Predicting the risk factors of difficult laparoscopic cholecystectomy step by step

Taha Yassein[a], Islam Iyoab[a], Ahmed Sallam[a], Manal Gomaa[b], Amr Sadek[a], Maher Osman[a], Tarek Ibrahium[a], Amr Mostafa Aziz[a]

Departments of [a]HBP Surgery and Liver Transplant, [b]Radiology, National Liver Institute, Menoufia University, Menoufia, Egypt

Correspondence to Amr Mostafa Aziz, MD, Department of Surgery, National Liver Institute, Menoufia University, Shebin El-koom, Menoufia 32511, Egypt. Tel: +20 114 999 9664; fax: +20 482 234 586; e-mail: amraziz055@yahoo.com

Background
Laparoscopic cholecystectomy (LC) has become the gold standard in the treatment of symptomatic gallstones. It has replaced open cholecystectomy as the therapeutic modality in the treatment of cholelithiasis.

Aim
The aim of the study is to determine the predictive factors for difficult LC step by step using clinical and ultrasonography parameters.

Patients and methods
This is a prospective study conducted on 75 patients suffering from chronic calculous cholecystitis and planned for LC at the National Liver Institute, Menoufia University . All patients were compared according to demographic data, clinical data, laboratory profile, abdominal ultrasound result, and operation data.

Results
Difficult gallbladder (GB) bed dissection was found significantly related to patients with a history of acute cholecystitis, positive Murphy's sign, history of endoscopic retrograde cholangiopancreatography (ERCP) and GB wall thickness more than 3 mm during inspection. Distended GB and dense adhesions were found statistically significant in increasing the risk of bile and stone spillage during operation. Difficulty of extraction of GB was found in patients with a history of ERCP, distended GB and GB wall thickness more than 3 mm. Risk of conversion to open was found significantly related to patients with a history of biliary pancreatitis and patients with a history of ERCP. Operative time was found prolonged in cases with a history of biliary pancreatitis, history of ERCP, distended GB, multiple stones, and dense adhesions encountered during the first 5 min inspection.

Conclusion
BMI, history of acute attacks, positive Murphy's sign, history of ERCP, history of biliary pancreatitis, GB wall thickness more than 3 mm, multiple GB stones, and dense adhesion does pose difficulty in various steps during LC. So, preoperative prediction of possible difficulties may help a surgeon in choosing the approach (open/laparoscopic) most suitable for a particular patient, counseling the patient about it.

Keywords:
cholecystectomy, difficult, laparoscopy

Introduction

The popularity of gallbladder (GB) diseases is variable among adults in developed and developing countries. In addition, it is studied as an important risk for morbidity such as cholecystitis, cholangitis, and pancreatitis [1,2]. Laparoscopic cholecystectomy (LC) has many profits over open cholecystectomy in terms of minimum postoperative pain, shorter hospital stay, improved cosmetics, and early recovery. Most of the factors such as morbid obesity, and previous upper abdominal surgery which were studied as pure contraindication for pursuing LC have no longer remained as pure contraindications. The number of contraindications has come down undoubtedly over time [3].

Patients with long-standing disease and past bouts of cholecystitis or pancreatitis are at a higher risk of experiencing a difficult operation or conversion and may be at increased risk of bile duct injury or injury to the nearby viscera [4]. LC may be rendered difficult by different problems encountered during surgery such as difficulties in accessing the peritoneal cavity, setting up a pneumoperitoneum, accessing peritoneal cavity, releasing adhesions, identifying anatomy, anatomical variety and dissecting the GB or extracting the excised

GB [5]. It is important to recognize that the need for conversion to laparotomy is neither a failing nor a complication, but an attempt to avert complication and ensure patient safety [6,7].

The purpose of this study is to determine the predictive factors for difficult LC step by step using clinical and ultrasonography parameters.

Patients and methods

This is a prospective study including 75 eligible patients who underwent LC between May 2016 and January 2017 at the National Liver Institute, Menoufia University. All the patients had symptomatic cholelithiasis, normal laboratory tests, and nondilated bile ducts. After approval of institutional review board (IRB).

Exclusion criteria

(1) LC performed with other laparoscopic intervention.
(2) LC performed with common bile duct exploration.
(3) Absolute contraindication for LC like cardiovascular disease, pulmonary disease, coagulopathies, and end-stage liver disease.

