Does difficulty assessment of laparoscopic cholecystectomy using currently available preoperative scores need revision?

Sherif Boraii[a], Doaa H. Abdelaziz[b,c]

Departments of [a]Hepatobiliary Surgery, [b]Clinical Pharmacy, The National Hepatology and Tropical Medicine Research Institute, Cairo, [c]Clinical Pharmacy and Pharmacy Practice, Faculty of Pharmaceutical Sciences and Pharmaceutical Industries, Future University in Egypt, Cairo, Egypt

Correspondence to Doaa H. Abdelaziz, PhD, Department of Clinical Pharmacy, The National Hepatology and Tropical Medicine Research Institute, 10 A Kasr Al-Einy Street, Fom El-Khalig, Cairo, 4260010, Egypt.
Tel (office): 202 236 49005; fax: 202 236 8372;
e-mail: abdelaziz.h.doaa@gmail.com

Introduction
Risk factors used for preoperative anticipation of a difficult laparoscopic cholecystectomy should be identified to prevent complications beforehand. The aim of this study was to evaluate factors predicting difficulty and the possibility of conversion to open cholecystectomy before surgery.

Patients and methods
Patients diagnosed with symptomatic cholelithiasis and scheduled for elective laparoscopic cholecystectomy were enrolled in the study. Patient's age and sex, previous hospital admissions, BMI, previous abdominal scar, a palpable gall bladder, gall bladder wall thickness, the presence of pericholecystic fluid collection, and impacted stone are considered risk factors that were used to calculate preoperative scores. Surgical procedure was categorized intraoperative as easy, difficult, or very difficult on the basis of duration of surgery or conversion to open cholecystectomy.

Results
There was no significant difference between intraoperative difficulty regarding age, sex, BMI, and the presence of either abdominal scar or impacted stone. The absence of previous history of hospitalization and the presence of nonpalpable gall bladder were significantly associated with intraoperative categorization as easy cases (P=0.002).

Discussion and conclusion
The evaluated scoring system requires meticulous revision for the factors included. Insensitive factors could be removed without negative effect on the outcome. Focus should be directed toward significant items regarding sonography findings. It could be applied as a useful tool to predict easy cases but needs adjustment for the factors considered in case of predicting difficult and very difficult cases. The experience of the surgeon is an important factor in assessing difficulty intraoperative.

Keywords:
conversion, laparoscopic cholecystectomy, predicting difficulty

Introduction
Based on its minimal invasiveness, less postoperative pain, and early recovery, laparoscopic cholecystectomy (LC) is the gold standard for managing symptomatic gallstone diseases [1,2]. However, it is one of the most complicated surgical operations owing to various difficulties such as anatomical variations, presence of dense adhesions, as well as presence of contracted or gangrenous gall bladder [3,4]. Elsewhere, the rate of conversion to open cholecystectomy ranged from 1 to 35% [2,5].

Preoperative anticipation of an uneasy LC can help surgeons to prevent intraoperative complications beforehand. Therefore, this study evaluated factors predicting LC difficulty and the possibility of open cholecystectomy conversion before surgery.

Patients and methods
This was an observational prospective study conducted on 60 patients from November 2018 to June 2019. All patients scheduled for elective LC who came to the Department of Surgery in a tertiary hospital were enrolled in the study after signing an informed consent. Exclusion criteria from the study included age below 20 years old, presence of obstructive jaundice, dilatation of common bile duct, and patients who were medically unfit for anesthesia. The cases of LC to open conversion owing to equipment failure or any emergency surgery were excluded from the study. This study was started after

it had been approved by the institute's ethical committee and was performed in accordance with the ethical standards and with the revised Helsinki Declaration of 2000.

