The surprise of difficult complicated laparoscopic cholecystectomy: a preoperative predictive scoring system to avoid it

Mohamed B.M. Kotb, Abd-Elrahman El Abasy, Mostafa T. Ahmed, Mahmoud T. Ayoub

Department of General Surgery, Faculty of Medicine, Assiut University Hospital, Assiut, Egypt

Correspondence to Mohamed B.M. Kotb, MD, Assiut University Hospital, Assiut 71511, Egypt. Mobile: 01012127297; e-mail: kotb.kottb73@gmail.com

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Introduction and aim
Laparoscopic cholecystectomy (LC) has been accepted as the procedure of choice for management of troublesome gallbladder stones. (a) Difficult LC is a challenging problem, and still iatrogenic injuries occur. (b) This study aims to evaluate a preoperative score that predicts difficulty of LC. The benefit of such valuable scoring tool is to choose the suitable procedure and surgeon for each patient, which would give best results and fewer complications.
Background
The more a technique is practiced and spread, the more the need to assess its results and technique based on evidence-based medicine. (c) Difficult cholecystectomy is a problem that general surgeons encounter commonly. Common bile duct injuries have a serious postoperative morbidity and mortality potential. (d) We focused our effort to develop and validate an easy scoring system to predict difficult LC preoperatively.
Patients and methods
This is a prospective study that included 100 patients who underwent LC at Assiut university hospitals. The operator for all cases was the same experienced surgeon. There were 17 variables from history, clinical examination, radiological, and laboratory findings. Difficult LC was defined as the duration of surgery in minutes is longer than average operative time for the same experienced surgeon.
Results
It was noticed that patients with difficult LC had significantly higher mean age (49.11 ± 5.56 vs. 40.78 ± 12.07 years; P<0.001), BMI (31.65 ± 4.92 vs. 21.16 ± 2.60 kg/m^2; P<0.001), previous history of upper abdominal operations (0 vs. 10%; P=0.02), acute cholecystitis (6.7 vs. 42.5%; P<0.001), acute pancreatitis (1.7 vs. 15%; P=0.01), thick gallbladder wall (6.75 vs. 47.5%; P<0.001), and high alkaline phosphatase (15 vs. 37.5%; P=0.01) in comparison with those with easy LC. Mean operative time was 82.50 ± 27.84 min. A total of 60 (60%) cases were classified as easy LC, whereas 40 (40%) cases were classified as difficult LC.
Conclusion
We could predict difficult LC cases preoperatively with the help of this scoring system, and hence, high-risk patients may be informed regarding the probability of conversion and choose the best suitable surgeon accordingly.

Keywords:
difficult, laparoscopic cholecystectomy, prediction, scoring

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Introduction

Laparoscopic cholecystectomy (LC) is now accepted as the gold standard procedure for the treatment of gallstone diseases in both emergency and elective situations, replacing the old conventional approach of open cholecystectomy [1]. There are many advantages in favor of LC against OC such as less postoperative pain, early recovery to regain normal activities, earlier oral intake, decreased postoperative hospital stay, and quite importantly better cosmetic results [2]. This worldwide spread and increasing practice of LC made it important to assess its results and technique on the background of evidence-based medicine. Twenty-five years and more have passed since the introduction of LC [3]. The surgical practice has improved and conversion rate is decreasing in comparison with the previous decade; however, still BDI and vascular injuries are reported. Iatrogenic BDI has great postoperative morbidity and mortality potential. Multiple studies and meta-analyses have concluded that many of these intraoperative accidents are avoidable. Ductal and vascular anatomical variants, pathological conditions,

and adhesions are the main causes of iatrogenic BDI during the dissection of Calot's triangle [4]. Numerous studies had been carried out to predict the risk and difficulty of LC aiming to optimize the operative results by either selecting the patient suitable for the procedure or providing a well-experienced surgical team for specific patients [5].

Patients and methods

This prospective nonrandomized clinical study was conducted in the Department of General Surgery at Assiut University Hospitals from January 2019 to December 2019 and was approved by the Institutional Research Board of Faculty of Medicine at Assiut University. IRB local approval number is 17100679. Inclusion criteria for this study were adult male or female patients, aged above 18 years, and undergoing elective LC due to symptomatic gallstones disease. Patients with complicated calculus cholecystitis at the time of admission, patients undergoing LC with other laparoscopic surgical procedures, and converted cases due to equipment failure were excluded from this study. Variables under study were divided into independent variables and outcome variables. Independent variables were age, sex, BMI, previous attacks of acute cholecystitis, previous attacks of pancreatitis, history of upper abdominal surgery, neutrophil and alkaline phosphatase level, and ultrasonographic findings of the gallbladder. The outcome variable was assigned as the time taken from first port incision to last port site closure in minutes. Difficult LC was defined as the duration of surgery in minutes is longer than average operative time for the same experienced surgeon. A written informed consent was offered to all participants in this study. Before the day of surgery, all patients had full laboratory investigations and surgical fitness assessments. The operator for all cases was the same experienced surgeon with a long history of successful LC. We used the standard four-port technique in the American position. Analysis of different preoperative risk factors and their effect on the outcome variable was performed using the *t* test. *P* value of less than 0.05 was considered significant.

