Difficulties In Laparoscopic Cholecystectomy Regarding Gender: Comparative study

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Received: 6 October 2022
Revised: 21 October 2022
Accepted: 5 November 2022
Published: 28 April 2023

The Egyptian Journal of Surgery 2023, 41:1491–1506

Background
Some authors are concerned about the male sex as a risk factor for laparoscopic cholecystectomy (LC).
Aim
This study aimed to do a comparative study of difficulties in LC between male and female patients regarding preoperative predictive factors of difficult LC, intraoperative findings, postoperative complications, and outcomes.
Patients and methods
This is a prospective study of 100 patients. The patients were divided into two groups: female and male groups. Data related to patients were recorded and subjected to analysis to assess the difficulties in LC regarding sex.
Results
Of the 100 patients, 70% were females and 30% were males. The mean age and total associated comorbidities were significantly increased in males in comparison with females (P=0.001 and 0.027, respectively). Age more than 50 years and history of hospitalization were significantly higher among males versus females (P=0.006 and 0.003, respectively). The mean total preoperative score was significantly higher among males versus females (P=0.001). The majority of males had difficult and very difficult preoperative score (60%) compared with only 34.3% among females, which was statistically significant (P=0.020). Approximately two-thirds of the males had an intraoperative difficult and very difficult course (63.4%), compared with nearly one-third among females (34.3%), with a significant difference (P=0.025). The operative time and postoperative hospital stay were significantly increased in males versus females (P=0.007 and 0.017, respectively).
Conclusion
Difficult LC was more prevalent in males versus females and the male sex may be considered a risk factor for difficult LC.

Keywords:
cholelithiasis, comparative study, sex, laparoscopic cholecystectomy

Egyptian J Surgery 41:1491–1506

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Introduction

Cholelithiasis is the most common biliary disease [1]. Gallstones are present in 10–15% of the general population and are asymptomatic in most of them (>80%); moreover, the prevalence of gallstones varies widely in different parts of the world [2]. Approximately 1–2% of asymptomatic cases will eventually develop symptoms needing cholecystectomy yearly, thus making cholecystectomy the most common surgical procedure performed by general surgeons [3]. Laparoscopic cholecystectomy (LC) is the gold standard procedure for the management of cholecystitis owing to the short hospital stay, less postoperative pain, and improved cosmoses. Despite advances in technological procedures and personal experiences, the conversion to open laparotomy during LC is still encountered in some cases to minimize complications. The conversion rate is reported between 3 and 24% [4,5]. Risk factors for the perioperative complications of LC have been of major interest. It is well agreed that the risk factors that could predict conversion include acute cholecystitis, older age, male sex, obesity, and a thickened gallbladder wall. Many studies have shown that symptomatic gallstones, inflammation, and fibrosis are more extensive in men than in women. These findings supported the observation of high conversion rate in men than in women [6,7]. The factors influencing difficulties in LC were increased age, acute and thick-wall chronic cholecystitis, wide and short cystic duct, cholecysto-digestive fistula, previous upper abdominal surgery, obesity, liver cirrhosis, anatomic variations, cholangiocarcinoma, and low surgeon's

caseload [8]. Of late, male sex as a factor for conversion of LC to open surgery has gained utmost recognition. Several researchers have reported a significant association between the male sex and a higher rate of conversion, which may be attributed to the increased severity of gallstone disease (GSD) among men [9,10]. On the contrary, data from a few studies failed to demonstrate male sex as a risk factor for conversion [11]. The key factor affecting the decision to convert open surgery is the anatomical 'changes' such as adhesions and distortions due to the severe fibrosis induced by inflammation. Although true anatomical abnormalities in the biliary and vascular system (i.e. aberrant biliary channels, duct of Luschka, and aberrant or accessory cystic artery) are rather rare, many reported variations in the biliovascular tree may also lead to conversion to avoid the injury [12]. The work aimed to do a comparative study of difficulties in LC between male and female patients regarding preoperative predictive factors of difficult LC, intraoperative findings, postoperative complications, and outcomes.

Patients and methods

The study design

This prospective study was conducted at the department of general surgery in Sohag University Hospital for elective LC in the period from November 1, 2021 to August 30, 2022.

Ethics approval and consent to participate

Written informed consent was taken from all participating patients or their legal guardians. Ethical approval was obtained from the medical research ethics committee under IRB Registration number: Soh-Med-21-10-42.

Study population

This is a prospective study of 100 patients (males and females), aged from 20 to 70 years, and suffering from symptomatic cholelithiasis who will be admitted to the department of general surgery at Sohag University Hospital for elective LC in the period from November 1, 2021 to August 30, 2022. The patients were divided into two groups: female group and male group. This research is a comparative study of difficulties in LC between male and female patients regarding preoperative predictive factors of difficult LC (Preoperative Scoring System), intraoperative findings (intraoperative scoring factors), postoperative complications, and outcomes. Data were collected and subjected to analysis. LC was performed under general anesthesia, by using CO_2 gas for pneumoperitoneum with 12 mmHg pressure. Two 10-mm and two 5-mm ports were used.

Preoperative data

Diagnosis of symptomatic GSD was based on history, clinical examination, and laboratory and radiological investigations. The preoperative predictive factors of difficult LC (preoperative scoring system by Randhawa and Pujahari [13]) include the following: (a) history such as age, sex, and history of hospitalization for acute cholecystitis; (b) clinical data such as BMI=weight (kg)/height (m^2), abdominal scar, and palpable GB; and (c) sonographic data such as wall thickness of GB, pericholecystic collection, and impacted stone.

Intraoperative parameters

Various intraoperative parameters were faced while doing LC, which were used for categorization and grading of the difficulty level of LC, as reported by Randhawa and Pujahari [13]. The time of operation was calculated from the first port-site insertion till the last port site closure (Figs 1–6).

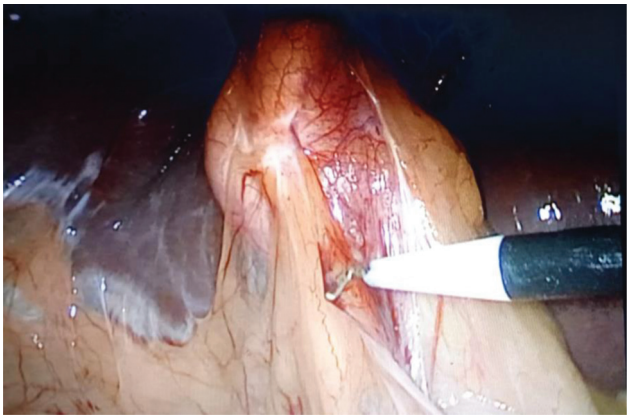
Postoperative parameter

It included postoperative complications such as port site infection, wound infection, wound dehiscence, biliary leakage, intestinal obstruction, fecal fistula, intra-abdominal sepsis, intra-abdominal hemorrhage, pneumonia, pulmonary embolism, and re-exploration and length of hospital stay (in days).

Surgical outcomes

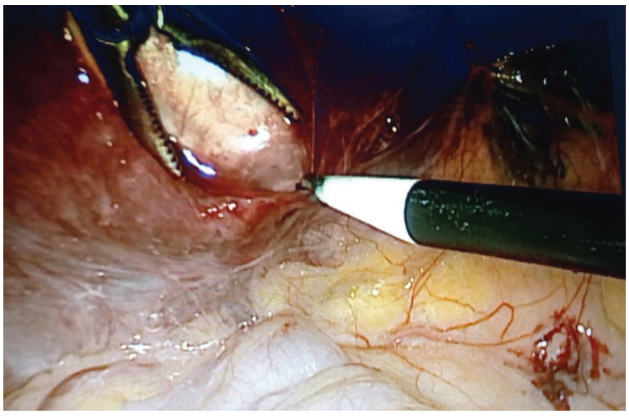
Morbidity: major pathologic symptoms that might threaten the life of patients, such as biliary leakage, hemorrhage, sepsis, bowel obstruction, pneumonia, renal failure, and pulmonary embolism, were recorded.

Figure 1



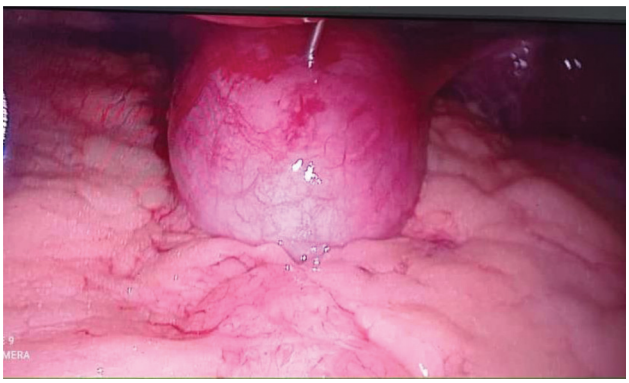
Male patient shows gross adhesions of GB with omentum, duodenum and stomach. Completed laparoscopically. GB, gallbladder.