Diagnosis of symptomatic cholelithiasis was confirmed using abdominal ultrasonography. One day before surgery, a preoperative score was calculated for every patient by simple allocation of points according to history, clinical parameters, and sonography findings. History and patient's characteristics included age, sex, and previous hospital admissions owing to acutely inflamed gall bladders. Clinical parameters included BMI, previous abdominal scar categorized as supraumbilical or infraumbilical, and the presence of palpable gall bladder. Sonography findings included gall bladder wall thickness and the presence of pericholecystic fluid collection and impacted stone. Each of the previous parameters was scored 0, 1, or 2 as described by Randhawa and Pujahari [6]. Preoperative scores up to 5 were defined as easy, scores 6–10 as difficult, and scores 11–15 as very difficult LC. Cholecystectomies were performed by a single experienced laparoscopic surgeon. CO_2 pneumoperitoneum was used as usual with 15 mmHg pressure and through the standardized four-port technique (two 10-mmHg ports and two 5-mmHg ports). Monopolar electrocautery was used as the hemostatic modality. All patients were administered prophylactic antibacterial agents at anesthesia induction and continued 1 day after surgery. All the cases received standard postoperative care and follow-up. Surgery time was calculated from first skin incision to last wound closure. Surgical procedure was categorized intraoperative as easy operation if the surgeon took less than 60 min to complete. If LC took more than 60 min but less than 120 min, it was considered as a difficult operation. A very difficult operation was considered when the patient was converted to open cholecystectomy or the surgeon took more than 120 min to complete. Conversion to open surgery was done through Kocher incision laparotomy.

Statistical analysis
All data were analyzed using the software Statistical Package for the Social Science (SPSS 15.0; SPSS Inc., Chicago, IL, USA). χ^2 test was used to detect the significance between the preoperative prediction of difficulty and the actual score identified during LC. Area under receiver operating characteristic (ROC) was used to find the diagnostic and predictive value of the score in anticipating the surgery difficulty intraoperative.

Results
A total of 60 patients with a mean age of 47.52±13.38 years (range, 20–74 years) and a mean BMI of 29.07 ±4.22 kg/m^2 (range, 24–40 kg/m^2) were included. Most patients were males with a percentage of 63.3% (n=38). Mean intraoperative time was 52.7 ±12 min (range, 40–115 min). Conversion rate from laparoscopic to open cholecystectomy was 8.3%. Conversion was required in five cases, all because of unclear anatomy during dissection. Two cases were converted owing to the presence of pericholecystic abscess and empyema of the gall bladder. The extensive invasion of a malignant gall bladder to the stomach, liver, and the colon was the reason behind conversion in one patient. The presence of a shrunken gall bladder with unclear anatomy led to conversion in a single patient, whereas the last patient who required conversion had Mirizzi syndrome. Cystic artery was injured in a single cirrhotic female patient (1.67%) whose preoperative predictive score was 5 but was assessed intraoperative as a difficult procedure that required 83 min to complete. Cystic artery injury or spillage of bile was not the reason for conversion in any of the studied cases. Spillage of bile was detected in 12 (20%) cases, with a mean intraoperative time of 52.92±3.4 min (range, 47–58 min), and all of them were assessed intraoperative as an easy grade LC. Saline irrigation and suction were used to manage bile spillage successfully. Postsurgery stay in the hospital was 1.03±0.7 days.

At preoperative score of 7, which represents the best cutoff value, sensitivity and specificity of this scoring method were 77.8 and 86.3%, respectively. At the value of 5, the score could predict the surgery difficulty with sensitivity and specificity of 88.9 and 68.6%, respectively. Area under ROC curve was 0.902, as clear in Fig. 1. Prediction came true in 97.2% for easy LC. A total of 23 patients were predicted preoperatively as a difficult LC where their scores ranged from 6 to 10. Two of these 23 patients, were assessed intraoperative as difficult LC and five patients were converted to open cholecystectomy. A single female had score equal 11 preoperatively but was assessed intraoperative as a difficult procedure that required 80 min to complete, as clear in Table 1.

Operative time was statistically prolonged in cases categorized as difficult or very difficult versus those categorized as easy cases according to preoperative assessment score.

Figure 1
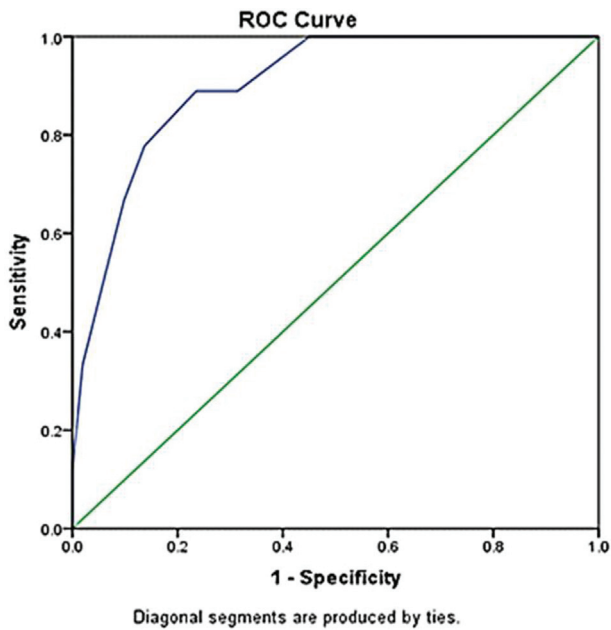
Area under the receiver operating characteristic curve to predict the surgical difficulty based on the preoperative scores.

