Predictive Factors of Difficult Laparoscopic Cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy is considered the gold standard treatment of symptomatic cholelithiasis, preoperative prediction of the difficult surgery is an important aspect of planning laparoscopic surgery.
Objective: The purpose of this prospective study is to evaluate, analyze, and document different predictive factors of difficult laparoscopic cholecystectomy and whether conversion rate to open surgery and complications can be minimized during laparoscopic cholecystectomy. **Patients and Methods:** This is a prospective clinical study done on 100 patients complaining of calcular cholecystitis admitted to having (LC) at the Department of Surgery Faculty of Medicine Al-Azhar University Hospital in Assiut and Al-Arish General Hospital from May 2018 to January 2020.
Results: Univariate analysis of pre-operative risk factors versus operative data variables showed that male gender was associated with prolonged operative time. Age above 45 years was associated with prolonged dissection time, GB bed dissection time. BMI of 30 or more was associated with prolonged GB bed dissection time. Palpable GB was associated with prolonged operative time, prolonged GB bed dissection time, prolonged GB extraction time, and increased risk for conversion to open surgery. Distended GB in ultrasound was associated with prolonged operative time. Solitary stone in GB was associated with prolonged extraction time. **Conclusion:** Pre-operative factors can help to predict a difficult LC. This information may be useful to both the patient and the treating surgeon. Prediction of a difficult procedure would allow the surgeon to discuss the likelihood of conversion with the patient and prepare him/her psychologically as well as planning their recovery and explaining their absence from work.
Keywords: Laparoscopic Cholecystectomy, Predictive Factors.

INTRODUCTION

Laparoscopic cholecystectomy LC) since its advent in 1987[(1)] has dramatically replaced open cholecystectomy in the management of cholecystolithiasis[(2)]. Laparoscopic cholecystectomy provides a safe and effective treatment for most patients with symptomatic gallstones[(3)] and is the treatment of choice for cholelithiasis. It has now become the most common operation performed by general surgeons[(4)].

The advantages of laparoscopic cholecystectomy are earlier return to bowel function, less postoperative pain, cosmetics, shorter length of hospital stay, earlier return to full activity, and decreased overall cost [(5-7)]. Conversion to open cholecystectomy is neither a complication nor a failure but an attempt to avoid a complication[(8)]. Most previous contraindications to (LC), such as morbid obesity, previous upper abdominal surgery, and acute cholecystitis are no longer absolute contraindications[(9)], with the growing experience, a selection criterion has become more liberal [(10)]. The levels of difficulties during (LC) can be predicted based on certain preoperative clinical, laboratory, or radiological parameters[(11)].The purpose of this prospective study is to evaluate, analyze, and document different predictive factors of difficult laparoscopic cholecystectomy and whether conversion rate to open surgery and complications can be minimized during laparoscopic cholecystectomy.

PATIENTS AND METHODS

This is a prospective clinical study done on 100 patients complaining of calcular cholecystitis admitted to having (LC) at the Department of Surgery Faculty of Medicine Al-Azhar University Hospital in Assiut and Al-Arish General Hospital from May 2018 to January 2020.

Surgical procedure (LC) adopted by all surgeons corresponded with the American method: The patient is placed in the supine position, the surgeon stand on the left side of the patient. Pneumoperitoneum is created with carbon dioxide gas.

Patients were excluded from the study according to the following criteria: Patients with a history of upper abdominal surgery, patients with evidence of concomitant choledocholithiasis or dilated bile ducts, patient contraindication to laparoscopic cholecystectomy e.g. uncompensated cardiac and respiratory patient, and pregnancy.

Information's obtained for every patient admitted at least 1 day before elective (LC) for symptomatic cholelithiasis included: The patient's characteristics: gender, age and body habits (BMI), the patient's history: jaundice, number of previous acute attacks of cholecystitis previous abdominal surgery, and ERCP, clinical examination**:** positive Murphy's sign and palpable gall bladder, preoperative laboratory tests**,** serum alkaline phosphatase, AST, ALT, GGT, and routine investigation CBC, PT, PC, INR, RBS, urea, creatinine, bilirubin and Hepatitis virus profile, and preoperative imaging**:** (ultrasound of gall bladder and biliary tree).

Ethical Considerations:

An approval of the study was obtained from Al-Azhar University academic and ethical committee.

Received:2 /10 /2020
Accepted:20 /11 /2020

Every patient signed an informed written consent for acceptance of the operation.