Figure 2



Male patient shows partially intrahepatic GB with gross adhesions with omentum and duodenum. Completed laparoscopically. GB, gallbladder.

Figure 3



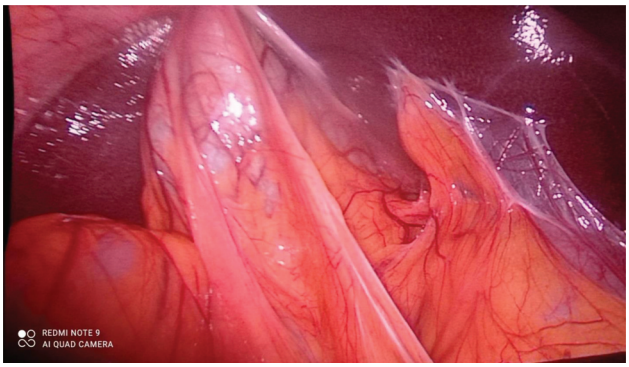
Male patient shows percutaneous aspiration of pyocele of the GB. Completed laparoscopically. GB, gallbladder.

Figure 4

Male patient shows percutaneous aspiration of pyocele of the GB (infected bile). Completed laparoscopically. GB, gallbladder.

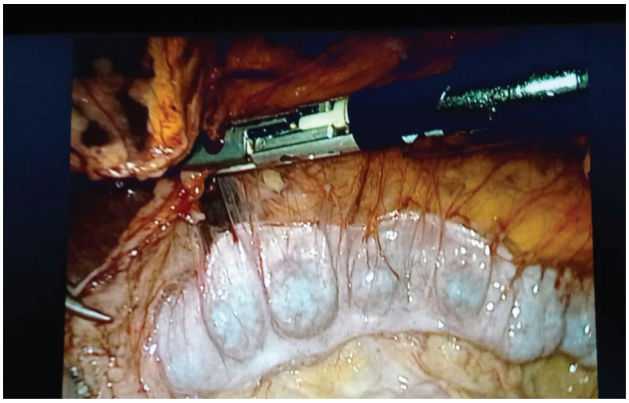
(1) Mortality: operative death was defined as death occurring while in the hospital following surgery.
(2) All these data were recorded and subjected to analysis to assess the difficulties in LC regarding sex.

Figure 5



Male patient shows gross adhesions of GB with omentum, duodenum, stomach and transverse colon (previous history of sleeve gastrectomy). Completed laparoscopically. GB, gallbladder.

Figure 6



Female patient shows gross adhesions bet. transverse colon and anterior abdominal wall obscuring the GB and liver. Completed laparoscopically. GB, gallbladder.

Statistical analysis

Statistical package for the social sciences (IBM-SPSS), version 25 (August 2017; IBM-Corporation, Chicago, Illinois, USA) was used for statistical data analysis. Data were expressed as mean, SD, number, and percentage. Mean and SD was used as the descriptive value for quantitative data. Student t test was used to compare the means between two groups. Mann–Whitney tests were used instead of Student t test for nonparametric data to compare medians rather than means. Pearson χ^2 test was used to compare percentages of qualitative variables, and Fisher's exact test was used instead for nonparametric data. Receiver operating characteristics curve (ROC curve) analysis was done to assess the predictive value of preoperative risk factors as a screening tool for the preoperative and intraoperative outcomes and to calculate the most suitable cut-off values that provide the highest possible accuracy (highest

sensitivity and specificity at the same time). Univariate binary logistic regression analysis was done to assess the possible risk factors for preoperative risk factors, and those with significant univariate regression were included in the multivariate binary logistic regression analysis model to estimate if any of them could be considered an independent risk factor. For all of these tests, the level of significance (*P* value) was set as follows:

(1) No significance, *P* value more than 0.05.
(2) Significance, *P* value less than 0.05.
(3) High significance, *P* value less than 0.001.

Results

Of the 100 patients, 70% were females and 30% were males (with a female to male ratio of 2.33 : 1) who underwent elective LC for symptomatic cholelithiasis. Their age ranged from 20 to 70 years. The mean age was significantly increased in males compared with females (48.87±10.64 vs. 40.01±12.92; *P*=0.001). There was a significant difference between females and males regarding special habits, especially cigarette and goza (hookah) smokers, where the vast majority of males had at least one special habit compared with only ~10% among females (*P*≤0.001 and 0.005, respectively), as shown in Table 1.

Table 1 Comparison between females and males as regards patient characteristics

	Females	Males	*P* value
Age			
Mean±SD	40.01±12.92	48.87±10.64	0.001 (S)
Special habits [*n* (%)]			
Cigarette	3 (4.3)	13 (43.3)	<0.001 (HS)
Goza	5 (7.1)	9 (30)	0.005 (S)
Others	0	5 (16.7)	0.002 (S)

Table 2 Comparison between females and males as regards preoperative data

	Females [*n* (%)]	Males [*n* (%)]	*P* value
Symptoms			
Right hypochondrial colicky pain	34 (48.6)	15 (50)	0.896 (NS)
Right hypochondrial dull aching pain	30 (42.9)	11 (36.7)	0.564 (NS)
Abdominal discomfort	22 (31.4)	14 (46.7)	0.146 (NS)
Nausea	21 (30)	10 (33.3)	0.741 (NS)
Vomiting	17 (24.3)	11 (36.7)	0.206 (NS)
Fever	2 (2.9)	1 (3.3)	1.000 (NS)
Abdominal clinical examination			
Palpable gallbladder	9 (12.9)	7 (23.3)	0.236 (NS)
Rigidity	8 (11.4)	5 (16.7)	0.523 (NS)
Tenderness	30 (42.9)	16 (53.3)	0.335 (NS)
Rebound tenderness	6 (8.6)	5 (16.7)	0.298 (NS)
Muscle guarding	9 (12.9)	4 (13.3)	1.000 (NS)
Boas sign	3 (4.3)	2 (6.7)	0.635 (NS)
Murphy's sign	32 (45.7)	14 (46.7)	1.000 (NS)
Comorbidities			
Hypertension	11 (15.7)	9 (30)	0.102 (NS)
DM	8 (11.4)	5 (16.7)	0.523 (NS)
COPD	1 (1.4)	4 (13.3)	0.027 (S)
BMI>30	14 (20)	7 (23.3)	0.708 (NS)
Cardiac diseases	7 (10)	5 (16.7)	0.338 (NS)
CVA	0	1 (3.3)	0.300 (NS)
Liver cirrhosis	0	0	–
Total associated comorbidities	21 (30)	16 (53.3)	0.027 (S)
Radiological findings			
Plain radiograph abdomen	0	0	–
Abdominal CT	7 (10)	4 (13.3)	0.729 (NS)
ERCP	6 (8.6)	3 (10)	1.000 (NS)
Abdominal sonar	70 (100)	30 (100)	1.000 (NS)
ASAPS classification grade			
I	51 (72.9)	17 (56.7)	0.112 (NS)
II	19 (27.1)	13 (43.3)	
Length of hospital stay (in days)	2.76±2.65	4.30±2.95	0.017 (S)

COPD, chronic obstructive pulmonary disease; ERCP, endoscopic retrograde cholangio-pancreatography.

