Preoperative predictive factors of difficult laparoscopic cholecystectomy

Mohamed R. Saad, Mansour Kabbash, Alaa Yassen, Khaled A. T. Suleiman, Ibrahim Elzayat

Department of Surgery, Faculty of Medicine, Aswan University Hospital, Aswan, Egypt

Correspondence to Alaa Yassen, MSc degree in General Surgery, Department of Surgery, Faculty of Medicine, Aswan university hospital, Aswan, 81513, Egypt. Tel: 01143204036; e-mail: alaa.3012@gmail.com

Received: 17 October 2023
Revised: 2 November 2023
Accepted: 6 November 2023
Published: 31 January 2024

The Egyptian Journal of Surgery 2024, 43:56–62

Background
Laparoscopic cholecystectomy is a routine start-up procedure for any surgeon interested in the field of laparoscopy. However, one may encounter complex cases that may increase the risk of perioperative complications. It is crucial to identify these cases preoperatively for better surgical planning. Herein, we studied preoperative risk factors for difficult cholecystectomy procedures in our Egyptian tertiary care center.

Methodology
One hundred patients were enrolled in our study, and their cholecystectomy procedures were classified as easy, difficult, or very difficult based on two parameters; preoperative scoring system and intraoperative findings.

Results
There was a significant agreement between preoperative difficulty prediction score and intraoperative findings (k=0.858, $P<0.001$). Procedure difficulty was associated with patient hospitalization ($P<0.001$), previous supraumbilical surgeries ($P=0.004$), previous acute cholecystitis ($P<0.001$), previous jaundice ($P=0.049$), previous endoscopic biliary clearance ($P=0.022$), increased gallbladder wall thickness ($P=0.001$), and pericholecystic fluid collection ($P=0.014$). Conversion to the open approach was needed in 6 cases (6%). Age, sex, BMI, and impacted stone did not significantly impact procedure difficulty ($P>0.05$).

Conclusion
Multiple preoperative parameters have been significantly associated with the increased difficulty of the laparoscopic cholecystectomy procedure. Properly identifying these parameters and their inclusion into a scoring system would be greatly helpful in determining difficult cases during the preoperative period.

Keywords:
cholelithiasis, laparoscopic cholecystectomy, difficult procedure, predictors

Egyptian J Surgery 43:56–62

1110-1121

Introduction

Gallstone disease, or cholelithiasis, is a common clinical entity frequently encountered in medical and surgical practices [1,2]. Such patients may be asymptomatic. Nonetheless, they may develop serious complications like acute cholecystitis, pancreatitis, obstructive jaundice, and pancreatitis [3].

Currently, laparoscopic cholecystectomy is the main management option for patients with symptomatic cholelithiasis [4], and it has been integrated into the majority of surgical training courses as the ideal operation to start with when one intends to learn laparoscopic surgery [5]. However, it is still a highly technical procedure as the operating surgeon may face anomalies or difficulties at the Calot triangle. This could lead to dreadful perioperative consequences like bile leakage, common bile duct injury, or injury to the hepatic arterial system [6–8].

Difficult cholecystectomy procedures not only increase operative time and intraoperative blood loss but also increase the risk of perioperative complications and the need for conversion to the open approach. Therefore, it is crucial to identify these cases preoperatively as that would help to improve patient counseling, operative theatre ergonomics, and properly select high-volume surgeons for such cases instead of trainees [5].

The Egyptian literature is poor with trials addressing the predictors of difficult cholecystectomy, although the procedure is commonly performed in Egypt, even on a daily basis in some surgical centers. That is why we conducted the present trial to elucidate preoperative predictors of difficult laparoscopic cholecystectomy.

That would help surgeons to predict the difficulty of the procedure based on preoperative findings, which would give a guide in decision-making (e.g., the patient should be performed by a high-volume laparoscopic surgeon or preparing the operative theatre for conversion to the open procedure).