Preoperative variables

Preoperative variables included are sex, age, BMI, symptoms of pain, dyspepsia and vomiting, history of jaundice, acute cholecystitis, or acute biliary pancreatitis. Clinical signs of cholecystitis: tender right hypochondrium, positive Murphy's sign and palpable GB, history of endoscopic retrograde cholangiopancreatography (ERCP), or any comorbidity like cardiac, renal, or diabetes mellitus.

Abdominal ultrasound variables

GB wall thickness was estimated (thick ≥3 mm vs. normal <3 mm). The calculus size (small <1 cm vs. large ≥1 cm); the number of GB stone, solitary versus multiple; common bile duct diameter: (normal <8 mm vs. dilated ≥8 mm); and liver parenchyma (normal, fatty infiltration, liver fibrosis) were included.

Operative variables (outcomes)

Access to peritoneal cavity (the operating surgeon described the access to peritoneal cavity as 'easy' or 'difficult'); intraoperative assessment within 5 min from port insertion including intrahepatic or nonvisualized GB, contracted GB, and dense intraperitoneal adhesions; Calot's and GB bed dissection; biliary and stone spillage; bleeding during surgery; duration of surgery (min); difficult extraction of GB; and conversion to open cholecystectomy. Bleeding during surgery was graded as minimal, mild, moderate, or severe [8]. Duration of surgery included the time from insertion of the Veress' needle to closure of the trocar insertion site, and will be evaluated as a continuous variable.

Postoperative follow-up

Bile leak, jaundice, bleeding, fever, and vomiting.

Statistical analysis

Data were presented as mean±SD and range where appropriate. Comparisons between groups were made using Fisher's exact test. P value less than 0.05 was considered statistically significant. All statistical analyses were conducted using SPSS, version 21 software (SPSS Inc. by IBM, Chicago, Illinois, USA).

Results

Twenty-seven (36%) patients were men and 48 (64%) patients were women with the mean age of the patients being 37.9±9.8 (range, 22–60 years). The mean BMI was 30.2±6.67 kg/m^2 (range, 20–49 kg/m^2). Concerning past medical history and comorbidities, nine (12%) patients had diabetes mellitus and nine (12%) patients had ischemic heart disease. History of jaundice occurred in 12 (16%) cases, biliary pancreatitis in nine (12%) cases, ERCP in six (8%) cases, acute attack in 45 (60%) cases, and positive Murphy's sign in 69 (92%) cases.

Abdominal ultrasound showed that six (8%) patients had contracted GB, 45 (60%) patients had average sized GB, and 24 (32%) patients had distended GB. Thirty (40%) patients had GB wall thickness less than 3 mm, while 45 (60%) patients had GB wall thickness more than 3 mm. Fifty-four (73%) patients had a stone of less than 1 cm in diameter, while for 21 (28%) patients it was more than 1 cm in diameter. Fifteen (20%) patients had solitary GB stone and 60 (80%) patients had multiple stones. Normal liver parenchyma was seen in 45 (60%) patients, fatty liver in 27 (36%) patients, and fibrotic liver in three (4%) patients.

Operative data

Peritoneal access using open Hasson's technique was found difficult in 18 (24%) patients due to the high BMI, which is high BMI more than 32 kg/m^2. First 5 min inspection showed adhesions in 21 (28%) patients; most of these adhesions were between the omentum and the GB, distended GB in six (8%)

patients, sessile GB in six (8%) patients, and no significant findings in 42 (56%) patients. Difficult dissection of adhesions and Calot's triangle occurred in 33 (44%) patients. Bleeding during dissection occurred in nine (12%) patients and it was minimal in six (8%) patients and moderate in three (4%) patients. Biliary and stone spillage occurred in 30 (40%) patients. Conversion to open occurred in six (8%) patients. Difficult extraction of GB was noticed in 27 (36%) patients and there was no postoperative bile leak, bleeding, nor fever.

Statistical analysis
Difficulty in peritoneal access
High BMI more than $32 \, \text{kg/m}^2$ was found statistically highly significant ($P<0.001$) for access to peritoneal cavity using open Hasson's technique (Fig. 1).