Operative technique:

Patient preparation: the patients were operated on, in the supine position with a steep head-up tilt once the pneumoperitoneum has been established. **Creation of pneumoperitoneum:** with the closed technique using safety port after insufflation. **Insertion of ports, initial inspection, and exposure of the triangle of Calot:** four ports were used, optical (11mm), one 5mm and one 11mm operating, and one 5mm assisting port using the American approach. **Dissection of the cystic pedicle:** to separate the cystic duct anteriorly from the cystic artery behind then the cystic artery and the cystic duct was clipped separately (double proximal, single distal clips) and then divided by scissors. **Detachment of gallbladder from the liver:** by dissection through the areolar tissue plane binding the gallbladder to the Glisson's capsule. **Extraction of the gallbladder:** through the 11mm operating port directly or in a glove that acted as a safeguard against stone loss and contamination of the exit wound (Figure 1).

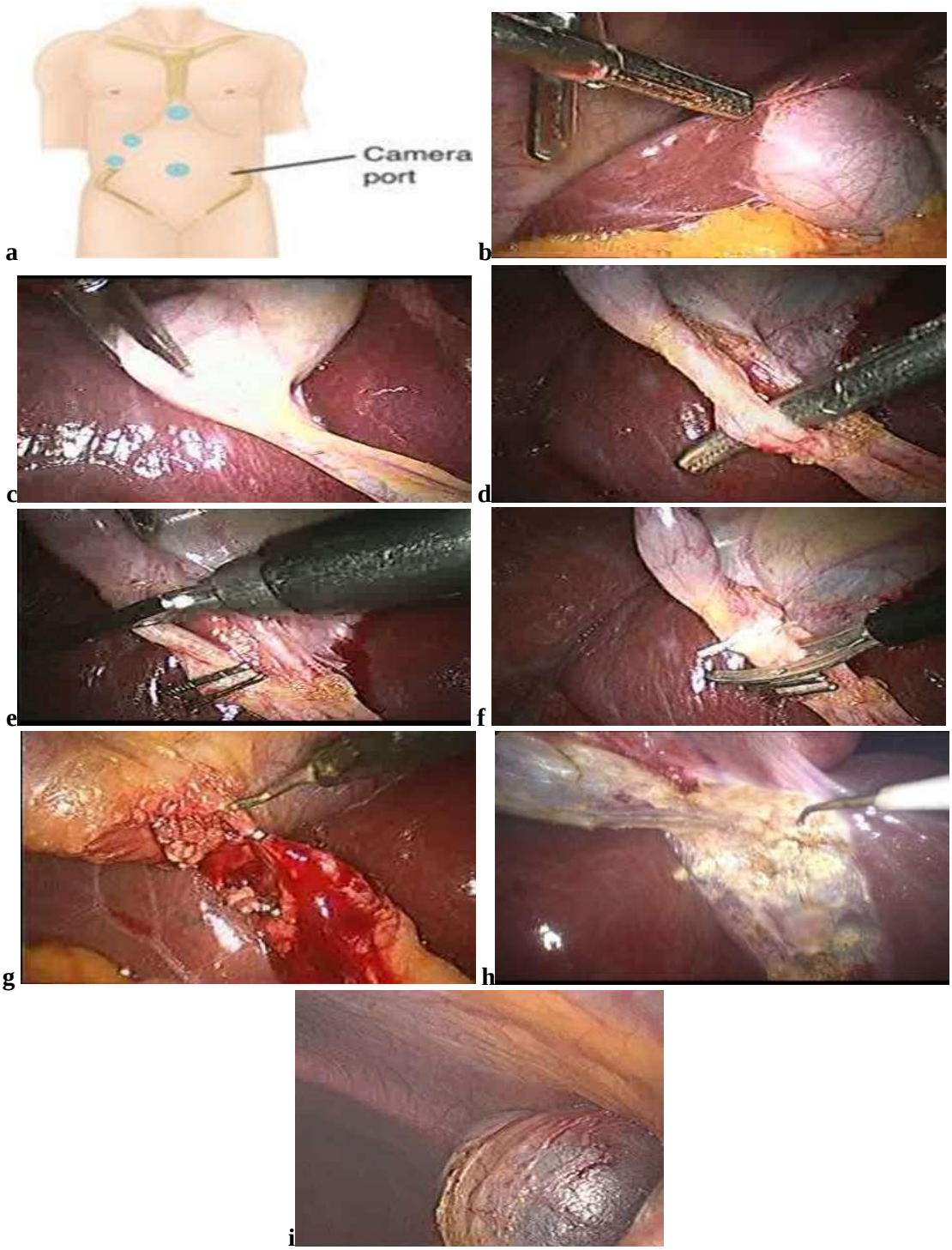

Figure (1): **a)** Port sites. **b)** Laparoscopic view of the gall bladder area. **c)** The Hartmann's pouch is retracted. **d)** Cystic duct is dissected. **e)** Clips are applied to the cystic duct. f) The cystic duct is transected using scissors. g) The cystic artery is identified, clipped, and dissected. h) Hook electrocautery is used to dissect the gallbladder off the liver bed. **i)** Gall bladder extraction through the subxiphoid trocar site.