Patients and methods

The present prospective interventional trial was performed at Aswan University General Surgery Department over a 1-year duration, from May 2022 to April 2023. Our study was designed for adult patients diagnosed with symptomatic cholelithiasis and presented to our outpatient clinic during the previously mentioned period for laparoscopic cholecystectomy. We started patient enrollment after obtaining ethical approval from our university scientific committee, and all patients signed a written consent explaining the benefits and possible risks of the laparoscopic procedure.

Our patients received the standard preoperative assessment, including proper history taking [focusing on symptoms with its duration, previous hospitalization, previous attacks of jaundice, previous abdominal surgery, previous endoscopic retrograde cholangiopancreatography (ERCP)], clinical examination (focusing on body mass index BMI, complexion, abdominal scars, and palpation of the right upper abdominal quadrant), in addition to abdominal ultrasonography (focusing on gallbladder wall thickness, the presence of impacted stone at Hartmann pouch, and the presence of pericholecystic fluid collection). Additionally, routine preoperative investigations were ordered for all patients. We excluded patients with acute cholecystitis on presentation, concomitant common bile duct stone, bleeding diathesis, or who were unfit for general anesthesia or laparoscopy.

The patients were admitted to our ward the day before the procedure, and we calculated the cholecystectomy difficulty score published by Randhawa and Pujahari for all patients [9] (Fig. 1). The total score ranges between 0 and 15, with higher scores indicating more difficulty (easy operation 0–5, difficult operation 6–10, and very difficult operation 11–15). These scores were recorded to be compared with intraoperative findings.

In the operative theatre, the procedures were performed under general anesthesia when the patient was in a reverse Trendelenburg position with a slight tilt towards the left. The abdominal cavity was insufflated via the Veress needle, followed by the entry of the periumbilical camera port. After careful exploration of the abdominal cavity, the remaining three ports were introduced (two working ports at the right and left midclavicular lines one inch below the costal margin and an assisting port at the right anterior or midaxillary lines).

The gallbladder was grasped from its fundus and retracted cranially, then the Hartmann pouch was grasped for better exposure of the Clot triangle. Careful dissection was done till identifying the cystic artery and duct, which were clipped individually and then divided after achieving the critical view of safety. Then the gallbladder was dissected from the bed with the aid of a diathermy hook. Then, the gallbladder was

Figure 1

History			Max. score
Age	<50 yrs (0)	>50 yrs (1)	1
Sex	Female (0)	Male (1)	1
H/o Hospitalization	N (0)	Y (4)	4
Clinical			
BMI wt (kg)/ht (mt^2)	<25 (0)	25–27.5 (1) > 27.5 (2)	2
Abdominal scar	N (0)	Infra-umbilical (1) supra-umbilical (2)	2
Palpable gallbladder	N (0)	Y (1)	1
Sonography			
Wall thickness	Thin (0)	Thick > 4 mm (2)	2
Pericholecystic collection	N (0)	Y (1)	1
Impacted stone	N (0)	Y (1)	1

H/o = history of, N = No, Y = Yes
Total maximum score - 15

The scoring factors published by Randhawa and Pujahari [9].

extracted from the abdominal cavity through the 1 cm working port. Finally, the ports were closed with nonabsorbable sutures. If the conversion was needed (difficult gallbladder grasping, dense adhesions at Calot, ductal injury, or uncontrollable bleeding), it was performed through a right subcostal incision. The operative time and need for conversion to the open approach were recorded.

According to the actual intraoperative findings, the procedures were classified as easy, difficult, or very difficult. 'Easy' operation was established when the operative time was less than one hour, with no biliary spillage, or arterial injuries, whereas 'difficult' operation was established when the operative time ranged between 1 and 2 h, associated with biliary or stone spillag, without conversion to the open approach. If the patient was converted to the open approach or the operative time lasted more than two hours, the procedure was considered 'very difficult' [9]. The actual intraoperative findings were compared with the preoperative difficulty score findings to measure its predictability for the difficult procedure.