Difficult Calot's and gallbladder bed dissection
Factors affecting difficult cholecystectomy, first 5-min inspection (dense adhesions), history of acute attacks, history of ERCP, GB wall thickness more than 3 mm (contracted or distended). GB was statistically significant ($P<0.05$) for difficult cholecystectomy, while history of biliary pancreatitis and texture of liver parenchyma was insignificant for difficult cholecystectomy (Table 1).

Factors affecting risk of biliary and stone spillage
The univariate analysis for factors affecting the risk of biliary and stone spillage, distended GB ($P=0.011$) and dense adhesion encountered during the first 5 min inspection ($P<0.006$) were statistically highly significant (Table 2).

Figure 1
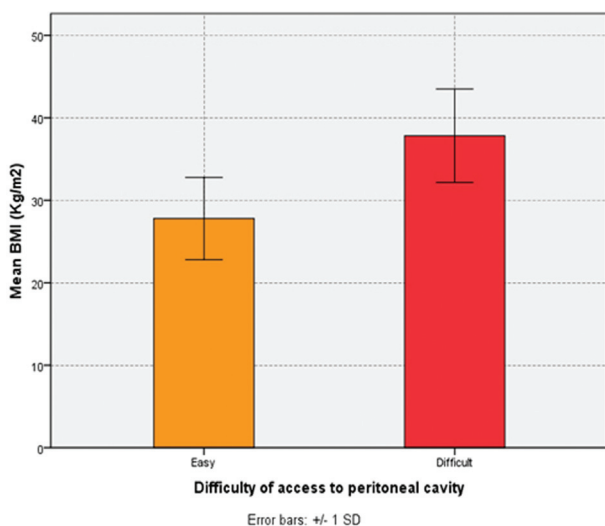
Relationship between BMI and difficulty in peritoneal access.

Bleeding during dissection
History of biliary pancreatitis, history of ERCP, and presence of adhesions were statistically significant factors affecting the risk of bleeding during dissection (Table 3).

Difficulty in gallbladder extraction
Factors affecting difficulty of extraction of GB are history of ERCP, distended GB, GB wall thickness more than 3 mm, and dense adhesions during the first 5 min were statistically highly significant ($P<0.05$) for extraction of GB which dealt with by extension of the 10 mm port epigastric wound or using extracorporeal suction from GB neck or using a retrieval bag (Table 4).

Factors affecting conversion to open
Factors predicting the risk of conversion to open such as dense adhesions ($P=0.001$), history of biliary pancreatitis ($P=0.02$), and history of ERCP ($P=0.005$) were statistically significant ($P<0.05$) for conversion to safe open cholecystectomy, especially if

Table 1 Factors affecting difficulty of dissection of Calot's triangle

	Difficulty of dissection of Calot's triangle [n (%)]		P value
	Easy	Difficult	
History of acute attack			
No	21 (50.0)	9 (27.3)	**0.046**
Yes	21 (50.0)	24 (72.7)	
Murphy's sign			
No	6 (14.3)	0	**0.032**
Yes	36 (85.7)	33 (100.0)	
History of biliary pancreatitis			
No	39 (92.9)	27 (81.8)	0.17
Yes	3 (7.1)	6 (18.2)	
History of ERCP			
No	42 (100.0)	27 (81.8)	**0.006**
Yes	0	6 (18.2)	
Gallbladder size			
Contracted	3 (7.1)	3 (9.1)	0.064
Average	30 (71.4)	15 (45.5)	
Distended	9 (21.4)	15 (45.5)	
Gallbladder wall thickness (cm)			
<0.3	21 (50.0)	9 (27.3)	**0.046**
>0.3	21 (50.0)	24 (72.7)	
Liver parenchyma			
Normal	27 (64.3)	18 (54.5)	0.17
Fatty	15 (35.7)	12 (36.4)	
Fibrotic	0	3 (9.1)	
First 5-min inspection			
Nonsignificant	33 (78.6)	9 (27.3)	**0.001**
Adhesion	3 (7.1)	18 (54.5)	
Distended GB	6 (14.3)	0	
Sessile GB	0	6 (18.2)	

ERCP, endoscopic retrograde cholangiopancreatography; GB, gallbladder. Bold means that this parameters is significant ($P<0.05$).