Results

Patients with difficult LC had significantly higher mean age (49.11 ± 5.56 vs. 40.78 ± 12.07 years; *P*<0.001). A total of 19 (47.5%) patients with difficult LC were more than 50 years old, whereas only eight (13.3%) patients with easy LC were more than 50 years old. Mean BMI was significantly higher among patients with difficult LC (31.65 ± 4.92 vs. 21.16 ± 2.60 kg/m^2; *P*<0.001). There were 37 (92.5%) patients with BMI more than 25 kg/m^2, whereas only three (7.5%) patients with BMI less than 25 kg/m^2. Moreover, patients with difficult LC had significantly higher frequency of previous upper abdominal surgery (10 vs. 0%; *P*=0.02), acute cholecystitis (42.5 vs. 6.7%; *P*<0.001), acute pancreatitis (15 vs. 1.7%; *P*=0.01), thick gallbladder wall (47.5 vs. 6.75%; *P*<0.001), and high alkaline phosphatase (37.5 vs. 15%; *P*=0.01) in comparison with those with easy LC. Mean operative time was significantly longer among patients with difficult LC (109.87 ± 19.33 vs. 51.10 ± 4.56 min; *P*<0.001). Other characteristics showed no significant differences between both groups of patients (Table 1).

Multivariate regression analysis for prediction of difficult LC: based on the current study, predictors of difficult LC included age more than 50 years (odds ratio=4.9), BMI exceeding 25 kg/m^2 (odds ratio=11.34), previous upper abdominal operations (odds ratio=3.11), acute cholecystitis (odds ratio=2.22), and thick-walled gallbladder (odds ratio=4.30). Based on these predictors, each patient had allocated points, and the total number of patients with difficult LC was significantly higher than those with easy LC (15.60 ± 5.44 vs. 5.50 ± 2.20; *P*<0.001) (Table 2).

Accuracy of the proposed score in the current study to predict difficult LC: it was noticed that at cut-off point more than 13, this proposed score had 70% sensitivity and 90% specificity for prediction of difficult LC with the overall accuracy of 82% and area under the curve of 0.88.

Discussion

The study enrolled 100 patients with mean age of 41.70 ± 13.64 years, ranging between 19 and 85 years old. In this study, age was a significant risk factor for the prediction of difficult LC. The mean age for difficult cases was 49.11 ± 5.56 years, and the mean age for easy cases was 40.78 ± 12.07 years, with *P* value less than 0.001. Other studies conducted by Lee and colleagues, Khan and colleagues, Randhawa and colleagues, and Wiebke and colleagues, found that age over 50 years is a significant risk factor. The explanation of this relationship between age and difficulty was suggested to be the long history of gallstone disease and increased attacks of cholecystitis [6–9].

In this study, we included 75 (75%) female patients and 25 (25%) male patients. Our study revealed that male sex was not a significant predictor for difficult LC. In studies conducted by Priyadarshini and Adusumilli [10], and Nachnani and Supe [11], the difference between male and female groups was not significant. In another study done by Lipman *et al.* [12], 50.9% of male patients required conversion to open cholecystectomy.

Table 1 Characteristics of enrolled patients based on the type of cholecystectomy

	Easy (*N*=60)	Difficult (*N*=40)	*P* value
Age (years)			
Class	40.78 ± 12.07	9.11 ± 5.56	< 0.001
<50 years	52 (86.7)	21 (52.5)	< 0.001
> 50 years	8 (13.3)	19 (47.5)	
BMI (kg/m^2)			
Class	21.16 ± 2.60	31.65 ± 4.92	< 0.001
< 25 kg/m^2	36 (60)	3 (7.5)	< 0.001
> 25 kg/m^2	24 (40)	37 (92.5)	
Sex			
Male	12 (20)	13 (32.5)	0.12
Female	48 (80)	27 (67.5)	
Hypertension	4 (6.7)	4 (10)	0.40
Diabetes mellitus	1 (1.7)	3 (7.5)	0.17
Previous history of			
Abdominal operations	0	4 (10)	0.02
Acute cholecystitis	4 (6.7)	17 (42.5)	< 0.001
Acute pancreatitis	1 (1.7)	6 (15)	0.01
Biliary colic in last 3 weeks	51 (86.4)	38 (95)	0.14
Palpable gallbladder	0	2 (5)	0.40
Hypochondrial tenderness	8 (13.3)	11 (27.5)	0.06
Thick wall gallbladder	4 (6.7)	19 (47.5)	< 0.001
Pericholecystic collection	0	2 (5)	0.15
Shrunken gallbladder	8 (13.3)	5 (12.5)	0.57
High neutrophil	4 (6.7)	3 (7.5)	0.58
High fibrinogen	4 (6.7)	5 (12.5)	0.25
High alkaline phosphatase	9 (15)	15 (37.5)	0.01
Operative time (min)	51.10 ± 4.56	109.87 ± 19.33	< 0.001

Data are expressed as mean (SD) and frequency (percentage). *P* value was significant if less than 0.05.