The main outcome of that research was to delineate preoperative factors that predict difficult laparoscopic cholecystectomy, while our secondary objective was to measure the predictability of the preoperative score in identifying difficult cases.

Our data were tabulated in an Excel sheet and then analyzed using the SPSS software for MacOS. We expressed our categorical data as numbers and percentages, while numerical data were presented as means, standard deviations, and ranges. To compare easy, difficult, and very difficult groups, we applied the χ^2 test for the former data type, while the Anova test was applied for the latter. Agreement between the preoperative score and intraoperative findings was done by Cohen's kappa. Any *P*-value less than 0.05 was considered statistically significant.

Results

Our patients' ages ranged between 25 and 70 years (mean=43.43). Most patients were females (69%), while the remaining cases were men. Their BMI ranged between 22.8 and 39.8 kg/m^2 (mean=30.66). Regarding their previous history, previous hospitalization was reported in 37% of our patients. Additionally, a previous acute cholecystitis attack was present in 20 (20%) cases. Although a previous history of jaundice was present in 9% of our cases, only 2 of these 9 cases required ERCP and common bile duct clearance.

Abdominal examination revealed an infraumbilical scar in 17 (17%) cases, a supraumbilical one in another 17 (17%) cases, while the gallbladder was palpable in 16 (16%) patients. The preoperative ultrasonographic assessment revealed pericholecystic fluid collection in 57 (57%) cases, while 25 patients had an impacted stone in the Hartmann pouch. The mean thickness of the gallbladder wall was 3.42 mm (range, 2–5.8). Table 1 summarizes the previous data.

In Table 2, the estimated preoperative difficulty score ranged between 1 and 13 (mean=6.11). According to the preoperative score, easy, difficult, and very difficult procedures were predicted in 45, 47, and 8% of patients, respectively.

The mean operative time was 92.37 years (range, 40–150). Intraoperative events included biliary or stone spillage (45%) and duct injury (3%), while conversion to the open approach was needed in 6 cases (6%). According to operative findings, easy, difficult, and very difficult operations were encountered in 49, 45, and 6% of cases, respectively (Table 3).

There was a significant agreement between the preoperative difficulty prediction score and intraoperative findings (k=0.858, $P<0.001$),

Table 1 General demographic, clinical, and radiological data in the included 100 cases

	Cases (no=100)
Age	
Range	25–70
Mean±SD	43.43±11.84
Sex	
Female	69 (69.0)
Male	31 (31.0)
Hospitalization	37 (37.0)
BMI	
Range	22.8–39.8
Mean±SD	30.66±3.78
Abdominal scar	
Infraumbilical	17 (17.0)
Supraumbilical	17 (17.0)
Palpable gallbladder	16 (16.0)
Previous history	
Acute attack of cholecystitis	20 (20.0)
Jaundice	9 (9.0)
Previous ERCP	2 (2.0)
Radiological findings	
Gallbladder wall thickness	
Range	2.0–5.8
Mean±SD	3.42±1.41
Pericholecystic fluid collection	57 (57.0)
Impacted stone	25 (25.0)

Table 2 Preoperative difficulty score and the predicted difficulty levels in the included 100 cases

	Cases (no=100)
Total score	
Range.	1.0–13.0
Mean±SD.	6.11±2.84
Difficulty	No. (%)
Easy	45 (45.0)
Difficult	47 (47.0)
Very difficult	8 (8.0)

Table 3 Operative data in the included 100 cases

	Cases (no=100)
Operation time	
Range	40.0–150.0
Mean±SD	92.37±43.1
Complications	No. (%)
Bile/stone spillage	45 (45.0)
Injury to duct	3 (3.0)
Conversion to open surgery	6 (6.0)
Difficulty	
Easy	49 (49.0)
Difficult	45 (45.0)
Very difficult	6 (6.0)

indicating the reliability of the applied score in the prediction of difficult cholecystectomy (Table 4).