Table 2 Factors affecting the risk of bile and stone spillage

	Bile and stone spillage [n (%)]		P value
	No	Yes	
Murphy's sign			
No	3 (6.7)	3 (10.0)	0.678
Yes	42 (93.3)	27 (90.0)	
History of biliary pancreatitis			
No	42 (93.3)	24 (80.0)	0.144
Yes	3 (6.7)	6 (20.0)	
History of ERCP			
No	42 (93.3)	27 (90.0)	0.678
Yes	3 (6.7)	3 (10.0)	
Gallbladder size			
Contracted	3 (6.7)	3 (10.0)	**0.011**
Average	33 (73.3)	12 (40.0)	
Distended	9 (20.0)	15 (50.0)	
Gallbladder wall thickness (cm)			
<0.3	21 (46.7)	9 (30.0)	0.149
>0.3	24 (53.3)	21 (70.0)	
Gallbladder stone size (cm)			
<1	33 (73.3)	21 (70.0)	0.753
>1	12 (26.7)	9 (30.0)	
Gallbladder stone number			
Solitary	12 (26.7)	3 (10.0)	0.139
Multiple	33 (73.3)	27 (90.0)	
Liver parenchyma			
Normal	27 (60.0)	18 (60.0)	0.079
Fatty	18 (40.0)	9 (30.0)	
Fibrotic	0	3 (10.0)	
First 5-min inspection			
Nonsignificant	30 (66.7)	9 (30.0)	**0.006**
Adhesions	12 (26.7)	12 (40.0)	
Distended GB	0	6 (20.0)	
Sessile GB	3 (6.7)	3 (10.0)	

ERCP, endoscopic retrograde cholangiopancreatography; GB, gallbladder. Bold means that this parameters is significant ($P<0.05$).

Table 3 Factors increasing the risk for bleeding during dissection

	Bleeding during dissection [n (%)]		P value
	Minimal	Moderate	
Murphy's sign			
No	6 (8.3)	0	1
Yes	66 (91.7)	3 (100.0)	
History of biliary pancreatitis			
No	66 (91.7)	0	**0.001**
Yes	6 (8.3)	3 (100.0)	
History of ERCP			
No	69 (95.8)	0	**0.001**
Yes	3 (4.2)	3 (100.0)	
Gallbladder size			
Contracted	6 (8.3)	0	0.07
Average	45 (62.5)	0	
Distended	21 (29.2)	3 (100.0)	
Gallbladder wall thickness (cm)			
<0.3	30 (41.7)	0	0.27
>0.3	42 (58.3)	3 (100.0)	
Gallbladder stone size (cm)			
<1	51 (70.8)	3 (100.0)	0.56
>1	21 (29.2)	0	
Gallbladder stone number			
Solitary	15 (20.8)	0	1
Multiple	57 (79.2)	3 (100.0)	
Liver parenchyma			
Normal	42 (58.3)	3 (100.0)	0.37
Fatty	27 (37.5)	0	
Fibrotic	3 (4.2)	0	
First 5-min inspection			
Nonsignificant	42 (58.3)	0	0.099
Adhesions	18 (25.0)	3 (100.0)	
Distended GB	6 (8.3)	0	
Sessile GB	6 (8.3)	0	

ERCP, endoscopic retrograde cholangiopancreatography; GB, gallbladder. Bold means that this parameters is significant ($P<0.05$).

there other risk factors like liver cirrhosis or old age (Table 5).

Factors affecting operative time
Factors affecting prolongation of operative time are history of biliary pancreatitis (median=45 min; range, 40–200 min), history of ERCP (median=122.5 min; range, 40–200 min), distended GB (median=48 min; range 40–200), cases with multiple stones (median=40 min; (range, 30–200 min), and dense adhesions during the first 5-min inspection (median=50 min; range, 40–200 min) were found statistically significant in prolongating the operative time (Table 6).

Discussion
LC being the standard in the management of symptomatic GB stones, preoperative determination

of the risk of conversion is a crucial aspect of planning laparoscopic surgeries. It is crucial to predict difficult LC preoperatively so that senior surgeons can be requested to be present during surgery rather than less experienced junior surgeons prolonging the surgery which may lead to intraoperative complications; therefore, early decision of conversion can be made [9]. Many studies have attempted to design a scoring system to determine difficult LC, but most of them are complex, use a large number of determining factors, and they are difficult to use in day to day practice [10–13].