Regarding preoperative data, the most common symptom was right hypochondrial pain (either colicky or dull aching), followed by abdominal discomfort, nausea, vomiting, and fever, with nonsignificant differences between males and females. The most common signs were tenderness, Murphy's sign, then palpable gallbladder, rigidity, muscle guarding, rebound tenderness, and lastly Boas sign, with nonsignificant differences between males and females. Concerning comorbidities, males had an overall higher prevalence of comorbidities (53.3%) compared with only 30% among females, with a significant difference (P=0.027). However, regarding the individual comorbidities, the most common was BMI more than 30 followed by hypertension and then diabetes and cardiac diseases. They showed an insignificant difference between females and males but with higher incidence among males than females; however, the only comorbidity that showed a significant difference was chronic obstructive pulmonary disease, which was much higher among males (13.3%) compared with females (only one case, 1.4%) (P=0.027). This may be due to increased prevalence of smoking among the male group. Radiological findings showed an insignificant difference between males and females [preoperative endoscopic retrograde cholangio-pancreatography was higher in males than females (10.00 vs. 8.57%)]. The ASAPS criteria were worse among males compared with females (43.3 vs. 27.1% in class II), with a nonsignificant difference (P=0.112). Males had a longer duration of hospital stay (4.3 days) compared

Table 3 Comparison between females and males as regards preoperative scoring factors

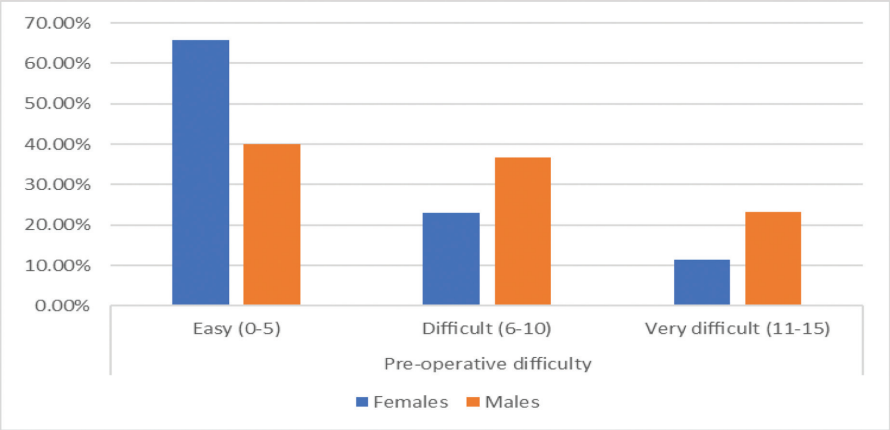
	Females [*n* (%)]	Males [*n* (%)]	*P* value
History			
Age			
<50 years	56 (80)	16 (53.3)	0.006 (S)
>50 years	14 (20)	14 (46.7)	
History of hospitalization due to acute cholecystitis			
No	48 (68.6)	11 (36.7)	0.003 (S)
Yes	22 (31.4)	19 (63.3)	
Clinical parameters			
BMI			
<25	24 (34.3)	8 (26.7)	0.347 (NS)
25–27.5	22 (31.4)	14 (46.7)	
>27.5	24 (34.3)	8 (26.7)	
Abdominal scar			
No	40 (57.1)	25 (83.3)	0.003 (S)
Infraumbilical	26 (37.1)	2 (6.7)	
Supraumbilical	4 (5.7)	3 (10)	
Palpable gallbladder			
No	61 (87.1)	23 (76.7)	0.236 (NS)
Yes	9 (12.9)	7 (23.3)	
Sonography			
Wall thickness of gallbladder			
Thin <4 mm	18 (25.7)	6 (20)	0.540 (NS)
Thick >4 mm	52 (74.3)	24 (80)	
Pericholecystic collection			
No	65 (92.9)	26 (86.7)	0.446 (NS)
Yes	5 (7.1)	4 (13.3)	
Impacted stone			
No	55 (78.6)	20 (66.7)	0.208 (NS)
Yes	15 (21.4)	10 (33.3)	
Number of stones			
Solitary	15 (21.4)	8 (26.7)	0.588 (NS)
Multiple	55 (78.6)	22 (73.3)	
Total score			
Total score	4.84±3.74	7.57±3.70	0.001 (S)
Preoperative difficulty			
Easy (0–5)	46 (65.7)	12 (40)	0.020 (S)
Difficult (6–10)	16 (22.9)	11 (36.7)	
Very difficult (11–15)	8 (11.4)	7 (23.3)	

with females (only 2.76 days), with a significant difference (P=0.017), as shown in Table 2.

Regarding preoperative scoring factors, age more than 50 years and history of hospitalization due to acute cholecystitis were significantly higher among males compared with females (P=0.006 and 0.003, respectively). In contrast, abdominal scars were significantly higher among females compared with males (P=0.003). The main total preoperative score was significantly higher among males (7.57±3.70) compared with females (4.84±3.74), with P=0.001. The majority of males had either difficult or very difficult preoperative scores (36.7+23.3=60%) compared with only about one-third (22.9 +11.4=34.3%) among females, which was statistically significant (P=0.020). However, BMI, palpable gallbladder, the wall thickness of gallbladder, pericholecystic collection, and impacted stones were statistically insignificant between the two studied groups but had a higher incidence in males than females except multiple stones, which had a higher incidence in females, as shown in Table 3 and Figs 7 and 8.

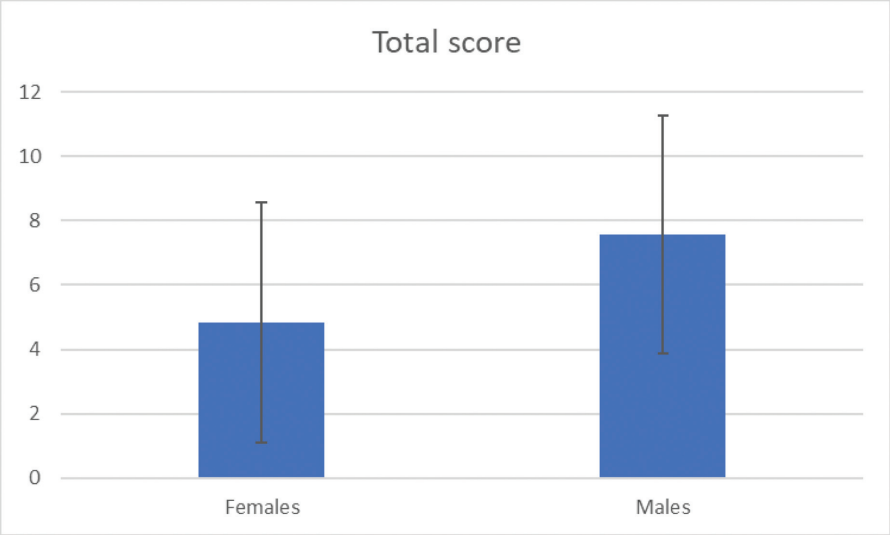
Concerning intraoperative findings, approximately two-thirds of males had an intraoperative difficult or very difficult course (19 patients=63.4%), compared with nearly about one-third among females (24 patients=34.3%), with a significant difference (P=0.025). The most important single factor was the operative time, which shows that it is less than 60 min in 65.7% of females, 60–120 min in 21.4% of them, and more than 120 min in only 12.9% of them,

Figure 7



Comparison between females and males concerning the preoperative difficulty.

Figure 8

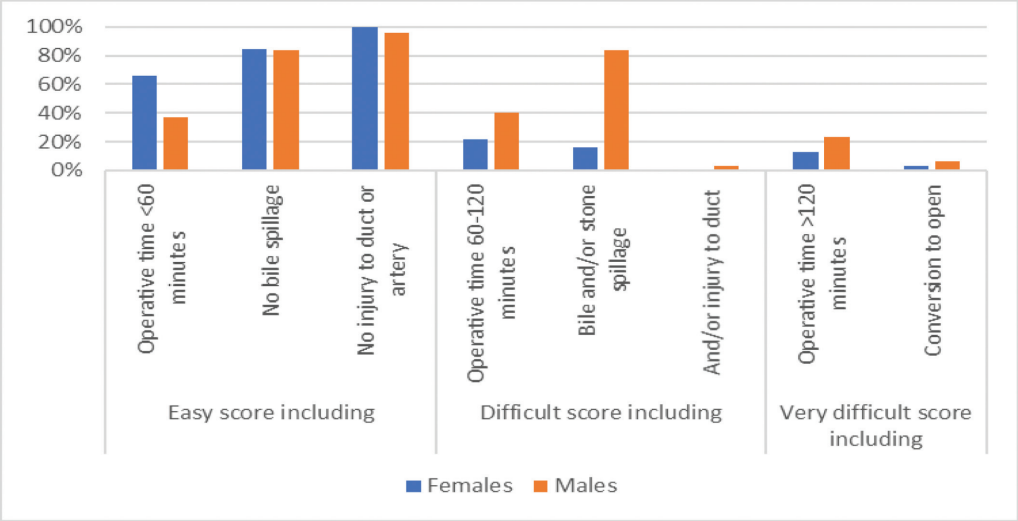


Comparison between females and males in total score.