When comparing easy, difficult, and very difficult cases (based on actual intraoperative findings), no significant difference was noted between the three groups regarding patients' ages or genders (P=0.912 and 0.453, respectively). Nonetheless, the hospitalization rate showed a significant increase with the increased intraoperative difficulty (62.2% and 100% of difficult and very difficult cases, respectively, compared with only 6.1% in easy cases $P<0.001$), as illustrated in Table 5.

Patients' BMI and the presence of a palpable gallbladder did not have any significant impact on operative difficulty (P=0.124 and 0.233, respectively). However, the presence of a supraumbilical scar was associated with increased operative difficulty (P=0.004), as 50% of the very difficult cases had that scar compared with 6.1% in the easy group (Table 6).

Regarding previous history findings, previous attacks of cholecystitis, previous history of jaundice, and previous ERCP were significantly associated with increased operative difficulty, as the previous three parameters were more common in the difficult and very difficult groups compared with the easy group. Nonetheless, that significance faded away with previous abdominal surgery (P=0.099) (Table 7).

According to radiological findings, we noted a significant increase in gallbladder wall thickness in association with increased operative difficulty (P=0.001). Moreover, the presence of pericholecystic fluid collection was also a significant marker for operative difficulty (P=0.014). Nevertheless, the presence of impacted stone did not significantly impact intraoperative difficulty (P=0.799) (Table 8).

Discussion

The current investigation was done to elucidate preoperative risk factors for difficult cholecystectomy

Table 4 Agreement between preoperative predictive score and actual intraoperative difficulty

	Preoperative predictive factors				
	Easy	Difficult	Very difficult	kappa (κ)	*P*-value
Difficulty					
Easy	45	4	0	0.858	<0.001*
Difficult	2	41	2		
Very difficult	0	0	6		

Table 5 Relation between surgery difficulty and baseline data

	Difficulty				
	Easy (n=49)	Difficult (n=45)	Very difficult (n=6)	test	*P*-value
Age				F=0.093	0.912
Range	25–68	25–70	25–60		
Mean±SD	43.86±11.54	42.87±12.43	44.17±11.46		
Sex	No. (%)	No. (%)	No. (%)		
Female	36 (73.5)	30 (66.7)	3 (50.0)	χ^2=1.585	0.453
Male	13 (26.5)	15 (33.3)	3 (50.0)		
Hospitalization	3 (6.1)	28 (62.2)	6 (100.0)	χ^2=1.585	<0.001*

Table 6 Relation between surgery difficulty and clinical data

	Difficulty				
	Easy (*n*=49)	Difficult (*n*=45)	Very difficult (*n*=6)	Test	*P*-value
BMI				F=2.134	0.124
Range	22.8–39.3	25–39.8	29.6–36.5		
Mean±SD	30±4.02	31.08±3.52	32.9±2.6		
Abdominal Scar	No. (%)	No. (%)	No. (%)		
No	40 (81.6)	25 (55.6)	1 (16.7)	χ^2=15.323	0.004*
Infraumbilical	6 (12.2)	9 (20.0)	2 (33.3)		
Supraumbilical	3 (6.1)	11 (24.4)	3 (50.0)		
Palpable gallbladder	9 (18.4)	15 (33.3)	2 (33.3)	χ^2=2.909	0.233

Table 7 Relation between surgery difficulty and history data

	Difficulty				
	Easy (*n*=49)	Difficult (*n*=45)	Very difficult (*n*=6)	χ^2	*P*-value
Previous history data	No. (%)	No. (%)	No. (%)		
Acute attack of cholecystitis	2 (4.1)	17 (37.8)	1 (16.7)	16.691	<0.001*
Jaundice	2 (4.1)	5 (11.1)	2 (33.3)	6.030	0.049*
Previous ERCP	0	1 (2.2)	1 (16.7)	7.596	0.022*
Previous abdominal surgery	4 (8.2)	11 (24.4)	1 (16.7)	4.629	0.099

Table 8 Relation between surgery difficulty and sonography data

	Difficulty				
	Easy (*n*=49)	Difficult (*n*=45)	Very difficult (*n*=6)	Test	*P*-value
Gallbladder wall thickness				F=8.026	0.001*
Range	2–5.8	2–5.8	4.3–5.7		
Mean±SD	3.03±1.21	3.61±1.47	5.18±0.62		
Pericholecystic collection	22 (44.9)	29 (64.4)	6 (100)	χ^2=8.472	0.014*
Impacted stone	11 (22.4)	12 (26.7)	2 (33.3)	χ^2=0.459	0.799

procedures in our tertiary surgical care setting. We also studied the relationship between the applied preoperative score and actual intraoperative difficulty in our cases.