In our study, BMI was studied as a sole factor in causing difficulty to peritoneal access and it was found highly significant ($P<0.001$), with strict use of open Hasson's technique of pneumoperitoneum. Obesity is known to make access to the peritoneal

Table 4 Factors affecting difficulty of extraction of gallbladder

	Difficulty of GB extraction [n (%)]		P value
	Easy	Difficult	
Murphy's sign			
No	6 (12.5)	0	0.082
Yes	42 (87.5)	27 (100.0)	
History of biliary pancreatitis			
No	45 (93.8)	21 (77.8)	0.063
Yes	3 (6.3)	6 (22.2)	
History of ERCP			
No	48 (100.0)	21 (77.8)	**0.001**
Yes	0	6 (22.2)	
Gallbladder size			
Contracted	6 (12.5)	0	<**0.001**
Average	36 (75.0)	9 (33.3)	
Distended	6 (12.5)	18 (66.7)	
Gallbladder wall thickness (cm)			
<0.3	24 (50.0)	6 (22.2)	**0.027**
>0.3	24 (50.0)	21 (77.8)	
Gallbladder stone size (cm)			
<1	36 (75.0)	18 (66.7)	0.593
>1	12 (25.0)	9 (33.3)	
Gallbladder stone number			
Solitary	12 (25.0)	3 (11.1)	0.23
Multiple	36 (75.0)	24 (88.9)	
CBD diameter (cm)			
<0.8	45 (93.8)	21 (77.8)	0.063
>0.8	3 (6.3)	6 (22.2)	
First 5-min inspection			
Nonsignificant	39 (81.3)	3 (11.1)	<**0.001**
Adhesions	3 (6.3)	18 (66.7)	
Distended GB	3 (6.3)	3 (11.1)	
Sessile GB	3 (6.3)	3 (11.1)	

CBD, common bile duct; ERCP, endoscopic retrograde cholangiopancreatography; GB, gallbladder. Bold means that this parameters is significant (P<0.05).

cavity difficult. This result was concurred by other authors who stated that BMI more than 27.5 to BMI more than 30 is a significant risk factor for difficult umbilical port entry [5,11,14–16]. Thus, in morbidly obese patients it is more beneficial and less complicating to use the Veress needle technique.

In this study, difficulty in dissection of adhesion, Calot's triangle, and GB bed dissection were statistically significant in patients with a history of acute attacks, patients with a history of ERCP, patients with positive Murphy's sign on clinical examination, patients with thickened GB wall thickness more than 3 mm, and patients with adhesions on first 5-min inspection). Also, Vivek et al. [11] and Ishizaki et al. [17] have reported that a history of previous attacks, post-ERCP status, and nonvisualization of GB are associated with significant inflammatory process that causes difficulty in dissection of adhesiolysis and the Calot's triangle.

Table 5 Factors increasing the risk of conversion to open

	Conversion to open [n (%)]		P value
	No	Yes	
Sex			
Male	27 (39.1)	0	0.082
Female	42 (60.9)	6 (100.0)	
BMI (kg/m^2)	30.13±6.94	31±1.1	0.363
History of acute attacks			
No	27 (39.1)	3 (50.0)	0.678
Yes	42 (60.9)	3 (50.0)	
History of biliary pancreatitis			
No	63 (91.3)	3 (50.0)	**0.02**
Yes	6 (8.7)	3 (50.0)	
History of ERCP			
No	66 (95.7)	3 (50.0)	**0.005**
Yes	3 (4.3)	3 (50.0)	
Gallbladder size			
Contracted	6 (8.7)	0	0.65
Average	42 (60.9)	3 (50.0)	
Distended	21 (30.4)	3 (50.0)	
Gallbladder wall thickness (cm)			
<0.3	30 (43.5)	0	0.075
>0.3	39 (56.5)	6 (100.0)	
Gallbladder stone size (cm)			
<1	48 (69.6)	6 (100.0)	0.177
>1	21 (30.4)	0	
Gallbladder stone number			
Solitary	15 (21.7)	0	0.339
Multiple	54 (78.3)	6 (100.0)	
Liver parenchyma			
Normal	42 (60.9)	3 (50.0)	0.74
Fatty	24 (34.8)	3 (50.0)	
Fibrotic	3 (4.3)	0	
First 5-min inspection			
Nonsignificant	42 (60.9)	0	**0.001**
Adhesions	18 (26.1)	3 (50.0)	
Distended GB	6 (8.7)	0	
Sessile GB	3 (4.3)	3 (50.0)	

ERCP, endoscopic retrograde cholangiopancreatography; GB, gallbladder. Bold means that this parameters is significant (P<0.05).