Table 4 Comparison between females and males as regards intraoperative findings

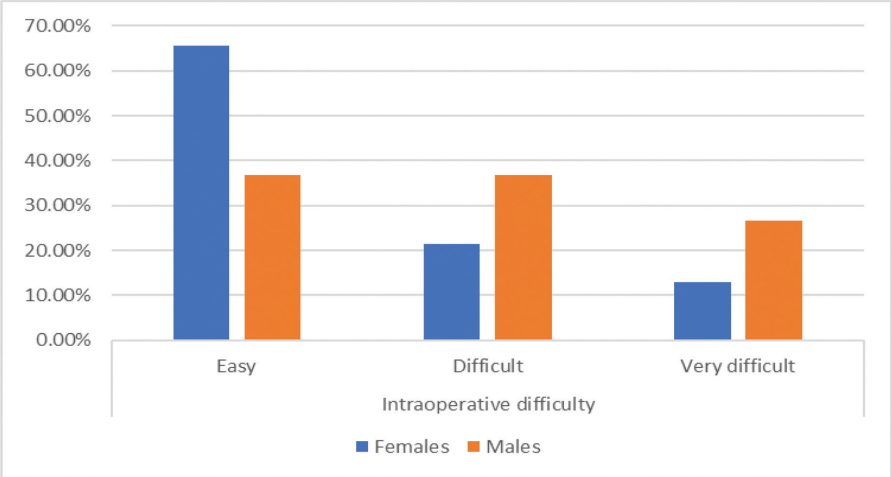
	Females [*n* (%)]	Males [*n* (%)]	*P* value
Easy score including			
Operative time <60 min	46 (65.7)	11 (36.7)	0.007 (S)
No bile spillage	59 (84.3)	25 (83.3)	1.000 (NS)
No injury to duct or artery	70 (100)	29 (96.7)	0.300 (NS)
Difficult score including			
Operative time 60-120 min	15 (21.4)	12 (40)	0.055 (NS)
Bile and/or stone spillage	11 (15.7)	5 (83.3)	1.000 (NS)
And/or injury to duct	0	1 (3.3)	0.300 (NS)
Very difficult score including			
Operative time >120 min	9 (12.9)	7 (23.3)	0.236 (NS)
Conversion to open	2 (2.9)	2 (6.7)	0.581 (NS)
Intraoperative difficulty			
Easy	46 (65.7)	11 (36.7)	0.025 (S)
Difficult	15 (21.4)	11 (36.7)	
Very difficult	9 (12.9)	8 (26.7)	

Figure 9



Comparison between females and males concerning intraoperative findings.

Figure 10



Comparison between females and males concerning an intraoperative difficulty.

compared with 36.7, 40, and 23.3% among males, respectively, with a significant difference (P=0.007), as shown in Table 4 and Figs 9–10. In female patients, two cases underwent conversion to open, where one case was due to cholecysto-duodenal fistula and the second case was due to Mirrizi syndrome type 4, and also in male patients, two cases underwent conversion to open, where one case was due to gross adhesions at Calot's triangle and the second case was due to intraoperative hemorrhage caused by injury of the cystic artery.

Most postoperative complications were more prevalent among male patients. Total postoperative complications showed an insignificant difference between males and females (P=0.270), as shown in Table 5 and Fig. 11. Re-exploration was done in one case among female patients owing to secondary hemorrhage caused by slipped clips of cystic artery and also in one case among male patients owing to biliary leakage caused by the duct of Luschka.

Table 5 Comparison between females and males as regards postoperative complications and outcome

	Females [*n* (%)]	Males [*n* (%)]	*P* value
Intra-abdominal hemorrhage	1 (1.4)	0	1.000 (NS)
Biliary leakage	0	1 (3.3)	0.300 (NS)
Postoperative jaundice	1 (1.4)	1 (3.3)	0.512 (NS)
Postcholecystectomy syndrome	1 (1.4)	0	1.000 (NS)
Intraabdominal collection	1 (1.4)	1 (3.3)	0.512 (NS)
Wound infection	1 (1.4)	0	1.000 (NS)
Port-site infection	4 (5.7)	2 (6.7)	1.000 (NS)
Fecal fistula	0	0	–
Pancreatitis	2 (2.9)	2 (6.7)	0.581 (NS)
Pneumonia	3 (4.3)	3 (10)	0.361 (NS)
Pulmonary embolism	0	0	–
Re-exploration	1 (1.4)	1 (3.3)	0.512 (NS)
Total postoperative complication	10 (14.3)	7 (23.3)	0.270 (NS)
Living	70 (100)	30 (100)	–

Regarding the relation between preoperative evaluation and intraoperative finding, among the 58 cases with a preoperative 'easy' score, 53 cases proved to be intraoperatively easy, whereas only four cases were difficult and one was very difficult intraoperatively. More than two-thirds of the 'difficult' cases according to the preoperative scoring proved to be difficult intraoperatively (20 of 27 cases), with four cases being easy and three very difficult. Lastly, among the 15 cases with a preoperative 'very difficult' score, 13 of them were very difficult intraoperatively, whereas only two cases were difficult and none were easy, as shown in Table 6.

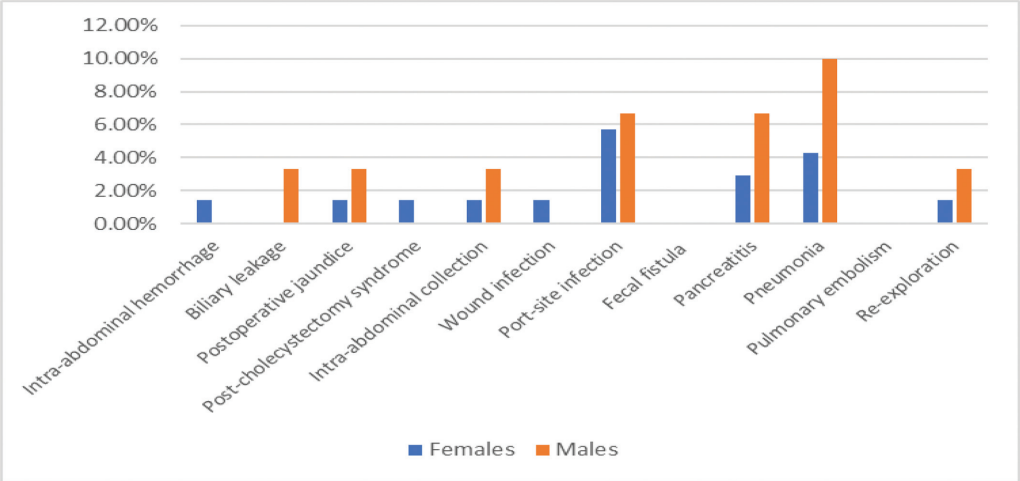
The degree of agreement between the preoperative evaluation of difficulty and the intraoperative

Table 6 Relation between preoperative evaluation (Preoperative Scoring System) and intraoperative finding (Intraoperative Scoring Factors)

	Preoperative scoring system [*n* (%)]			Total
	Easy	Difficult	Very difficult	
Intraoperative scoring				
Easy	53 (91.4)	4 (14.8)	0	57
Difficult	4 (6.9)	20 (74.1)	2 (13.3)	26
Very â difficult	1 (1.7)	3 (11.1)	13 (86.7)	17
Total	58	27	15	100

McNemar χ^2=1.200, P value of 0.753 (NS).

Figure 11



Comparison between females and males concerning postoperative complications and outcome.

difficulty showed that 86% of the cases agreed with the intraoperative course as expected by the preoperative scoring system, whereas eight cases went worse than expected and six were better than expected. The degree of agreement was higher among females (88.6%) compared with males (80%) but with a nonsignificant difference (P=0.448). The net result was that the degree of agreement between the preoperative evaluation of difficulty and the intraoperative difficulty was 86.00%; this indicates that the preoperative scoring system for preoperative prediction of difficulty levels in LC was a good predictor for the intra-operative difficulty levels, as shown in Table 7 and Fig. 12.

Table 8 shows that old age more than 50 years, history of hospitalization due to acute cholecystitis, BMI more than 25, abdominal scar, thick gallbladder wall, and impacted stone were significant using the univariate regression analysis as possible risk factors for poor outcome in females, whereas palpable gallbladder, pericholecystic collection and multiple stones were insignificant.

Table 7 Agreement between preoperative evaluation (Preoperative Scoring System) and intraoperative finding (Intraoperative Scoring Factors)

	Females [*n* (%)]	Males [*n* (%)]	Total [*n* (%)]
Agreed (same as expected)	62 (88.6)	24 (80)	86 (86)
Worse than expected	4 (5.7)	4 (13.3)	8 (8)
Better than expected	4 (5.7)	2 (6.7)	6 (6)
Total	70	30	100

χ^2=1.608, P value of 0.448 (NS).

Table 9 shows that none of the aforementioned factors showed significance by multivariate regression analysis as independent risk factors for poor outcomes in females, which means that the aforementioned risk factors may be interrelated and none of them is an independent risk factor by itself.