Post-operative:

Each patient will be monitored in the post-operative period for immediate and early complication as bleeding and bile leak. Antibiotic 3rd generation cephalosporin, oral feeding after 8 hours, discharge 12 to 24 hours post-operation, and outpatient clinic follow-up one week and two weeks after surgery.

Statistical analysis of the results:

Univariate analysis of pre-operative risk factors versus operative data variables was done using Student's t-test and Chi-squared test. Significance was demonstrated in every case. The significance of each pre-operative variable in every part of the operation was assessed separately to determine the independent risk factors. Then the sum of all significances led us to identify the independent risk factors that can predict difficult LC.

RESULTS

A total of 100 patients were included in this study; the majority of them were females [N=73 (73%)]. The patient characteristics are presented in Table (1). In our study, the mean age was 48.2 ± 12.5 years (range: 25–70 years). Most patients were in the age group of 41–50 years followed by the age group of 30–40. Out of 100 patients, 73 were females and 27 were male patients.

Table (1): Age and gender among studied cases.

Gender	**No.**		**%**
Female	73		73%
Male	27		27%
	Minimum	**Maximum**	**Mean ±SD**
Age in years	25	70	48.2 ± 12.5

Table (2): Patient age and BMI distribution.

	No.	**%**
Age distribution of the patients		
<30	15	15%
30–40	26	26%
41–50	37	37%
51–60	12	12%
> 60	10	10%
BMI kg/m²		
Normal **<25**	4	4%
Pre obese 25-29.9	42	42%
Obese30-34.5	43	43%
Morbid obese > 35	11	11%

Regarding ultrasonography findings, 74 patients had multiple stones, whereas 26 patients had solitary stone; moreover, 12 patients had impacted stone with difficult extraction, pericholecystic collection was present in 6 patients, distended gall bladder in 7 patients, 11 patients had wall thickness diameter minimum 2mm and maximum 5.8 mm, CBD diameter minimum 2mm and maximum 6.5 mm, and size of the stone was minimum 2.5 mm and maximum 26.7 mm. Distribution according to the ultrasound measurement table (3 & 4).

Table (3): Distribution of patients according to US finding

	Minimum	**Maximum**	**Mean±SD**
GB wall thickness (mm)	2.00	5.8	3.5± 2.01
Size of stone (mm)	2.5	26.7	9.9 ±6.3
CBD diameter (mm)	2.00	6.5	3.94± 1.01

Table (4): Patient's measurements

	NO.	**%**
Stones no:		
multiple	74	74 %
solitary	26	26 %
Distended GB		
Yes	7	7 %
No	93	93 %
Pericholecystic collection:		
Yes	6	6 %
No	94	94 %

Operative data:

28 cases were difficult LCs. The description of difficulties according to prolongation of operative time and according to causes in the following table (5).

Table **(5):** Patients difficult operative data

	Number of cases	**%**
Difficult to access the abdominal cavity	5	5
Difficult dissection in Calot's triangle	20	20
Difficult GB bed dissection	12	12
Difficult GB extraction	17	17
Perforation of GB	14	14
Bleeding	2	2
Conversion to Open Surgery	3	3

According to the number of difficulties in the same case the following table (6).

Table (6): Number of difficulties in the same case

Number of cases	Number of difficulties
15	1
9	2
5	3
3	4

We had 3 cases with 4 difficulties, difficult to access, difficult dissection in Calot's triangle, difficult GB bed dissection, and difficult GB extraction. The 3 cases had a history of an acute attack and solitary stone >1cm 2 male and one female. And 5 cases with 3 difficulties 4 female and one male all above 45 years and had a history of an acute attack. 9 cases with 2 difficulties 7female and 2 male.15 cases of one difficulty.

The following table (7) showing the relation between the preoperative factors and operative difficulty.

