic cholecystectomy, liver function tests, open cholecystectomy*

INTRODUCTION

Cholecystitis can occur suddenly, with symptoms such as fever along with intense pain in the right upper quadrant.[1] Laparoscopic cholecystectomy (LC) has now become the gold standard for the treatment of symptomatic gallstones.[2,3] LC may be rendered difficult by various challenges encountered during surgery such as difficulties in accessing the peritoneal cavity, creating a pneumoperitoneum, dissecting the

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gallbladder, or extracting the excised gallbladder.[4] Various parameters have been studied extensively to analyze their effects on LC, starting from a single variable to up to 34 parameters which include age, sex, acute attack requiring hospitalization, previous abdominal surgeries, presence of palpable gallbladder mass, presence of an abdominal scar, and BMI of the patient. Age is recognized as a risk factor for conversion, perhaps due to a long history of gallstone and increased number of cholecystitis attacks.[5] It has been observed that surgeons encountered difficulties while performing LC when there are dense adhesions at Calot's triangle, fibrotic and contracted gallbladder, acutely inflamed or gangrenous gallbladder and cholycystoenteric fistula, etc.[6] Various available literature suggest that male gender is a high-risk factor for difficult LC. Previous upper abdominal surgery has been listed as a poor predictor for safe LC because of adhesion formations. It may also pose a problem in creating pneumoperitoneum, thus making LC difficult.[7-9]

Abdominal ultrasound has become a reliable, quick, and noninvasive tool to diagnose gallstone disease.[10] Apart from its value in diagnosis, its findings may also predict the degree of difficulty involved in the procedure. One of the important ultrasonographic findings is maximum gallbladder wall thickness of >4 mm which indicates a contracted fibrotic gallbladder which is difficult to grasp. Apart from this, ultrasound also demonstrates a porcelain gall bladder, gallbladder-containing large impacted stone, especially in Hartmann's pouch. Pericholecystic collection implies inflammation around the gallbladder which makes LC difficult.[11]

History of previous attacks, nonvisualization of the gallbladder, pericholecystic, and peripancreatic fluid are associated with a significant inflammatory process that causes difficulty in the dissection of Calot's triangle and adhesiolysis.[12]

Abnormal liver function tests and elevated amylase may signify ongoing hepatitis, cholangitis, and pancreatitis that pose difficulty in dissection due to edema.[13]

This study was designed to know the preoperative safe predictors for LC based on various parameters which include age, sex, acute attack requiring hospitalization, deranged liver functions, and ultrasonographic findings. The level of difficulty predicted preoperatively based on these parameters was compared with the actual challenges encountered during the laparoscopic procedure. During the procedure, the level of difficulty encountered was categorized by developing a scoring system [Table 1], which is expected to help surgeons in making unbiased standard predictions.

Materials and Methods

This prospective study was conducted on 100 patients of either sex and of all age groups with a diagnosis of cholecystitis, over a 2-year period from January 1, 2017, to December 31, 2018. Preoperatively, a thorough history and physical examination were done in all patients. All required investigations, including Complete Blood Count (CBC), liver function tests, renal function tests, coagulation profile, serum amylase, serum lipase, and ultrasonography (USG), were carried out. LC was carried out, and intra-operative details were observed. Scores were given [Table 1], based on various parameters, which included time taken for the procedure, biliary or stone spilling, injury to the duct or artery, and conversion to open cholecystectomy, were recorded on a predesigned pro forma.

Inclusion criteria

1. Patients with cholecystitis confirmed by USG for the presence of gallstones.

Exclusion criteria

1. Patients with mass formation after an attack of acute cholecystitis
2. Patients having coagulation disorders
3. Pregnant patients
4. Patients not giving consent or unfit for general anesthesia.

Various parameters

Various parameters such as age, sex, previous attacks, previous surgery, deranged liver function tests, contracted or distended gallbladder, pericholecystic fluid, multiple stones, and gangrenous gallbladder were analyzed for predicting safe LC.

Chi-square test and *P* value were used to determine the statistical significance.

Results

Age

Minimum age of the patient undergoing LC was 22 years, and the maximum was 70 years. In the present study, 75% were in the age group of 31–60 years and the mean age was 43.44 ± 1.13 years [Table 2]. On analyzing the age data statistically [Table 3], it was observed that the preoperative prediction was correct in 100.0% of cases predicted as easy in the age group of ≤65 years, whereas 25.0% of the cases were correctly predicted as difficult in the age group of >65 years.

Sex

In the present study, 79.0% were female [Table 4]. It was observed that of 79 females, 4 cases were found to be moderately difficult, 2 cases were found to be

difficult, and 1 case was found to be very difficult as per the criteria in this study. While in males, of 21 cases, 2 were found to be moderately difficult, 2 were found to be difficult, and 2 were found to be very difficult.