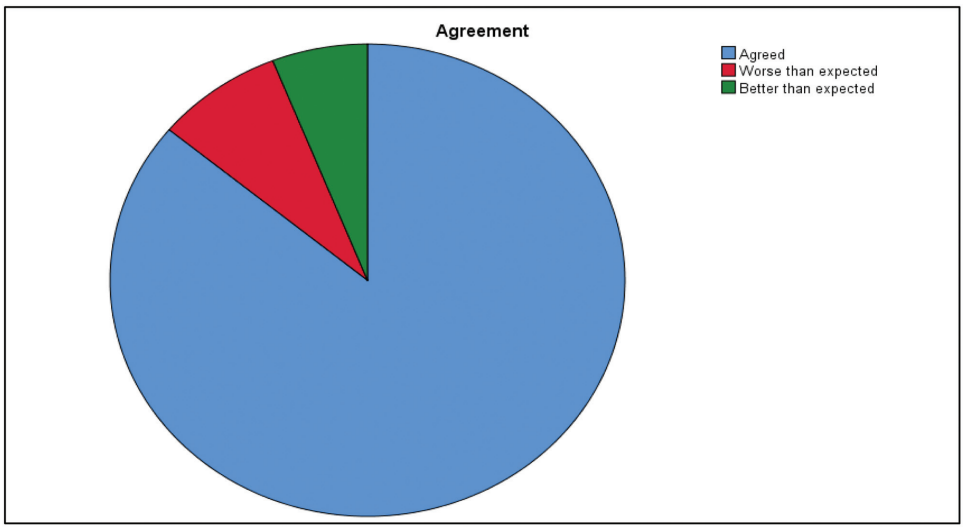
Table 10 shows that only old age more than 50 years was significant by univariate regression analysis as a possible risk factor for poor outcomes in males. Here, there was no need for a multivariate analysis of preoperative outcome with risk factors in males, as only one factor (old age) was significant in the univariate regression analysis.

Table 11 shows that old age more than 50 years, history of hospitalization due to acute cholecystitis, BMI more

Table 8 Univariate analysis of preoperative outcome with risk factors (predictive association of risk factors with the preoperative outcome) in females

	B	Odd's ratio	CI of odd's ratio	*P* value
Age >50 years	2.113	8.269	2.22–30.80	0.002
History of hospitalization due to acute cholecystitis	1.545	4.688	2.54–8.66	<0.001
BMI >25	1.309	3.702	1.75–7.85	0.001
Abdominal scar	1.036	2.819	1.19–6.68	0.019
Palpable gallbladder	22.414	5.431	–	0.999
Thick gallbladder wall	1.262	3.531	1.24–10.04	0.018
Pericholecystic collection	22.163	4.218	–	0.999
Impacted stone	4.270	71.556	8.33–614.8	<0.001
Multiple stones	1.114	0.328	0.10–1.06	0.063

Figure 12



Agreement between preoperative evaluation and intraoperative finding.

Table 9 Multivariate analysis of preoperative outcome with risk factors (predictive association of risk factors with the preoperative outcome) in females

	B	Odd's ratio	CI of odd's ratio	*P* value
Age >50 years	15.222	4.082	–	0.997
History of hospitalization due to acute cholecystitis	35.848	3.701	–	0.995
BMI >25	1.209	3.352	0.13–88.29	0.469
Abdominal scar	0.194	0.824	0.01–61.30	0.930
Thick gallbladder wall	0.041	0.960	–	1.000
Impacted stone	33.623	4.002	–	0.996

Table 10 Univariate analysis of preoperative outcome with risk factors (predictive association of risk factors with the preoperative outcome) in males

	B	Odd's ratio	CI of odd's ratio	*P* value
Age >50 years	2.303	10.000	1.64–60.92	0.013
History of hospitalization due to acute cholecystitis	6.023	4.129	–	0.998
BMI >25	1.155	3.173	0.99–10.23	0.053
Abdominal scar	1.046	2.847	0.49–10.50	0.243
Palpable gallbladder	1.705	5.500	0.59-53.22	0.141
Thick gallbladder wall	11.151	6.961	–	0.999
Pericholecystic collection	21.049	1.384	–	0.999
Impacted stone	1.386	4.000	0.67–23.73	0.127
Multiple stones	0.916	0.400	0.07–2.44	0.320

Table 11 Univariate analysis of intraoperative outcome with risk factors (predictive association of risk factors with the intraoperative outcome) in females

	B	Odd's ratio	CI of odd's ratio	*P* value
Age >50 years	1.593	4.920	1.42–17.05	0.012
History of hospitalization due to acute cholecystitis	1.175	3.239	2.08–5.05	<0.001
BMI >25	1.415	4.115	1.92–8.84	<0.001
Abdominal scar	0.929	2.531	1.09–5.89	0.031
Palpable gallbladder	3.114	22.500	2.61–194.3	0.005
Thick gallbladder wall	0.885	2.422	1.11–5.31	0.027
Pericholecystic collection	22.087	3.911	–	0.999
Impacted stone	3.258	28.000	5.10–132.5	<0.001
Multiple stones	0.671	0.511	0.16–1.64	0.259

than 25, abdominal scar, palpable gallbladder, thick gallbladder wall, and impacted stone were significant using univariate regression analysis as possible risk factors for poor intraoperative outcome in females. These factors were then included in the following multivariate regression analysis.

Table 12 shows that history of hospitalization due to acute cholecystitis and BMI more than 25 were

Table 12 Multivariate analysis of intraoperative outcome with risk factors (predictive association of risk factors with the intraoperative outcome) in females

	B	Odd's ratio	CI of odd's ratio	*P* value
Age >50 years	1.769	0.170	0.01–4.52	0.290
History of hospitalization due to acute cholecystitis	1.459	4.303	1.78–10.38	0.001
BMI >25	1.704	5.496	1.02–29.59	0.047
Abdominal scar	0.332	0.718	0.12–4.15	0.711
Palpable gallbladder	1.507	0.222	0.03–14.96	0.483
Thick gallbladder wall	0.295	0.744	0.19–2.90	0.671
Impacted stone	2.529	12.537	0.45–347.1	0.136

Table 13 Univariate analysis of intraoperative outcome with risk factors (predictive association of risk factors with the intraoperative outcome) in males

	B	Odd's ratio	CI of odd's ratio	*P* value
Age >50 years	3.079	21.667	2.23–210.1	0.008
History of hospitalization due to acute cholecystitis	0.911	2.487	1.46–4.23	0.001
BMI >25	0.552	1.737	0.60–4.99	0.306
Abdominal scar	0.945	2.574	0.45–14.73	0.288
Palpable gallbladder	1.529	4.615	0.48–44.76	0.187
Thick gallbladder wall	11.269	7.835	–	0.999
Pericholecystic collection	20.893	11.846	–	0.999
Impacted stone	1.186	3.273	0.55–19.45	0.192
Multiple stones	0.049	1.050	0.20–5.60	0.954

Table 14 Multivariate analysis of intraoperative outcome with risk factors (predictive association of risk factors with the intraoperative outcome) in males

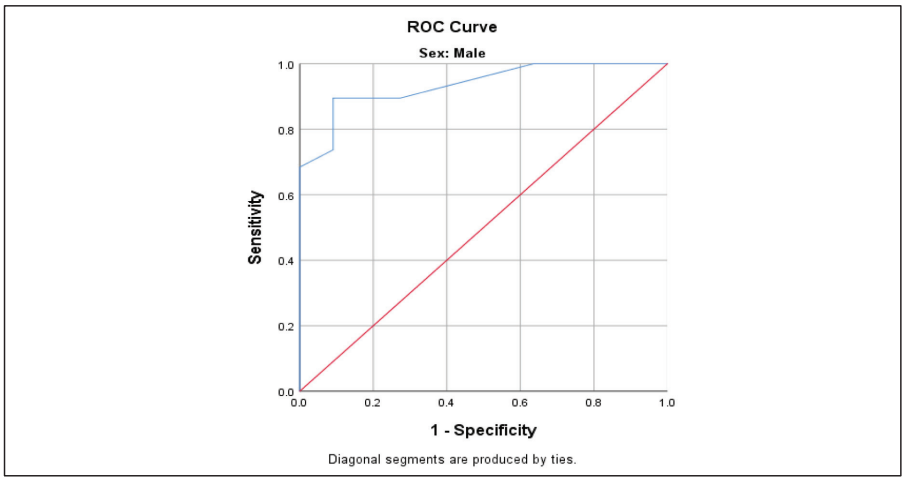
	B	Odd's ratio	CI of odd's ratio	*P* value
Age >50 years	2.843	17.173	1.0–293.6	0.050
History of hospitalization due to acute cholecystitis	0.864	2.373	1.27–4.44	0.007

significant in the multivariate regression analysis, and hence, these two factors could be considered independent risk factors for poor intraoperative outcomes among females.