Table 1 Correlations of preoperative score and the intraoperative outcome

Preoperative score	Easy [n (%)]	Difficult [n (%)]	Very difficult [n (%)]	Total [n (%)]
0–5	35 (58.33)	1 (1.67)	–	36 (60)
6–10	16 (26.67)	2 (3.33)	5 (8.33)	23 (38.33)
11–15	0	1 (1.67)	0	1 (1.67)
Total	51 (85)	4 (6.67)	5 (8.33)	60 (100)

The current study demonstrated that there is no significant difference between intraoperative categorization as easy or difficult and very difficult cases regarding age of the patients, sex, BMI, and the presence of either abdominal scar or impacted stone, as shown in Table 2. The absence of previous history of hospitalization owing to attacks of acute cholecystitis is significantly associated with intraoperative categorization as easy cases ($P=0.002$). All patients with nonpalpable gall bladder were categorized intraoperative as easy cases ($P=0.002$). Thickened gall bladder wall was observed in 100% of the difficult and very difficult cases ($P=0.041$). The presence of pericholecystic collection was significantly observed in difficult and very difficult cases ($P=0.001$), as presented in Table 2. There was no statistical significance between cirrhotic and noncirrhotic patients regarding intraoperative assessments of easiness of LC. Fourteen cirrhotic and 37 noncirrhotic patients were categorized as easy LC intraoperative ($P=0.704$).

Discussion

Understanding outcomes is a key to advanced health care. As conversion to open cholecystectomy is an essential part of safe surgical practice, a greater understanding of the factors leading to conversion and potential postoperative complications would be essential too. Literature is full of studies using different preoperative scores done to assess the difficulty of LC. This is done in a hope to prepare the surgeon and the staff to events which might happen, reduce intraoperative complications as much as possible, and to properly arrange the theater time.

The preoperative score used in this study is considered sensitive in the prediction of easy cases, but on the contrary, most of the difficult cases as assessed preoperatively have been labeled intraoperative as easy cases. The reason behind would be the experience of the surgeon, which plays a great role in getting around difficulties that might happen during the surgery.

It has been documented in literature that conversion rate ranged from 7 to 35% [5]. In the current study, conversion rate is 8.3%. All surgeries were performed by a single experienced surgeon where the experience of the surgeon should be regarded as the most important factor considered in for conversion. The conversion rate documented in the current study is higher than that documented by Sharma et al. [7] and Nidoni et al. [8], where overall conversion rates in their studies were 4 and 6%, respectively.

In the current study, cystic artery was injured in a single female patient, which required 83 min to complete through laparoscope, and bleeding was controlled using clip. The same findings were reported by Gupta et al. [9], where artery injury was documented in three cases, and all of them needed no conversion. A study performed by Cuschieri et al. [10] reported bleeding owing to cystic artery conversion as a cause of conversion.

Bile spillage was present in 20% of our cases, but none of them were converted owing to this cause. This is consistent with the results reported by Gupta et al. [9] where none of the cases that experienced bile spillage were converted. Frazee et al. [11] have reported conversion owing to spillage of bile. Intraoperative time in our cases that experienced bile spillage was less than 60 min, which were the same findings of Gupta et al. [9].