Table (7): Relation between the preoperative factors and operative difficulty

		Easy LC	Difficult LC
Gender	Male	17	10
	Female	55	18
Age	>45	39	17
	<45	33	11
BMI	>30	42	20
	<30	30	8
Previous abdominal surgery	No	63	23
	Yes	9	5
History of jaundice	No	67	27
	Yes	5	1
Previous ERCP	No	71	27
	Yes	1	1
Previous acute attack	No	68	16
	Yes	4	12
Murphy "sign	Negative	60	24
	Positive	12	4
Palpable GB	No	70	24
	Yes	2	4
Distended GB	No	70	23
	Yes	2	5
Stone no.	Multiple	58	16
	Solitary	14	12
Stone size	>1cm	16	16
	< 1cm	56	12
Pericholecystic collection	No	70	24
	Yes	2	4

Regarding intraoperative parameters, the mean of intraoperative time 52.9± 18.8 SD minutes time range from 17 minutes to 125 minutes. The operative time increased with male patients, age > 45, previous acute attack, distended palpable GB, multiple stones, large single stone, and pericholecystic collection as shown in the following table.

Table (8): Relation between the preoperative risk factors and mean operative time.

		Mean ± SD	P-Value
Gender	Male	67.65 ± 25.932	0.046*
	Female	55.43 ± 25.657	
Age	>45	57.43 ±28.745	0.332
	<45	52.32 ± 29.765	
BMI	>30	61.54 ± 32.121	0.234
	<30	55.14 ± 16.564	
Previous abdominal surgery	No	59.65 ±24.334	0.786
	Yes	59.11 ±24.211	
History of Jaundice	No	58.66 ±25.675	0.561
	Yes	54.76 ± 23.546	
Previous ERCP	No	55.11 ± 18.798	0.579
	Yes	57.66 ± 19.567	
Previous acute Attack	No	49.56 ± 23.760	0.543
	Yes	57.72 ± 29.786	
Murphy's sign	Negative	55. 43 ± 24.167	0.593
	Positive	59.34 ± 20.387	
Palpable GB	No	52.59 ±26.821	
	Yes	67.45 ± 18.782	0.045*
Distended GB	No	56.73 ± 26.674	0.048*
	Yes	69.89 ± 32.563	
Stone no.	Multiple	54.97 ± 24.564	0.234
	Solitary	64.22 ± 27.342	
Stone size	>1cm	66.77 ± 28.890	0.312
	< 1cm	56.54 ± 8.671	
Pericholecystic Collection	No	52.56 ± 23.675	0.435
	Yes	61.32± 24.675	

Statistical significance is present when (P < 0.05).

Table (9): Relation between preoperative factors and operative variant (significance of each).

	Operative time	Dissection time in Calot's triangle	GB bed dissection time	Extraction time	conversion
Gender	0.046*	0.260	0.256	0.897	0.591
Age	0.332	0.031*	0.043*	0.132	0.513
BMI	0.234	0.551	0.045*	0.633	0.643
Previous abdominal surgery	0.786	0.267	0.453	0.453	0.354
History of jaundice	0.561	0.341	0.256	0.678	0.654
Previous ERCP	0.579	0.451	0.341	0.765	0.345
Previous acute attack	0.543	0.356	0. 231	0.213	0.224
Murphy's sign	0.593	0.342	0.234	0.234	0.785
Palpable GB	0.045*	0.214	0.034*	0.006*	0.045*
Distended GB	0.048*	0.567	0.543	0.143	0.235
Stone no.	0.234	0.897	0.763	0.032*	0.576
Stone size	0.312	0.234	0.332	0.021*	0.546
Pericholecystic collection	0.435	0.398	0.397	0.114	0.044*

Perioperative complications:

As wound infection, chest infection, bleeding, and bile leak.

There is 8 case of port site infection at the epigastric port, 3 case of chest infection, 5 cases of bile leak 4 treated by conservative treatment and one by ERCP and stent, and 2 cases by bleeding one treated conservative and one by opening.

Table (10): Perioperative complication

	No	%
ound infection	8	8
est infection	3	3
eeding	5	5
le leak	2	2

DISCUSSION

Several studies have been published in the past years trying to assess risk factors for laparoscopic cholecystectomy [12-26]. This study is a further continuation of these studies using clinical criteria of the patient, laboratory findings, and ultrasonographic findings of the gall bladder and biliary system in many aspects.

In our study, 73 patients were females (73%). The mean operative time was longer in males (67.65 ± 25.932minutes) versus females (67.65 ± 25.932) and this was statistically significant (p=0.046). Male sex was considered an independent risk factor in many series [1,6,7,14,15,27-30]. **Lein and Huang**[21] in a study carried on patients presenting with symptomatic cholelithiasis concluded that male gender is a risk factor for severe symptomatic cholelithiasis. **Zisman *et al.***[22] conducted a retrospective study on conversion rates of elective laparoscopic cholecystectomy (LC) into open cholecystectomy (LC) concerning gender in 329 patients: 267 females and 62 males and revealed that the probability of conversion is five fold greater in males than females, 21% versus 4.5%, respectively (p = 0.0001). They attributed this striking difference to significantly more adhesions (p = 0.0002) and anatomical difficulties (p = 0.003) in males during LC; leading to conversion [22]. In our study, the effect of gender on the risk of conversion was not statistically significant due to the small number of converted cases "only 3 cases (3%)"but male gender was associated with prolonged operative time (p=0.046).