Table 13 shows that old age more than 50 years and a history of hospitalization due to acute cholecystitis showed significance by univariate regression analysis as possible risk factors for poor intraoperative outcomes in males. These factors were then included in the following multivariate regression analysis.

Table 14 shows that age over 50 years and history of hospitalization due to acute cholecystitis were significant in multivariate regression analysis, and hence, these two factors could be considered

Figure 13



Area Under the Curve

Area	Std. Error	P-value	Asymptotic 95% Confidence Interval Lower Bound	Upper Bound
0.935	0.043	**<0.001**	0.851	1.000

Receiver operating characteristic (ROC) curve and its area under the curve for prediction of intraoperative outcome based on the preoperative score in males.

independent risk factors for poor intraoperative outcomes among males.

ROC curve analysis shows that the preoperative scoring system could be used to predict the intraoperative outcome in males, with highly significant differences ($P \leq 0.001$). The analysis of this curve shows also that the most relevant cut-off point of the preoperative score for the prediction of poor intraoperative outcome (difficult or very difficult) was 6, with a sensitivity of 89.5% and a specificity of 90.9%, as shown in Fig. 13.

ROC curve analysis shows that the preoperative scoring system could be used to predict the intraoperative outcome in females, with highly significant differences ($P \leq 0.001$). The analysis of this curve shows also that the most relevant cut-off point of the preoperative score for the prediction of poor intraoperative outcome (difficult or very difficult) was 5.5, with a sensitivity of 87.5% and a specificity of 93.5%, as shown in Fig. 14.

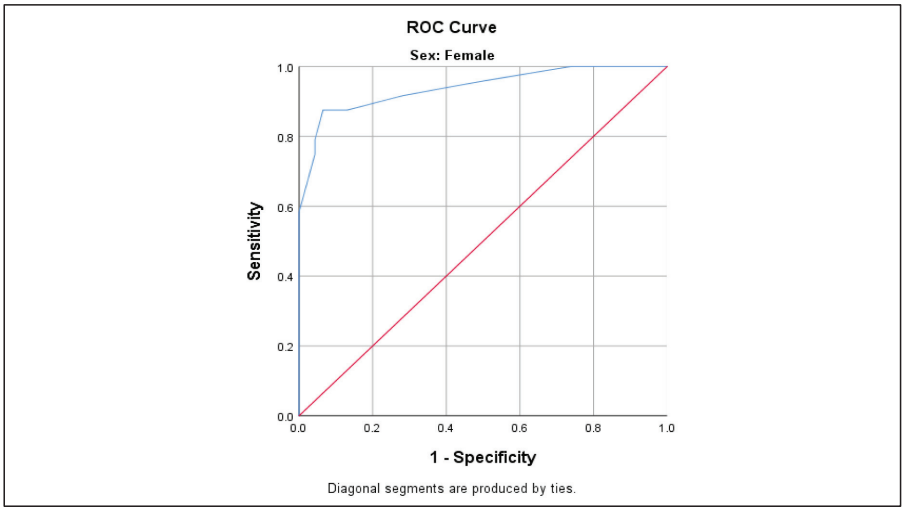
Discussion

Although LC is a safe, effective, and commonly performed operation, it has some difficulties in different stages of the operation [14]. The preoperative prediction of a 'difficult' procedure can be very important in this setting and can help the surgeon in being better prepared for the intraoperative challenges to give a tailored approach to older patients [15]. There is a need to evaluate various factors responsible for difficult LC [16].

Alqahtani *et al.* [17] found that the incidence of female patients was four times more than male patients with GSD. Numerous epidemiological studies across the globe have reported an increased incidence of GSD in women, especially during the fertile years. This can be attributed to raising estrogen levels during pregnancy, use of oral contraception forms, or estrogen replacement therapy, which leads to hypercholesteremia [18]. Similarly, a higher proportion of women patients were observed in the studies by Kumar *et al.* [19] (89.10%). This agrees with our results, where the majority of patients were females (70%) compared with males (30%), with a female to male ratio of 2.33 : 1.

Age more than 50 years is a significant risk factor for difficult LC in many studies [20]. Other studies reported that age more than 65 years is a risk factor for increased perioperative morbidity and conversion rates because of associated acute cholecystitis and a high ASA classification [21]. Many researchers have found age more than 60 years as a predictor of difficult LC, and the reason for older age being at risk is due to a

Figure 14



Area Under the Curve

Area	Std. Error	P-value	Asymptotic 95% Confidence Interval Lower Bound	Upper Bound
0.939	0.032	**<0.001**	0.876	1.000

Receiver operating characteristic (ROC) curve and its area under the curve for prediction of intraoperative outcome based on the preoperative score in females.

long history of gallstones and an increased number of acute attacks of cholecystitis. Besides, elderly patients have a higher likelihood of complicated biliary pathology as published by Kidwai *et al.* [22]. This concurs with our results, where the age was significantly increased in males in comparison with females (48.87±10.64 vs. 40.01±12.92; *P*=0.001). Moreover, as a preoperative risk factor, age more than 50 years was significantly increased in males compared with females (*P*=0.006). In males, age more than 50 years was considered an independent risk factor because it was significant in both univariate and multivariate analyses (*P*=0.008 and 0.050, respectively) in intraoperative outcomes with risk factors. In univariate analyses, age more than 50 was found to be statistically significant for the prediction of difficult LC in preoperative and intraoperative outcomes with risk factors in females and males (*P*=0.002 and 0.012, and *P*=0.013 and 0.008, respectively).

Nityasha *et al.* [23] reported that a history of acute cholecystitis was found to be a highly significant predictor of difficulty in LC (*P*<0.021) and patients with such a history were found to have 5.3 times more risk of having a difficult operation. Naik and Kailas [16] found that one of the preoperative parameters that significantly predicted difficult LC based on the clinical criterion was the presence of previous hospitalization for acute cholecystitis (*P*≤0.005). This correlates with our results, where history of hospitalization for acute cholecystitis was found to be significantly increased in males in comparison to females, with *P*=0.003, regarding preoperative scoring factors. In females and males, a history of hospitalization for acute cholecystitis was considered an independent risk factor for the prediction of difficult LC regarding intraoperative outcome with risk factors because it was statistically significant in both univariate and multivariate analyses (*P*≤0.001 and 0.001, and *P*=0.001 and 0.007, respectively).

Several studies have identified obesity and BMI more than 30 kg/m^2 as important risk factors for conversion of LC to open [24]. Concerning obesity, laparoscopic surgery is problematic due to many factors, as port placement in the obese patients needs longer time due to the thick abdominal wall, dissection at the Calot's triangle had some technical difficulties due to the ambiguous anatomy because of excessive intraperitoneal fat, and the difficulty in the manipulation of instruments through an excessively thick abdominal wall [25]. In our study, BMI was statistically insignificant between female and male

groups regarding preoperative scoring factors for difficult LC (P=0.347). However, in females, BMI greater than 25 was statistically significant in both univariate and multivariate analyses (P≤0.001and 0.047, respectively), so it was considered an independent risk factor for the prediction of difficult LC in intraoperative outcomes with risk factors.

Previous studies reported that associated comorbidities were higher in men (26.82%) than women (13.8%) and statistically significant (P=0.027) [26]. Other researchers found that patients with GSD may have many comorbid conditions, which might influence the surgical outcome of LC as well as increase the risk of its conversion to OC [19]. This correlates with our findings, where men had a higher incidence of total associated comorbidities as compared with women (53.3 vs. 30%), which was statistically significant (P=0.027).

Another presentation was found that abdominal scars showed a significant predictive factor for difficulty during LC (P=0.02) [27]. Moreover, other authors found that previous upper abdominal surgeries were a risk factor for conversion of LC to open [11]. Others reported a significant increase in females in comparison with males regarding prior abdominal surgeries (P=0.006) [26]. In contrast, studies by Coelho *et al.* [28] did not show any significant difference between male and female groups. In our presentation, abdominal scars were significantly higher among females compared with males concerning preoperative scoring factors (P=0.003).

Palpable gallbladder and abdominal tenderness were important patient factor predictors of a difficult procedure of cholecystectomy [29]. Others found that palpable GB and impacted stone (in univariate analysis) were found to be statistically significant to predict difficult LC [2]. Singh and Nath [30] published that if the gallbladder is palpable then it would be difficult, as there may be residual inflammation adhesion. In our research, there was an insignificant difference between female and male groups regarding palpable gallbladder, but it was more prevalent among male patients (23.3 vs. 12.9%) in preoperative scoring factors.