Table 2 Predictable factors for easy, difficult and very difficult cases

Risk factor	Number of patients [n (%)]	Difficult and very difficult cases (N=9) [n (%)]	Easy cases (N=51) [n (%)]	P value
Age				
≤50	31 (51.7)	3 (33.3)	28 (54.9)	0.292[a]
>50	29 (48.3)	6 (66.7)	23 (45.1)	
Sex				
Male	38 (63.3)	5 (55.6)	33 (64.7)	0.599[b]
Female	22 (36.7)	4 (44.4)	18 (35.3)	
Previous history of hospitalization				
Yes	15 (25)	6 (66.7)	9 (17.6)	0.002[b]
No	45 (75)	3 (33.3)	42 (82.4)	
BMI				
<25	3 (5)	0	3 (5.9)	0.606[b]
25–27.5	31 (51.7)	4 (44.4)	27 (52.9)	
>27.5	26 (43.3)	5 (55.6)	21 (41.2)	
Abdominal scar due to previous surgery				
Yes	3 (5)	1 (11.1)	2 (3.9)	0.391[a]
No	57 (95)	8 (88.9)	49 (96.1)	
Palpable gall bladder				
Yes	3 (5)	3 (33.3)	0	0.002[a]
No	57 (95)	6 (66.7)	51 (100)	
Gall bladder wall thickness				
Yes	43 (71.7)	9 (100)	34 (66.7)	0.041[b]
No	17 (28.3)	0	17 (33.3)	
Pericholecystic collection				
Yes	10 (16.7)	5 (55.6)	5 (9.8)	0.001[b]
No	50 (83.3)	4 (44.4)	46 (90.2)	
Impacted stone				
Yes	6 (10)	2 (22.2)	4 (7.8)	0.185[b]
No	54 (90)	7 (77.8)	47 (92.2)	
Total surgery time[c]		58.37±16.42	49.69±7.54	0.009[d]

[a]Fisher's exact test was used. [b]χ^2 test was used. [c]Data is obtained from 19 difficult and very difficult cases and 36 easy cases according to preassessment score. [d]Independent t test was used P value below 0.05 is considered statistically significant.

Conversion was documented in five cases in the present study where all of them were assessed as difficult operation according to the preoperative assessment score. As conversion occurs for reasons other than cystic artery injury and bile spillage, then intraoperative assessment could depend solely on surgeon experience.

Patients older than 50 years are considered having a significant risk factor for difficult LC as reported in various studies [12,13]. In the current study, the mean age of the cases that required conversion was 61.2±7.8 years, ranged from 52 to 73 years. In our study, although higher conversion rates had been observed in individuals older than 50 years, age was not documented as a significant predictor of LC difficulty (P=0.292). This might be attributed to the long surgical experience that exceeds 20 years in the field of laparoscopic surgery. These findings are consistent with the results observed by Gupta et al. [9].

Male sex was not considered as a significant factor in assessing LC difficulty in the present study, where 64.7% of the easy cases as assessed intraoperative were males (P=0.599). The same findings were observed by Gupta et al. [9]. On the contrary, various studies reported that male sex makes LC surgery a difficult operation [13–15]. Another study reported a significant higher conversion rate with male sex [16]. Again, the experience of the surgeon is the most important factor in assessing the cases intraoperative, as four patients out of the five cases that required conversion are males.

History of hospitalization either for recent or previous attacks of acute cholecystitis renders the surgery difficult with the possibility of conversion in some cases. In the current study, history of hospitalization was a significant predictor for LC difficulty (P=0.002). Six patients representing 66.7% of those who were assessed intraoperative as difficult or very difficult cases had a history of hospitalization owing to one or more acute cholecystitis attacks. Five patients out of those six were converted into open cholecystectomy. These findings were consistent with those observed in various studies [6,16,17]. This could be explained by

adhesions in the Calot's area that required more time for dissection.

A BMI higher than 25 was observed in 100% of the cases that were assessed intraoperative as difficult or very difficult cases, although did not significantly affecting the outcome (P=0.606). The same observation was identified by Rosen et al. [18] who stated that obesity could be considered a risk factor for assessing LC difficulty. This was owing to the large fat deposition around the gall bladder, making it more difficult to dissect the Calot's triangle.

The absence of abdominal scar owing to previous upper or lower abdominal surgery was observed in 49 patients, representing 96.1% of the cases that were categorized as easy LC as assessed intraoperative. The time required for gall bladder dissection in those patients was less than 60 min. A single female patient with infraumbilical scar was observed in the current study with no significant effect on prediction of LC difficulty (P=0.391). Time needed to complete LC for this single female patient who did not require conversion was 80 min, although scored 11 through the preoperative assessment. These findings were not consistent with those observed in other studies [13,14] which stated that the risk of conversion was high in cases that had previous abdominal surgery. The experience of the surgeon could overcome adhesions present between viscera and abdominal wall. Supraumbilical scar was not detected in any of the cases recruited in the current study as confirmed by Gupta et al. [9].