First of all, we found a strong agreement between the applied preoperative predictive score and actual intraoperative procedure difficulty (k=0.858, *P*<0.001). In the same context, other authors applied the same score in patients undergoing laparoscopic cholecystectomy, and they found that it had a 92% predictability for difficult cases, indicating its reliability in predicting difficult cholecystectomy procedures [9].

In our study, patients' age did not have a significant impact on procedure difficulty. Nogoy and colleagues agreed with our findings, as the same parameter had mean values of 44 and 48 years in the difficult and easy cases, respectively (*P*=0.161) [10]. However, other researchers noted a significant association between older age and procedure difficulty [9]. Older age could be associated with multiple previous attacks of acute cholecystitis or multiple previous abdominal surgeries, which make the laparoscopic procedure more difficult [11].

We did not identify the male gender as a risk factor for difficult procedures (*P*=0.453), and the same findings were also reported by Nogoy and his associates when they studied the association between gender and operative difficulty (*P*=0.512) [10]. Moreover, Gupta and colleagues confirmed the previous findings regarding gender [12]. Contrarily, Nachnani and Supe found that male age was associated with more dense adhesions and fibrosis at the Calot triangle, which increased the procedure difficulty [13].

Our findings revealed that previous hospitalization was a risk factor for procedure difficulty (*P*<0.001). Gupta and colleagues agreed with our findings, as previous hospitalization was reported in 50% of difficult cases, compared with 30% of easy cases (*P*=0.31) [12]. The previous hospitalization may indicate previous cholecystitis attacks, which are linked to the procedure severity, as explained later on.

In our study, no significant association was noted between patients' BMI and the procedure difficulty, and that was also reported by Bourgouin and colleagues who found no significant difference between easy and difficult cases regarding their BMI distribution ($P>0.05$) [5]. Gupta and colleagues reported similar findings [12]. However, Rosen and colleagues found a significant association between obesity (increased BMI) and procedure difficulty [14].

We identified the presence of supraumbilical scars as a risk factor for difficult cholecystectomy procedures ($P=0.004$). It is reasonable that the presence of previous scars secondary to intraabdominal procedures is associated with intraabdominal adhesions that may hinder port entry and easy dissection. Even the previous scars may overlie incisional hernia that may contain bowel content and increase the complexity of the procedure [11]. Other studies confirmed our findings [11,15].

Our findings showed that the presence of a palpable gallbladder was not associated with increased procedure difficulty ($P=0.233$). Atta and his associates confirmed our findings, as the same parameters turned out to be insignificant between easy and difficult cases (0% vs. 2.5%, respectively $P=0.552$) [16].

Previous acute cholecystitis attack was a significant predictor for procedure difficulty in the current study ($P<0.001$). In agreement with our findings, another study noted that patients in the difficult cholecystectomy group had a significantly higher prevalence of previous acute cholecystitis attacks (18.2% vs. 2.6% in the easy group $P<0.001$) [5]. Other studies also confirmed the same association between previous cholecystitis and technical difficulties [17,18]. Like any form of acute inflammation, acute cholecystitis will yield fibrosis and adhesions around the gallbladder and Calot triangle, which makes the procedure more challenging. Contrarily, Stanisic and colleagues denied that association between previous history of acute cholecystitis and procedure difficulty (27.3% vs. 16.4% in easy cases $P=0.55$) [19].