Gallbladder wall thickness was found to have a highly significant statistical association with the outcome of LC (P<0.0001) [27]. The thick-walled gallbladder has been identified as a risk factor in the conversion of LC to open surgery in several studies [26]. Kala *et al.* [31] published that GB wall thickness more than 4 mm was considered a predictor of difficult LC and the same has been shown in the various pieces of literature. In our presentation, the wall thickness of the gallbladder (>4 mm) was statistically insignificant between the studied groups (P=0.540) but had a higher incidence in males than females (80 vs. 74.3%).

There was a statistically significant association between pericholecystic collection on sonography and LC difficulty [27]. Agarwal *et al.* [32] reported that pericholecystic collection was found to be a strong predictor of difficult LC. Naik and Kailas [16] found that pericholecystic collection was not statistically significant in predicting difficulty (P=1.18). The pericholecystic collection was not significant, although it is a marker for the acute state; the result agreed with other studies, which revealed that preoperative ultrasound can help expect the operative difficulty of LC [33]. This agrees with our results, pericholecystic collection showed an insignificant difference between female and male groups (P=0.446) regarding preoperative predictors of difficult LC but was more prevalent in males than females (13.3 vs. 7.1%).

Kidwai *et al.* [22] concluded that impacted stones at Hartmann's pouch make dissection difficult because of the difficulty in holding GB at Hartmann's pouch. Husain *et al.* [34] found that stone size of more than 1 cm was a significant factor for difficult and very difficult LC (P<0.05). In our study, impacted stones showed an insignificant difference between female and male groups (P=0.208) regarding preoperative predictors of difficult LC but more prevalent in males than females (33.3 vs. 21.4%).

Bat [35] found that gallbladder stone number was not significant (P=0.5). Kidwai *et al.* [22] found that patients with multiple GB calculi had difficulty during LC. Husain *et al.* [34] found that multiple stones were a nonsignificant factor for difficult and very difficult LC (P>0.05). Similar to our results, multiple GB calculi showed an insignificant difference between female and male groups (P=0.588) regarding preoperative scoring factors for prediction of difficult LC but were more prevalent in females than males (78.6 vs. 73.3%).

The conversion rate in literature was between 7 and 35% [36]. Other researchers reported that difficult cases were associated with a conversion rate of 25% [37]. Moreover, other studies reported that the conversion rate was between 3 and 24% [4,5]. In our study, the conversion rate showed an insignificant

difference between the two studied groups (P=0.581), but the incidence was more in males than females (6.7 vs. 2.9%). Two cases of female patients underwent conversion to open (one case was due to cholecystoduodenal fistula and the second case was due to Mirrizi syndrome type 4). Moreover, two cases of male patients underwent conversion to open (one case was due to gross adhesions at Calot's triangle and the second case was due to intraoperative hemorrhage caused by injury of the cystic artery).Studies reported that the incidence of postoperative complications in both male and female groups was very less, and the intergroup difference was not significant statistically (P=0.70) [15,17]. Moreover, other investigators observed that the postoperative complications and outcomes were statistically insignificant between female and male groups [38]. This agrees with our results, where there was an insignificant difference between female and male groups regarding total postoperative complications and outcomes (P=0.270). However, they were more prevalent among males than females (23.3 vs. 14.3%).

Some investigators found that postoperative hospital stay was similar for both men and women groups [26], and this finding can be correlated with studies by Bazoua and Tilston [11], Kumar *et al.* [19], and Coelho *et al.* [28]. However, other researchers reported a longer duration of postoperative stay in male patients [39,40]. Moreover, another study reported that hospital stay in male patients was 5.0 ±2.52 days, whereas in female patients was 3.64±1.40 days (statistically significant with P=0.001) [38]. In our presentation, postoperative hospital stay was significantly increased in the male group in comparison with the female group (4.30±2.95 vs. 2.76±2.65; P=0.017).

The operative time was significantly increased in males in comparison with females (P=0.007). This concurs with studies by Bazoua and Tilston [11], Coelho *et al.* [28], and Alqahtani *et al.* [17], where the average operative time was longer in males than females and the difference was statistically significant.

From the results of our presentation, males had difficulty with LC more than females, and it can be considered as a risk factor for difficult LC owing to the following reasons: regarding the preoperative scoring system, the total preoperative score of prediction of difficult LC was significantly increased in males in comparison with females (7.57±3.70 vs. 4.84±3.74; P=0.001). The majority of males had difficult and very difficult preoperative scores (36.7+23.3%=60% compared with females (22.9+11.4%=34.3%), which were statistically significant (P=0.02). However, BMI, palpable gallbladder, wall thickness of gallbladder, pericholecystic collection, and impacted stone were statistically insignificant between the two studied groups but had a higher incidence in males than females. Regarding the intraoperative findings, approximately two-thirds of the males had an intraoperative difficult and very difficult course (36.7 +26.7%=63.4%) compared with nearly one-third among females (21.4+12.9%=34.3%), with a significant difference (P=0.025). The operative time was significantly increased in males in comparison with females (P=0.007). Moreover, males had a longer duration of hospital stay (4.3 days) compared with females (only 2.76 days), with a significant difference (P=0.017).

Regarding the relation between preoperative evaluation and intraoperative findings, among the 58 cases with a preoperative easy score, 53 (91.4%) cases proved to be intraoperatively easy, whereas only four (6.9%) cases were difficult and one (1.7%) was very difficult intraoperatively. More than two-thirds of the 'difficult' cases according to the preoperative scoring proved to be difficult intraoperatively (20 of 27 case=74.1%), with four (14.8%) cases being easy and three (11.1%) were very difficult. Lastly, among the 15 cases with a preoperative 'very difficult' score, 13 (86.7%) of them showed very difficult intraoperative findings, whereas only two (13.3%) cases were difficult and none were easy. Moreover, the degree of agreement between the preoperative evaluation of difficulty and the intraoperative difficulty was 86.00%; this indicates that the preoperative scoring system for prediction of difficulty levels in LC was a good predictor for the intraoperative difficulty levels. Therefore, great attention was given to the preoperative scoring system in all patients who underwent LC.

Regarding the univariate and multivariate analyses of preoperative outcomes with risk factors, in females, age more than 50 years, history of hospitalization due to acute cholecystitis, BMI more than 25, abdominal scar, thick gallbladder wall, and impacted stone were statistically significant in univariate analysis (P=0.002, P<0.001, P=0.001, P=0.019, P=0.018, and P<0.001, respectively), but in the multivariate analysis they were statistically insignificant. However, in males, only age more than 50 years was statistically significant in univariate analysis.

Regarding the univariate and multivariate analyses of intraoperative outcomes with risk factors, in females,

history of hospitalization due to acute cholecystitis and BMI more than 25 were statistically significant in univariate and multivariate analyses ($P \leq 0.001$ and $P < 0.001$, and 0.001 and 0.047, respectively), and hence, these two factors could be considered as independent risk factors for poor intraoperative outcome with risk factors, but age more than 50 years, abdominal scar, palpable gallbladder, thick gallbladder wall, and impacted stone were statistically significant ($P=0.012$, $P<0.031$, $P=0.005$, $P=0.027$, and $P<0.001$, respectively) in the univariate analysis as possible risk factors for poor intraoperative outcome. In males, only age more than 50 years and history of hospitalization due to acute cholecystitis were significant in univariate and multivariate analyses ($P \leq 0.008$ and $P < 0.001$ and $P=0.050$ and $P=0.007$, respectively), and hence, these two factors could be considered as independent risk factors for poor intraoperative outcome with risk factors.

In males, ROC curve analysis showed that the preoperative scoring system could be used to predict the intraoperative outcome, with a highly significant difference ($P \leq 0.001$).

In females, ROC curve analysis showed that the preoperative scoring system could be used to predict the intraoperative outcome, with highly significant differences ($P \leq 0.001$).

Conclusion

Regarding our results, we concluded that difficult LC appears to be more prevalent in males compared with females and the male sex may be considered a risk factor of difficult LC, owing to males having an overall higher prevalence of comorbidities (53%) compared with only 30% among females, with a significant difference ($P=0.027$). Older age more than 50 years and history of hospitalization were significantly higher among males compared with females regarding preoperative scoring factors ($P=0.006$ and 0.003, respectively). Total preoperative scores were significantly increased in males in comparison with females ($P=0.001$). The majority of males had either difficult or very difficult preoperative scores (60%) compared with 34.3% among females, which were statistically significant ($P=0.02$). Approximately two-thirds of the males had an intraoperative difficult and very difficult course (63.4%) compared with nearly one-third among females (34.3%), with a significant difference ($P=0.025$). The operative time was significantly increased in males in comparison with females ($P=0.007$). Postoperative hospital stay was significantly increased in the male group in comparison with the female group ($P=0.017$).