The absence of a palpable gall bladder was identified in 100% of the cases labeled intraoperative as easy operation with a significant correlation (P=0.002). One study conducted by Randhawa and Pujahari [6] and another one conducted by Gupta et al. [9] had correlated significant association between palpable gall bladder and intraoperative difficulty, which were consistent with our findings. This might be attributed to difficulty to catch hold of gall bladder fundus in distended palpable ones. This could be time consuming owing to spillage of gall bladder content into peritoneal cavity.

Thickened gall bladder wall is considered an ultrasonography warning for the laparoscopic surgeon. A gall bladder wall thicker than 4 mm is a potential for a difficult LC operation [17]. It is considered a significant factor in prediction of conversion to open cholecystectomy as observed in previous studies [14,19]. In the present study, 100%

of the patients (nine patients) assessed intraoperatively as difficult or very difficult cases had a thick gall bladder wall (>4 mm) with a significant association (P=0.041). All the patients who required conversion in the current study had a gall bladder wall thicker than 4 mm as assessed preoperatively. These findings might highlight the idea of accepting the preoperative score in predicting difficulty regarding thickness of gall bladder, considering it a significant risk factor. The same results were observed by a study performed by Gupta et al. [9], where thick gall bladder wall was documented in 54 patients, and its significance for difficulty prediction was ascertained. The absence of any ultrasonography findings that could differentiate between easy and difficult LC as concluded by Carmody et al. [20] should be further investigated on a larger sample size in controlled multicenter trials.

Another ultrasonography finding of acute cholecystitis is the presence of pericholecystic fluid [21]. It is considered a significant factor in prediction of LC difficulty as observed by Randhawa and Pujahari [6]. In the current study, the absence of pericholecystic collection by ultrasound was documented in 90.2% of the cases assessed intraoperative as easy operations with a significant association (P=0.001). Five patients who were assessed intraoperative as difficult or very difficult cases had pericholecystic collection by ultrasound; one of them was converted to open cholecystectomy.

As a result, the evaluated scoring system needs to be revised. Insensitive factors such as age, sex, BMI, and the presence of abdominal scar could be removed without negative effect on the outcome. Focus should be directed toward significant items regarding sonography findings.Sensitivity and specificity of the scoring system evaluated in the current study – at score 5–were 88.9 and 68.6% for prediction of difficulty, respectively. Area under the curve was 0.902. A previous study conducted by Randhawa and Pujahari [6] using the same score had reported sensitivity and specificity of 75 and 90.24%, respectively. Hence, in the current study, this scoring system was considered more sensitive than the study by Randhawa and Pujahari. Comparable to the results confirmed in the present study, sensitivity and specificity of 95.7 and 73.68%, respectively, were reported by Gupta et al [9], with a comparable value of area under ROC curve (0.86). In the current study, prediction came true in 97.2% for the easy cases, which is considered higher than what

has been seen by Gupta *et al.* [9] (90%) and those published by Randhawa and Pujahari [6] (88.8%). However, true prediction values for difficult cases in the current study was 37.5%, which is considered much lower than that reported by Randhawa and Pujahari [6] (92.2%) and by Gupta *et al.* [9] (88%). Therefore, this scoring system could be considered more sensitive in the prediction of easy LC more than its prediction for the difficult cases.

The scoring system evaluated in the current study requires meticulous revision as some included variables are not considered significant and thus it should not be applied in practice as granted. The evaluated scoring system could be applied as a useful one to predict easy cases. However, it is considered insensitive in predicting difficult and very difficult cases and/or conversion and needs verification before using it as it might be deceiving for junior surgeons who would take over an easy operation while it is a difficult one. A new score should focus only on the significant variables, and the experience of the surgeon should be taken into consideration as an important factor while assessing difficulty intraoperative.

Preoperative prediction of a difficult LC would help nurses to be ready for open conversion by preparing open surgery setup nearby. It would allow for a proper arrangement of theatre timetable and might help the medical staff to take a decision to refer a patient to another facility if an experienced surgeon who can manage a difficult operation is not around.

Conflicts of interest
There are no conflicts of interest.

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