In the current trial, we found that previous ERCP was a risk factor for difficult procedures ($P=0.022$). The injection of contrast material into the biliary tree would elicit an inflammatory reaction around the duct and the Calot triangle, leading to the formation of dense adhesions and scarring. That would increase the difficulty of the procedure [20,21]. That could explain the increased operative difficulty in such cases.

We also noted that previous history of jaundice was a significant risk factor for difficult procedures ($P=0.049$). That parameter was not assessed in previous studies, but it may have previous endoscopic biliary clearance, which was associated with procedure difficulty.

In our study, the presence of pericholecystic fluid was significantly associated with difficult procedures ($P=0.014$). That was also reported by Atta and colleagues who detected the same finding in 8.6% of difficult cases, compared with 0.82% of easy cases ($P=0.014$) [16]. Gupta *et al.* reported the same association [12].

In the current study, increased gallbladder wall thickness was significantly associated with increased procedure difficulty ($P=0.001$). Another study also documented the association between increased gallbladder wall thickness and procedure difficulty, as increased thickness was detected in 61.11% of difficult cases, compared with 16.67% of easy cases ($P=0.005$) [12]. Stanisic *et al.* reported similar findings [19]. Increased gallbladder wall thickness may hinder easy retraction and grasping of the gallbladder during the procedure. It may also be an indicator of previous acute cholecystitis, which is also a documented predictor for difficult procedures.

Our findings revealed no significant association between impacted stone and procedure difficulty ($P=0.799$). Although Gupta and colleagues reported a higher incidence of impacted stones in difficult cases (85.71% vs. 14.29% in easy cases), that difference did not reach a statistical significance ($P=0.05$) [12]. On the other hand, Atta and colleagues found a significant association between the same previous parameter and procedure difficulty (39.7% vs. 5.7% in easy cases $P<0.001$) [16].

Finally, 1 should mention that 6 of our cases needed conversion to the open approach (6%), and that coincides with the range of conversion reported in the literature, which ranges between 1% and 15% [22]. The reader should notice that all of the detected risk factors for difficult procedures could be considered risk factors for conversion to the open approach, as all patients in the very difficult group underwent conversion to the open approach.

Our study has some limitations. The relatively small patient sample that was gathered from a single surgical institution is the main drawback. Our study was also limited to preoperative factors only, and we should have included some intraoperative parameters like liver status and surgeon experience. Also, we should have integrated our significant risk factors into our own score to be applied in our center. These limitations should be well addressed in future studies.

Conclusion

Multiple preoperative parameters have been significantly associated with the increased difficulty of the laparoscopic cholecystectomy procedure. The proper identification of these parameters and their inclusion into a scoring system would be greatly helpful in determining difficult cases during the preoperative period. That would help us in better surgical planning for difficult cases (like being performed by a highly experienced surgeon).

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Jorba R, Pavel MC, Llàcer-Millán E, Estalella L, Achalandabaso M, Julià-Verdaguer E, *et al.* Contemporary management of concomitant gallstones and common bile duct stones: a survey of Spanish surgeons. Surg Endosc 2021; 35:5024–5033.

2 Yu MH, Kim YJ, Park HS, Jung SI. Benign gallbladder diseases: Imaging techniques and tips for differentiating with malignant gallbladder diseases. World J Gastroenterol 2020; 26:2967–2986.

3 Pauli JM. Pregnancy and Cholelithiasis. In: Docimo Jr S, Pauli EM, editors. Clinical Algorithms in General Surgery: A Practical Guide. Cham: Springer International Publishing; 2019. 845–848.

4 Gutt C, Schläfer S, Lammert F. The Treatment of Gallstone Disease. Dtsch Arztebl Int 2020; 117:148–158.

5 Bourgouin S, Mancini J, Monchal T, Calvary R, Bordes J, Balandraud P. How to predict difficult laparoscopic cholecystectomy? Proposal for a simple preoperative scoring system. Am J Surg 2016; 212:873–881.