Recommendation

Proper preparation of patients preoperatively is needed. Preoperative predictive factors of difficult LC (Preoperative Scoring System) were a good predictor for the intra-operative difficulty levels, so great attention was given to the preoperative scoring system in all patients who underwent LC and could be used to plan the intervention. Adequate training and experience of the surgeon, proper execution of appropriate technique, and accurate identification of the anatomy are essential guidelines for the prevention of complications.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Shaffer EA. Gallstone disease: epidemiology of gallbladder stone disease. Best Pract Res Clin Gastroenterol 2006; 20:981–996.

2 Saleem AA, Abdallah HA. Evaluation of preoperative predictive factors for difficult laparoscopic cholecystectomy in comparison with intraoperative parameters. Egypt J Surg 2018; 37:504–511.

3 Selvi TR, Sinha P, Subramaniam PM, Konapur PG, Prabha CV. A clinicopathological study of cholecystitis with special reference to analysis of cholelithiasis. Int J Basic Med Sci 2011; 2:68–72.

4 Livingston EH, Rege RV. Technical complications are rising as common duct exploration is becoming rare. J Am Coll Surg 2005; 201:426–433.

5 Bulbuller N, Ilhan YS, Baktir A, Kirkil C, Dogru O. Implementation of a scoring system for assessing difficult cholecystectomies in a single center. Surg Today 2006; 36:37–40.

6 Grönroos JM, Hämäläinen MT, Karvonen J, Gullichsen R, Laine S. Is male gender a risk factor for bile duct injury during laparoscopic cholecystectomy?. Langenbeck's Arch Surg 2003; 388:261–264.

7 Yol S, Kartal A, Vatansev C, Aksoy F, Toy H. Sex as a factor in conversion from laparoscopic cholecystectomy to open surgery. JSLS 2006; 10:359–363.

8 Hussain A. Difficult laparoscopic cholecystectomy: current evidence and strategies of management. Surg Laparosc Endosc Percutan Tech 2011; 21:211–217.

9 Genc V, Sulaimanov M, Cipe G, Basceken SI, Erverdi N, Gurel M, *et al.* What necessitates the conversion to open cholecystectomy? A retrospective analysis of 5164 consecutive laparoscopic operations. Clinics 2011; 66:417–420.

10 Zhang WJ, Li JM, Wu GZ, Luo KL, Dong ZT. Risk factors affecting conversion in patients undergoing laparoscopic cholecystectomy. ANZ J Surg 2008; 78:973–976.

11 Bazoua G, Tilston MP. Male gender impact on the outcome of laparoscopic cholecystectomy. J Soc Laparoendosc Surg 2014; 18:50–54.

12 Larobina M, Nottle PD. Extrahepatic biliary anatomy at laparoscopic cholecystectomy: is aberrant anatomy important?. ANZ J Surg 2005; 75:392–395.

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

14 Solmaz A, Gülçiçek OB, Biricik A, Erçetin C, Yiğitbaş H, Yavuz E, *et al.* Evaluation of the parameters increasing intraoperative difficulty scores of elective laparoscopic cholecystectomy. J Liver Clin Res 2016; 3:1023–1028.

15 Guida F, Monaco L, Schettino M, Porfidia R, Iapicca G. Predictive factors of difficult procedure in octogenarians undergoing elective laparoscopic

cholecystectomy: a single center experience. J Ital Surg Assoc 2016; 37:68–70.

16 Naik C, Kailas CT. Predicting difficulty in laparoscopic cholecystectomy by clinical, hematological and radiological evaluation. Int Surg J 2016; 4:189–193.

17 Alqahtani R, Ghnnam W, Alqahtani M, Qatomah A, AlKhathami A, Alhashim A. Role of male gender in laparoscopic cholecystectomy outcome. Hospital 2015; 40:40–155.

18 Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: cholelithiasis and cancer. Gut Liver 2012; 6:172–187.

19 Kumar J, Kumar P, Meena K, Siddiqui AA. Male gender as an independent risk factor for laparoscopic cholecystectomy: an outcome analysis at a teaching institute. Saudi J Health Sci 2017; 6:104–109.

20 Sahu SK, Agrawal A, Sachan PK. Intraoperative difficulties in laparoscopic cholecystectomy. J Chir (Iaşi) 2013; 2:149–155.

21 Tarcoveanu E, Epure O, Zugun F, Bradea C, Moldovanu R. Male gender – difficulty factor in cholecystectomies for cholelithiasis. Rev Med Chir Soc Med Nat Iasi 2002; 106:768–772.

22 Kidwai R, Pandit R, Issrani R, Prabhu N. Assessment of risk factors for conversion from difficult laparoscopic to open cholecystectomy-a hospital based prospective study. J Krishna Inst Med Sci 2016; 5:84–97.

23 Nityasha DS, Sharma V, Saharan A, Bakshi V. Evaluation of predictive factors for conversion of laparoscopic cholecystectomy. Int J Enhanc Res Med Dent Care 2016; 3:7–10.

24 Manandhar K, Manandhar S. Does the male gender govern conversion of laparoscopic cholecystectomy?. J Patan Acad Health Sci 2019; 6:14–20.

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

26 Bahadur A, Bisht SD, Rathi Y, Shukla A, Aggarwal A. Is gender a determinant for the outcome of laparoscopic cholecystectomy? Int Surg J 2020; 7:3959–3964.

27 Ghanem Y, Fahmy K, Refaat D, Mouhammed M. Preoperative prediction of difficult laparoscopic cholecystectomy: in Zagazig university hospitals. Zagazig Univ Med J 2017; 23:1–13.

28 Coelho JCU, Dalledone GO, Schiel W, Berbardin JDP, Claus CMP, Matias JEF, *et al.* Does male gender increase the risk of laparoscopic cholecystectomy?. ABCD Arq Brasil Cirur Dig (São Paulo) 2019; 32:2.

29 Lowndes B, Thiels CA, Habermann EB, Bingener J, Hallbeck S, Yu D. Impact of patient factors on operative duration during laparoscopic cholecystectomy: evaluation from the National Surgical Quality Improvement Program database. Am J Surg 2016; 212:289–296.

30 Singh AK, Nath U. Predictor of difficult laparoscopic cholecystectomy. Indian J Appl Res 2016; 6:619–623.

31 Kala S, Verma S, Dutta G. Difficult situations in laparoscopic cholecystectomy: a multicentric retrospective study. Surg Laparosc Endosc Percutan Tech 2014; 24:484–487.

32 Agarwal D, Arora D, Avasthi A, Kothari A, Dangayach KK. Study of 292 patients for prediction of difficult laparoscopic cholecystectomy using detailed history, clinical and radiological parameters. Int Surg J 2016; 3:349–353.

33 Atmaram DC, Lakshman K. Predictive factors for conversion of laparoscopic cholecystectomy. Indian J Surg 2011; 73:423–426.

34 Husain A, Pathak S, Firdaus H. Assessment of operative predictors for difficulty in laproscopic cholecystectomy. Int J Contemp Med Res 2016; 3:1232–1234.

35 Bat O. The analysis of 146 patients with difficult laparoscopic cholecystectomy. Int J Clin Exp Med 2015; 8:16127–16131.

36 Khan IA, El-Tinay OE. Laparoscopic cholecystectomy for acute cholecystitis. Saudi Med J 2004; 25:299–302.

37 Szabo K, Rothe A, Shamiyeh A. Laparoscopic cholecystectomy-review over 20 years with attention on acute cholecystitis and conversion. Eur Surg 2012; 44:28–32.

38 Masanashetty SN, Sindhu S, Devaprashanth M. Can difficulties in laparoscopic cholecystectomy be anticipated preoperatively: evaluation of a scoring system. Int Surg J 2020; 7:1199–1203.

39 Ambe PC, Köhler L. Is the male gender an independent risk factor for complication in patients undergoing laparoscopic cholecystectomy for acute cholecystitis?. Int Surg 2015; 100:854–859.

40 Kanakala V, Borowski DW, Pellen MGC, Dronamraju SS, Woodcock SAA, Seymour K, *et al.* Risk factors in laparoscopic cholecystectomy: a multivariate analysis. Int J Surg 2011; 9:318–323.