The mean age in our study was 48.2 ± 12.5 years. Most of the patients were in the third and fourth decades. The term elderly is used in medical literature to describe people older than 65 years. **Chan *et al.***[31] declared that advanced age with concomitant medical conditions may be associated with increased postoperative complications and more frequent conversion to OC. **Kumar and Tiwary**[13] in a study carried on 536 patients who underwent LC in a North India university hospital, concluded that age above 65 years is not associated with increased risk for difficulty or conversion with attribution to surgeon's experience and skills.

In our study, because most of our patients were below 65 years of age (99%) we compared between age group below and above the mean age for the group (45 years). Age above 45 years was associated with prolonged dissection time (p=0.031) and prolonged GB bed dissection time (p=0.043).

In our study, the mean BMI was 29.9 ± 5.3kg/m2. Fifty-four of our patients were obese (54%). In our study, obese patients had a longer mean operative time (61.54 ± 32.121minutes) versus non-obese patients (55.14 ± 16.564). BMI of 30 or more was associated with prolonged GB bed dissection time (p=0.045). This was mainly due to large fatty omentum that may obscure the triangle of Calot and large fatty liver with difficult GB dissection[32].

Schrenk *et al.*[14] in a study on 300 patients who underwent LC from 1994 to 1997 in Ludwig Boltzmann

Institute for Surgical Laparoscopy, Austria, concluded that obesity was associated with difficult dissection in the triangle of Calot.

Simopoulos *et al.*[33] declared that LC is effective and safe in patients with morbid obesity, as it carried low risks of conversion and peri-operative complications, and suggested that LC is the selected approach for these patients. Moreover, the rapid mobilization and hospital discharge following LC may provide extra benefit to these patients. **Angrisanil *et al.*[34]** and **Phillips *et al.*[32]** had similar results.

Our patients with previous acute attacks of cholecystitis, 16 patients (16%), had longer operative time (mean=57.72 ± 29.786min) due to difficulty to identify anatomy during dissection but this was statistically insignificant.

Kumar and Tiwary[13] found that a history of acute attacks is an insignificant risk factor for difficult LC.

However, **Sanabria *et al.*[35]** found in their study of 628 patients that patients with a history of multiple attacks were significantly associated with conversion.

In our study, patients with palpable GB, 6 patients (6%), had significantly longer operative time (p=0.045), prolonged GB bed dissection time (p=034), prolonged GB extraction time (p=0.006) and conversion to OC (p=0.045). This might be due to adhesions that made dissection difficult and lack of plane of cleavage between the GB and the liver.

Alponat *et al.* [23] studied several predictive factors for conversion of laparoscopic cholecystectomy and showed that local signs of cholecystitis are significant predictors for conversion to OC.

In our study, distended GB in ultrasound, 7 patients (7%), was associated with prolonged operative time (p=0.048) due to difficulty in grasping the gall bladder. **Van der Velden *et al.* [24]** in a study on 346 patients considered gallbladder distention as a sonographic sign associated with a high relative risk for conversion.

In our study, the pre-operative parameters that significantly predicted difficult LC were based on: The patient's characteristics: gender, age, and body habitus. The patient's history: jaundice, previous acute attacks of cholecystitis, and previous abdominal surgery. The presence of local signs of cholecystitis especially palpable GB.

The findings in ultrasonography: the shape of the GB, number, and size of stones and liver parenchyma. In a study on 1,676 patients, **Fried *et al.* [26]** found that age, gender, acute cholecystitis, obesity, and distended GB were significant predictors for conversion from LC to OC[26]. Their results were close to our findings.

CONCLUSIONS

Pre-operative factors can help to predict a difficult LC. This information may be useful to both the patient and the treating surgeon. Prediction of a difficult procedure would allow the surgeon to discuss the likelihood of conversion with the patient and prepare him/her psychologically as well as planning their recovery and explaining their absence from work. Another benefit would be to allow more efficient scheduling of the operating lists and ensuring the availability of a more experienced laparoscopic surgeon for the procedure. A high predicted risk of conversion may allow the surgeon to take an early decision to convert to laparotomy when difficulty is encountered during dissection; this may shorten the duration of surgery and decrease the associated morbidity.

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