6 Miura da Costa K, Saxena AK. Complications in pediatric laparoscopic cholecystectomy: systematic review. Updates Surg 2021; 73:69–74.

7 Guiab K, Evans T, Brigode W, Stamelos G, Sebekos K, Siddiqi M, *et al.* Complications After Inpatient Laparoscopic Cholecystectomy: Effect of Surgeon Experience, Procedure Volume, and Other Surgeon-Based Characteristics. Am Surg 2022; 88:1798–1804.

8 Kreimer F, Cunha DJ, Ferreira CC, Rodrigues TM, Fulco LG, Godoy ES. COMPARATIVE ANALYSIS OF PREOPERATIVE ULTRASONOGRAPHY REPORTS WITH INTRAOPERATIVE SURGICAL FINDINGS IN CHOLELITHIASIS. Arq Bras Cir Dig 2016; 29:26–29.

9 Randhawa JS, Pujahari AK. Preoperative prediction of difficult lap chole: a scoring method. Indian J Surg 2009; 71:198–201.

10 Nogoy DM, Padmanaban V, Balazero LL, Rosado J, Sifri ZC. Predictors of Difficult Laparoscopic Cholecystectomy on Humanitarian Missions to Peru Difficult Laparoscopic Cholecystectomy in Surgical Missions. J Surg Res 2021; 267:102–108.

11 Vivek MA, Augustine AJ, Rao R. A comprehensive predictive scoring method for difficult laparoscopic cholecystectomy. J Minim Access Surg 2014; 10:62–67.

12 Gupta N, Ranjan G, Arora MP, Goswami B, Chaudhary P, Kapur A, *et al.* Validation of a scoring system to predict difficult laparoscopic cholecystectomy. Int J Surg 2013; 11:1002–1006.

13 Nachnani J, Supe A. Pre-operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters. Indian J Gastroenterol 2005; 24:16–18.

14 Rosen M, Brody F, Ponsky J. Predictive factors for conversion of laparoscopic cholecystectomy. Am J Surg 2002; 184:254–258.

15 Fraser SA, Sigman H. Conversion in laparoscopic cholecystectomy after gastric resection: a 15-year review. Can J Surg 2009; 52:463–466.

16 Atta HM, Mohamed AA, Sewefy AM, Abdel-Fatah AS, Mohammed MM, Atiya AM. Difficult Laparoscopic Cholecystectomy and Trainees: Predictors and Results in an Academic Teaching Hospital. Gastroenterol Res Pract 2017; 2017:6467814.

17 Kama NA, Kologlu M, Doganay M, Reis E, Atli M, Dolapci M. A risk score for conversion from laparoscopic to open cholecystectomy. Am J Surg 2001; 181:520–525.

18 Lal P, Agarwal PN, Malik VK, Chakravarti AL. A difficult laparoscopic cholecystectomy that requires conversion to open procedure can be predicted by preoperative ultrasonography. JSLS 2002; 6:59–63.

19 Stanisic V, Milicevic M, Kocev N, Stanisic B. A prospective cohort study for prediction of difficult laparoscopic cholecystectomy. Ann Med Surg (Lond) 2020; 60:728–733.

20 El Nakeeb A, Ezzet H, Askar W, El Hanafy E, Hamdy E, Atef E, *et al.* Early Versus Late Cholecystectomy After Clearance of Common Bile Duct Stones by Endoscopic Retrograde Cholangiopancreatography: A Prospective Randomized Study. Surg Laparosc Endosc Percutan Tech 2016; 26:202–207.

21 Csendes A, Burdiles P, Maluenda F, Diaz JC, Csendes P, Mitru N. Simultaneous bacteriologic assessment of bile from gallbladder and common bile duct in control subjects and patients with gallstones and common duct stones. Arch Surg 1996; 131:389–394.

22 Nassar AHM, Zanati HE, Ng HJ, Khan KS, Wood C. Open conversion in laparoscopic cholecystectomy and bile duct exploration: subspecialisation safely reduces the conversion rates. Surg Endosc 2022; 36:550–558.