

Predictive pre-operative factors for difficult Laparoscopic Cholecystectomy by Scoring System

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Abstract

Objective: The objective of this study is to determine the frequency of difficult laparoscopic cholecystectomy and factors responsible for difficult laparoscopic cholecystectomy by using scoring system.

Material and Methods: After the ethical approval from institutional review, this cross-sectional study was conducted at the Department of Surgery, Surgical unit-6, Civil Hospital Karachi (DUHS) from 21-October -2020 to 21-May -2021. A total of 170 instances of laparoscopic cholecystectomy were performed by a solitary surgeon with extensive expertise. The grading criterion method utilized in the study conducted by Gupta and colleagues consists of a total of 15 scores, which are based on the level of difficulty. This scoring system relies on three primary factors: the patient's medical history, clinical data, and imaging studies Scores between 0 and 5 suggest an easy approach, scores between 6 and 10 indicate a challenging approach, and scores between 11 and 15 indicate a very difficult approach.

Results: This study included a cohort of 170 patients, with a mean age of 38.84 years \pm 12.22. Out of the total sample size of 105 patients, around 62% (n=65) were classified as easy cases, while 30.6% (n=32) were classified as difficult cases. Furthermore, a small subset of 13 patients, accounting for 8% of the total sample, fell into the category of very difficult cases. The scoring system had a positive predictive value of 89.5% for easy predictions and 94.2% for difficult predictions. The dissection of the gall bladder bed and the extraction process were found to be challenging. Statistical analysis revealed that age groups and gender were significant predictors of difficulty in performing laparoscopic cholecystectomy, with a p-value of less than 0.05.

Conclusion: The pre-operative scoring system used in this study demonstrates both reliability and utility in predicting the level of difficulty associated with laparoscopic cholecystectomy. In the present study, the scoring system had a positive predictive value of 89.5% for easy predictions and 94.2% for difficult predictions.

Keywords: Cholecystitis, cholecystectomy, laparoscopic, prospective, scoring system

Introduction:

Cholecystectomy is a commonly performed surgical intervention in the biliary tract, primarily indicated for the removal of the gallbladder in cases of stone formation or inflammation.¹ The laparoscopic cholecystectomy (LC) procedure has gained widespread acceptance as the primary approach and is now considered the benchmark for the effective treatment of

symptomatic cholelithiasis.^{1,2} The laparoscopic cholecystectomy surgery has several benefits compared to the traditional open cholecystectomy, including reduced trauma, shorter hospitalization, improved cosmetic results, decreased pain, and expedited recovery.^{3,4} Nevertheless, certain research have indicated that laparoscopic cholecystectomy exhibits a greater incidence of complications as compared to the conventional

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open cholecystectomy. The complications associated with the procedure encompass various adverse events, such as common bile duct injury, gallbladder perforation, bile leakage, visceral structure and vascular injury during the use of Veress needle and trocar, as well as additional complications including external biliary fistula, metastatic port-site deposits, perihepatic collection, wound sepsis, adhesions, foreign body inclusions, hematoma, and cholelithoptysis.^{1,3} During the initial stages of the laparoscopic cholecystectomy era, the percentage of conversion to an open operation ranged from 2% to 15%. Following extensive study and comprehension of the laparoscopic technique, coupled with the progressive accumulation of surgical expertise, the conversion rate has declined to an estimated range of 1-6%. This conversion aimed to mitigate any consequences arising from the numerous challenges faced throughout the procedure.⁵ The level of difficulty is assessed in instances where there are dense adhesions present at Calot's triangle, a prior history of upper abdominal surgery, past cholecystostomy, an acutely inflamed and gangrenous gallbladder, Mirizzi's syndrome, empyema of the gallbladder, and cholecystoduodenal or cholecystogastric fistula.¹

Various pre-operative and intra-operative factors have been identified as potential risk factors that can complicate the process of laparoscopic cholecystectomy. These factors include higher body mass index (BMI), advanced age, male gender, prior history of abdominal surgery, the presence of acute cholecystitis accompanied by fever and the presence of gallbladder stones, leucocytosis, and specific ultrasonographical findings such as wall thickness of 4 mm or greater, impacted gallstones, gallbladder distention, and pericholecystic fluid collection.⁶ In their study, Kama et al., conducted an investigation that examined the association between various parameters and the risk of open cholecystectomy. These parameters included old age, male gender, diagnosed thickened gallbladder wall, and upper abdominal tenderness at the time of surgery, history of abdominal surgery, sonographically and the preoperative diagnosis of acute cholecysti-

tis.⁷ The results of their study revealed a significant correlation between these parameters and the risk of open cholecystectomy.