Table 2 Multivariate regression analysis for prediction of difficult laparoscopic cholecystectomy

	Odds ratio	95% CI	*P* value	Allocated points
Age > 50 years	4.9	1.19–12.34	0.02	5
BMI > 25 kg/m^2	11.34	2.49–19.11	< 0.001	11
Abdominal operations	3.11	1.29–7.77	< 0.001	3
Acute cholecystitis	2.22	1.44–3.46	0.01	2
Acute pancreatitis	2.11	0.73–2.27	0.08	0
Thick wall gallbladder	4.30	1.07–13.33	0.03	4
High ALK	1.23	0.22–187	0.12	0

ALK, alkaline phosphatase; CI, confidence interval; LC, laparoscopic cholecystectomy. *P* value was significant if less than 0.001.

Obese population are more liable to develop calculus gallbladder owing to increased synthesis of cholesterol by the liver [13]. In the present study, mean BMI was found to be significantly higher among patients with difficult LC (31.65 ± 4.92 vs. 21.16 ± 2.60 kg/m^2; *P*<0.001), where 37 (92.5%) patients had BMI more than 25 kg/m^2. In agreement with our study, Hussein and Raheef [14], Nachnani and Supe [11], and Baki [15] reported that BMI is a significant risk factor for difficulty and conversion rate.

In the present study, 21 patients had a history of acute cholecystitis. Patients with difficult LC had a significantly higher frequency of previous attacks of acute cholecystitis (42.5 vs. 6.7%; *P*<0.001) in comparison with patients with easy LC. Baki [15], in their study, observed that previous attacks of acute cholecystitis are significantly associated with a longer mean duration of surgery. Moreover, acute pancreatitis was found to be a statistically significant factor for difficult LC, (15 vs. 1.7%; *P*=0.01) in comparison with those with easy LC. In a study conducted by Nachnani and Supe [11], history of acute pancreatitis was proved to be the most common reason for conversion owing to failure to achieve a critical view of safety.

Previous abdominal surgeries lead to adhesions between viscera or omentum and anterior abdominal wall, and chances of injury of these structures during insertion of first port and risk of conversion are high [16]. In the current study, previous upper abdominal surgery was found to be significantly associated with difficult LC (10

vs. 0%; *P*=0.02) in comparison with patients with easy LC. The studies by Nachnani and Supe [11] and Wiebke *et al*. [9] concluded that previous upper abdominal surgery was a significant predictor for difficult LC.

In our study, ultrasound findings of the thick gallbladder wall, more than 4 mm, and shrunken gallbladder were found to be significant risk factors for difficult LC. The studies by Kulkarni and Kumar [17], Baral and Thapa [18], Nachnani and Supe [11], and Lipman *et al*. [12] reported that gallbladder wall thickness over 4 mm and contracted gallbladder were highly significant risk factors in predicting LC difficulty.

Odds ratio: in our study, LC was performed on 100 patients, and multiple preoperative variables were assessed to predict difficulty of LC. Age, sex, BMI, previous attacks of acute cholecystitis, previous attacks of pancreatitis, history of upper abdominal surgery, neutrophil and alkaline phosphatase level, and ultrasonographic findings of gallbladder were included as preoperative risk factors. Our results revealed that predictors for difficult LC were age more than 50 years old (odds ratio=4.9), BMI exceeded 25 kg/m^2 (odds ratio=11.34), thick gallbladder wall more than 4 mm (odds ratio=4.30), previous upper abdominal operations (odds ratio=3.11), past history of acute cholecystitis (odds ratio=2.22), and attacks of acute pancreatitis (odds ratio=2.11). Using these predictors with their different odds ratios, a proposed score has emerged. We found that this score was significantly higher among patients with difficult LC (15.60 ± 5.44 vs. 5.50 ± 2.20; *P*<0.001). The score at cutoff point more than 13 had 70% sensitivity and 90% specificity for prediction of difficult LC, with overall accuracy of 82% and area under the curve of 0.88.

Conclusion

We could predict difficult LC cases preoperatively with the help of this scoring system, and hence, high-risk patients may be informed regarding the probability of conversion and surgeons also may have to schedule the time and team for the operation appropriately. Surgeons can be aware of possible complications that may arise during surgery.

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Conflicts of interest

There are no conflicts of interest.

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