Table 1: Local grading

Grading	Parameters
Easy	Time taken <60 min
	No injury to duct or artery
	No conversion to open
Reasonably easy	Time taken >60 min
	No Injury to duct or artery
	No conversion to open
Moderately difficult	Time taken <60 min
	Injury to duct or artery
	No conversion to open
Difficult	Time taken >60 min
	Injury to duct or artery
	No conversion to open
Very difficult	Time taken >60 min
	No Injury to duct or artery
	Conversion to an open procedure
Severely difficult	Time taken >60 min
	Injury to duct or artery
	Conversion to an open procedure

Previous attacks of cholecystitis

Twenty-four cases had a history of previous attacks of cholecystitis ranging from mild-to-moderate intensity

Table 2: Age-wise distribution of patients

Age groups (years)	Number of patients (%)
21-30	18 (18.0)
31-40	31 (31.0)
41-50	27 (27.0)
51-60	15 (15.0)
61-70	9 (9.0)
>70	0 (0.0)
Total	100 (100.0)
Mean age	43.44±1.13
Range	22-70

Table 4: Sex distribution of patients

Sex distribution	Number of patients (%)
Male	21 (21.0)
Female	79 (79.0)
Total	100 (100)

Table 3: Correlation of age with peroperative outcome

Age group (years)	Outcome, *n* (%)						Total, *n* (%)
	Easy	Relatively easy	Moderately difficult	Difficult	Very difficult	Severely difficult	
≤65	71 (100)	11 (78.6)	5 (83.3)	3 (75.0)	3 (100)	2 (100)	95 (95.0)
>65	0 (0.0)	3 (21.4)	1 (16.7)	1 (25.0)	0 (0.0)	0 (0.0)	5 (5.0)
Total	71 (100)	14 (100)	6 (100)	4 (100)	3 (100)	2 (100)	100 (100)
χ^2			*P*			Significance	
17.043			0.004			HS	

HS: Highly significant

Table 5: Previous attacks of cholecystitis

Previous attacks	Outcome, *n* (%)						Total, *n* (%)
	Easy	Relatively easy	Moderately difficult	Difficult	Very difficult	Severely difficult	
Yes	4 (5.6)	11 (78.6)	5 (83.3)	2 (50.0)	1 (33.3)	1 (50.0)	24 (24.0)
No	67 (88.2)	3 (21.4)	1 (16.7)	2 (50.0)	2 (66.7)	1 (50.0)	76 (76.0)
Total	71 (100)	14 (100)	6 (100)	4 (100)	3 (100)	2 (100)	100 (100)
χ^2			*P*			Significance	
49.935			<0.001			HS	

HS: Highly significant

Table 6: Deranged liver function tests

Deranged LFT	Outcome, *n* (%)						Total, *n* (%)
	Easy	Relatively easy	Moderately difficult	Difficult	Very difficult	Severely difficult	
Yes	2 (2.8)	12 (85.7)	5 (83.3)	4 (100)	2 (66.7)	2 (100)	27 (27.0)
No	69 (97.2)	2 (14.3)	1 (16.7)	0 (0.0)	1 (33.3)	0 (0.0)	73 (73.0)
Total	71 (100)	14 (100)	6 (100)	4 (100)	3 (100)	2 (100)	100 (100)
χ^2			*P*			Significance	
73.831			<0.001			HS	

LFT: Liver function test, HS: Highly significant

Table 7: Ultrasonographic findings

Ultrasonographic findings	Outcome, *n* (%)						Total, *n* (%)
	Easy	Relatively easy	Moderately difficult	Difficult	Very difficult	Severely difficult	
Contracted	4 (5.6)	6 (42.9)	1 (16.7)	1 (25.0)	2 (66.7)	1 (50.0)	15 (15.0)
Distended	6 (8.5)	7 (50.0)	4 (66.7)	1 (25.0)	1 (33.3)	0 (0.0)	19 (19.0)
No	61 (85.9)	1 (7.1)	1 (16.7)	2 (50.0)	0 (0.0)	1 (50.0)	66 (66.0)
Total	71 (100)	14 (100)	6 (100)	4 (100)	3 (100)	2 (100)	100 (100)
χ^2			*P*			Significance	
53.880			<0.001			HS	

HS: Highly significant

Table 8: Pericholecystic fluid

Pericholecystic fluid	Outcome, *n* (%)						Total, *n* (%)
	Easy	Relatively easy	Moderately difficult	Difficult	Very difficult	Severity difficult	
Yes	4 (5.6)	11 (78.6)	2 (33.3)	2 (50.0)	3 (100)	2 (100)	24 (24.0)
No	67 (94.4)	3 (21.4)	4 (66.7)	2 (50.0)	0 (0.0)	0 (0.0)	76 (76.0)
Total	71 (100)	14 (100)	6 (100)	4 (100)	3 (100)	2 (100)	100 (100)
χ^2			*P*			Significance	
53.590			<0.001			HS	

HS: Highly significant

lasting for 1–2 days. Eight patients were hospitalized and treated with parenteral medications for 2–3 days. On analyzing the data statistically [Table 5], of 24 cases who had previous attacks, 5 came out to be moderately difficult; whereas of 76 cases that never had any previous attack, one came out to be moderately difficult.