Rizvi et al. [4] stated that the thickened GB was difficult to dissect because it had dense adhesions with the surrounding structures and in Calot's triangle. Chumillas et al. [18] have reported that to remove a difficult thick-walled inflamed GB using the fundus first technique was found to be very useful and helpful to clearly and safely expose the anatomy of the cystic duct, cystic artery, and common bile duct.

Preoperative endoscopic sphincterotomy has been considered to be associated with significant difficulty during LC by several authors [19–22]. Ranjith et al. [23] in their study observed a linear relevance between the time interval of post-ERCP and LC and the difficulty encountered during surgery.

Table 6 Factors affecting prolongation of operative time

	Operative time (min)			P value
	Median	Minimum	Maximum	
History of acute cholecystitis				
No	37.5	30	180	0.07
Yes	45.0	30	200	
History of biliary pancreatitis				
No	40.0	30	180	**0.045**
Yes	45.0	40	200	
History of ERCP				
No	40.0	30	180	**0.01**
Yes	122.5	45	200	
Gallbladder size				
Contracted	35.0	30	40	**<0.001**
Average	35.0	30	180	
Distended	48.0	40	200	
Gallbladder wall thickness (cm)				
<0.3	40.0	30	50	0.063
>0.3	46.0	30	200	
Gallbladder stone size (cm)				
<1	40.5	30	200	0.521
>1	40.0	30	90	
Gallbladder stone number				
Solitary	32.0	30	46	**0.004**
Multiple	43.0	30	200	
CBD diameter (cm)				
<0.8	40.0	30	180	0.121
>0.8	90.0	30	200	
Liver parenchyma				
Normal	36.0	30	200	0.15
Fatty	45.0	30	180	
Fibrotic	60.0	60	60	
First 5-min inspection				
Nonsignificant	35.0	30	60	**<0.001**
Adhesions	50.0	40	200	
Distended GB	45.0	40	50	
Sessile GB	145.0	110	180	

CBD, common bile duct; ERCP, endoscopic retrograde cholangiopancreatography; GB, gallbladder. Bold means that this parameters is significant ($P<0.05$).

Boerma *et al.* [19] and Metin *et al.* [24] assumed that the reasons for difficulty were due to changes in the anatomy and presence of dense adhesions. It has been postulated that repeated passage of small gallstones through the cystic duct into the biliary tract, multiple previous ERCPs and contrast material injection may cause obstruction, inflammation, or distortion of anatomy at Calot's triangle. It is also a known fact that ERCP and stenting increases the bacterial colonization in the bile, which may be a factor that may induce inflammation simulating cholangitis and subsequent scarring of the hepatoduodenal ligament, ultimately hindering the dissection of Calot's triangle [25]. The change in GB structure is also a factor which makes handling difficult. GB tends to become thick walled as a result of fibrosis secondary to previous inflammation. The ERCP-trigger off inflammatory reaction in the biliary tree and Calot's triangle may be the cause for scarring and fibrosis of the GB in the long run [11,24].

In our study, bile and stone spillage were found statistically significantly affected with distended GB and dense adhesion. This may be attributed to multiple perforations in GB during dissection. Sarli *et al.* [26] reported that when the analysis took the experience of the surgeon into account and the various parameters were evaluated with multivariate analyses, the surgeon's experience was the only factor related to GB perforation. It is likely that the expert surgeon carries out the LC without procuring lesions of the GB wall, even under conditions of great difficulty. This is in agreement with Jones *et al.* [27], who have observed that the event is more frequent when most laparoscopic cholecystectomies are performed by junior surgical residents.

In our study, a history of biliary pancreatitis, history of ERCP, and presence of adhesions were statistically significant factors affecting the risk of bleeding during dissection. Ranjith *et al.* [23] have stated that in cases with a history of preoperative ERCP, the bleeding was diffuse making visibility a problem and the subsequent fear of inadvertently damaging structures with an attempt to control the bleeding. Liver bed bleeding was also higher as the plane of dissection was altered due to adhesions and liver capsule tears. Use of a surgical gauze during dissection alleviated much of this difficulty.

In the current study, difficult extraction of GB was found in cases with a positive history of ERCP, distended GB, GB wall thickness more than 3 mm, and cases with dense adhesions on the first 5 min of inspection. Vivek *et al.* [11] and Gabriel *et al.* [28] perceived that difficulty in GB extraction was associated with distended GB and presence of multiple stones. A distended GB or the presence of multiple stones cause difficulty in extracting the specimen through the small incision, thus leading to the need to aspirate the GB, extend the epigastric port, and the increased probability of GB perforation during this procedure.

In our study, dense adhesions in the first 5 min, history of biliary pancreatitis, and history of ERCP were statistically significant for conversion to open cholecystectomy especially if there were other risk factors like liver cirrhosis, old age, or high BMI. The reason for conversion to open was due to un-identified anatomy and for fear of major biliary injury. The conversion rate to open surgery in LC has declined to 2–6% due to advances in laparoscopic skills in last

years [29]. The need for conversion to laparotomy is neither a failure nor a complication, but an attempt to avoid complications. It may be helpful to determine the risk of conversion of an LC to open cholecystectomy (OC) beforehand [30]. This may allow the patients to be better prepared for surgery and to plan their absence from work [31]. Also, such prediction may allow a surgeon to to take extra precautions to reduce intraoperative complications, and to convert from LC to OC at an earlier stage [5]. Age, sex, American Society of Anesthesiologists score, BMI, previous abdominal surgery, history of cholecystitis and pancreatitis, increased in biliary obstructive enzymes (gamma glutamyl transferase and alkaline phosphatase) are the most commonly studied factors for conversion to open surgery [32–38]. Schrenk *et al.* [34] have reported in a study of 1300 patients assessing 24 variables for conversion that patients with a history of acute cholecystitis within the last 3 weeks were at an increased risk of conversion. GB wall thickness has been identified as a risk factor for conversion in several studies. The thickness of GB associated with conversion varies from study to study. It was 3 mm in studies by Nachnani and Supe [5], Fried *et al.* [39], and Nidoni *et al.* [3] and 4 mm in a study by Jansen *et al.* [40], but in our study, GB wall thickness was not a significant factor for conversion to open. Several other studies have reported oppositely that GB wall thickness was of little or no benefit in predicting operative technical difficulty or conversion to an OC [9,19,29,41]. Ranjith *et al.* [23] and Le *et al.* [42] stated that adhesions is a major risk for conversion to open. While Prabhu *et al.* [43] stated that biliary pancreatitis is not a risk factor for conversion to open.The de Vries *et al.* [44] study showed that a significantly higher conversion rate was encountered when LC was performed 2–6 weeks after ERCP, as compared with 1 week after ERCP. Reports of LC performed within days after endoscopic sphincterotomy show conversion rates as low as those for patients with uncomplicated cholelithiasis [45–47]. This agrees with our study for LC post-ERCP, all of the cases with a history of ERCP in this study were done at 6 weeks post-ERCP.

In this study, biliary pancreatitis, history of ERCP, distended GB, multiple GB stones, and dense adhesions significantly prolonged the operative time. This may be attributed to difficult adhesiolysis and dissection during operation. In addition, our findings were concurred by Ranjith *et al.* [23], Vivek *et al.* [11], and Prabhu *et al.* [43].

Prabhu *et al.* [43] stated that interval cholecystectomy following an attack of acute biliary pancreatitis had prolonged operative time; this was attributed to dense adhesions and prolonged time taken for dissection and for braking down these adhesions.

Conclusion
This study concluded that concerning the predicting factors of difficult LC, BMI, history of acute attacks, positive Murphy's sign, history of ERCP, history of biliary pancreatitis, GB wall thickness more than 3 mm, multiple GB stones, and dense adhesion dose pose difficulty in various steps during LC. So, preoperative prediction of possible difficulties may help a surgeon in choosing the approach (open/laparoscopic) most suitable for a particular patient; the patient also need to be counseled about it.

Conflicts of interest
There are no conflicts of interest.

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