Deranged liver function tests

About 83.3% of the patients predicted as moderately difficult and 66.7% of the patients predicted as very difficult peroperatively had deranged liver function tests [Table 6].

Ultrasonographic findings

On analyzing the data statistically [Table 7], 25.0% of the patients predicted as difficult peroperatively and 66.7% of the patients predicted as very difficult peroperatively had contracted gallbladder on ultrasound and 25.0% of the patients predicted as difficult peroperatively and 33.3% of the patients predicted as very difficult peroperatively had distended gallbladder on ultrasound, whereas 85.9% of the patients predicted as easy preoperatively had normal gallbladder distension. On analyzing the data statistically [Table 8], 33.3% of the patients predicted as moderately difficult peroperatively had pericholecystic fluid on ultrasound and 66.7% of the patients predicted as moderately difficult peroperatively had no pericholecystic fluid on ultrasound.

Discussion

In the present study, 75% of patients were in the age group of 31–60 years and the mean age was 43.44 ± 1.13 years. This can be explained by the fact that the study was conducted on patients of symptomatic cholelithiasis undergoing LC, which is a disease of the middle age. On analyzing the age data statistically [Table 3], it was observed that the preoperative prediction was correct in 100.0% of cases predicted as easy in the age group of ≤65 years, whereas 25.0% of the cases were correctly predicted as difficult in the age group of >65 years. It was observed that older age (>65 years) was a significant risk factor for difficult LC ($P = 0.004$). The increase in difficulty with age has been reported by many authors. Kanaan *et al*.[14] gave older male as one of the main factors of conversion of LC to open cholecystectomy. Our results were similar in comparison to the other studies by Kanaan *et al*.[14] and Gabriel *et al*.[15] with age > 65 years being a significant risk factor. However, Gupta *et al*.[16] and Fried *et al*.[17] in their study had found that age was not a significant factor.

In our study, 79.0% of the patients were female. This higher incidence in females can be attributed to the fact that cholelithiasis is more common in females. In analyzing the data, it was found that the preoperative prediction in females was correct in 88.7% of the cases predicted as easy, whereas in males, preoperative prediction for difficulty was correct for 50.0% of cases and for a very difficult challenge was correct for 66.7% of cases. Although cholelithiasis is more common in females, males had higher risks of having difficult LC due to more intense inflammation or fibrosis to result into a difficult dissection in the Calot's triangle and the gallbladder bed as was reported by Lein and Huang.[7]

We found that of 24 cases who had previous attacks, 5 came out to be moderately difficult. A significant

correlation was seen between previous attacks of cholecystitis and some difficulties encountered during LC. Like the present study, many researchers such as Gabriel *et al*.,[17] Gupta *et al*.[16] and Nachnani and Supe[18] had found that the history of the previous hospitalization was a predictor for difficult cholecystectomy and higher conversion rate due to dense fibrotic adhesions, bleeding, and ductal injuries.

The deranged liver function tests and elevated serum amylase (ongoing cholangitis, hepatitis, and pancreatitis) were significant predictors for difficult LC (Chi-square = 73.831) and ($P < 0.001$), due to difficult dissection because of edema, and this finding was in accordance with the study of Alponat *et al*.[13]

The USG findings such as contracted gallbladder, distended gallbladder, multiple stones, and pericholecystic collection were observed significant risk factors (Chi-square = 53.880), ($P < 0.001$), because these factors caused significant difficulty in grasping of gallbladder, adhesiolysis as well as dissection of Calot's triangle and dissection of gallbladder from liver bed. These findings are consistent with observations of Singh and Ohri.[19]

Conclusions

LC has become the gold standard in the treatment of symptomatic gallstone disease. Elderly patients are more likely to have a difficult LC. Cholecystitis is more common in females, but difficulties are encountered more frequently while performing LC in males. Patients with recurrent cholecystitis tend to have more difficulties during surgery. Abnormal serum hepatic and pancreatic enzyme profiles are associated with difficulty in surgery. The preoperative USG can well predict difficulties during LC. Features like distended or contracted gallbladder are associated with subsequent difficulties during the surgery.

LC though mostly safe and uneventful can be difficult at times. What an inexperienced laparoscopic surgeon may consider difficult, the experienced laparoscopic surgeon may consider that to be very simple. With increasing experience selection criteria for LC has become more liberal, it is being used in more and more earlier contraindicated situations. In these circumstances, a lot of problems can be avoided by correct preoperative prediction of difficult cholecystectomy.

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Conflicts of interest

There are no conflicts of interest.

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