In order to facilitate provide patient counseling, surgical decision-making, mitigate the risk of complications, minimize the need for conversion to open cholecystectomy, and optimize cost-effectiveness, a preoperative scoring system was developed. This system incorporates various factors such as gender, age, clinical examination, medical history, laboratory results, and sonographic findings.⁸ Subsequently, the preoperative score is compared with an intraoperative difficulty score to predict the level of complexity associated with laparoscopic cholecystectomy. The aim of this study is to ascertain the prevalence of challenging laparoscopic cholecystectomy procedures and identify the contributing factors through the utilization of a scoring system.

Material and Methods:

After the ethical approval from institutional review, this cross-sectional study was conducted at the Department of Surgery, Surgical unit-6, Civil Hospital Karachi (DUHS) from 21-October -2020 to 21-May-2021. A sample size of n=170 patients was determined using the WHO open EPI sample calculator, using the reference based on the proportion of predictive pre-operative scoring of difficult laparoscopic cholecystectomy, where the proportions were as follows: Easy 141(67.14%), difficult 57(27.14%), and very difficult 12(5.71%).⁹ A 95% confidence interval was used, with the least prevalence and a margin of error of 3.5%. Through non-probability consecutive sampling, patients between ages 19-75 -years, of either gender, undergoing elective laparoscopic cholecystectomy were recruited for the present study.

Pregnant women, patients allergic to general anesthesia, with a history of previous abdominal surgery, or diagnosed with cholangitis choledocholithiasis, and acute pancreatitis were excluded from the present study. The examination of patients and subsequent surgical procedures are conducted by surgeons who possess expertise in

the fields of Laparoscopic and General surgery. The preoperative prediction compendious scoring tool examined various parameters and factors associated with it. These parameters included male gender, history of hospitalization for cholecystitis/pancreatitis, obesity as measured by BMI, previous upper abdominal surgery, presence of abdominal scars (such as midline, paramedian, previous umbilical, paraumbilical, or umbilical hernia repair scars), palpable gall bladder (as determined through abdominal examination), presence of impacted stone, and post ERCP and hematological/biochemical parameters.

The laparoscopic cholecystectomy was performed using the usual four-port approach, which involved the use of two 10 mm ports and two 5 mm ports. Ultrasonography was conducted on all patients using a consistent protocol to evaluate many aspects including gallbladder shape and size, pericholecystic collection, gallbladder wall thickness, calculus size, number of calculi, common bile duct diameter and presence of stones, as well as liver parenchyma. The pre-operative subjective evaluation score was documented, which was defined as a numerical value ranging from 0 to 5 for cases considered easy, 6 to 10 for cases considered difficult, and greater than 11 for cases considered very difficult. Intra-operative difficulties were also subjectively assessed and recorded by the operating surgeon, who was unaware of the pre-operative risk score for difficulty. The criteria for classifying a laparoscopic cholecystectomy as difficult were established as a duration exceeding 60 minutes, ultimately resulting in the conversion to an open cholecystectomy. Difficult laparoscopic cholecystectomy procedures are characterized by challenges such as the presence of adhesions, prolonged length, and other relevant characteristics.

The data was gathered by employing a comprehensive Performa encompassing many characteristics related to the difficulty level in doing LC. Following the data gathering process, data analysis was conducted using the SPSS version

23. Quantitative variables such as Age, Weight, Height, BMI, Systolic and Diastolic Blood Pressure, and duration of surgery (in minutes) were subjected to calculations of descriptive statistics, including measures such as mean, and standard deviation, and both numbers and percentages where applicable.

To address potential confounding variables, stratification was employed to compare the outcome variables associated with Laparoscopic cholecystectomy, specifically the levels of difficulty (easy, difficult, and very difficult), across various age groups, operative time, duration of surgery, gender distribution, and previous history of acute cholelithiasis. Statistical tests such as the chi-square test or Fisher exact test were utilized for analysis. The P-value was established using a 95% confidence range and a significance level of 5%.

Results:

Table 1 represents the clinical and demographic parameters of the study participants. The Mean±S.D of participants age 38.84 ± 12.22 years. The present study observed that a significant proportion of patients, specifically 102 individuals (60%), were under the age category of greater than 35 years. Conversely, a smaller proportion of patients, namely 68 individuals (40%), were found to be younger than 35 years old. A total of 28 (16%) patients were male, while 142 (84%) individuals, were females. The male-to-female ratio was 1:5, indicating a higher prevalence of female patients compared to male patients. The Mean±S.D of the participant's body mass index (BMI) was 24.77 ± 4.8 kg/m². The Mean±S.D of the participant's systolic and diastolic blood pressure values were 124.97 ± 10.83 and 73.81 ± 4.56 mmHg, respectively. A significant proportion of patients, specifically 86 (50.6%), had systolic blood pressure readings over 120 mmHg. Similarly, the majority of patients, 95 (56.5%), had diastolic blood pressure values higher than 75 mmHg. The Mean±S.D participant's stone size was 0.81 ± 0.48 cm. A total of 80 patients (47.1%) had a documented history of previous episodes of acute cholecystitis. The present

Table 1: Descriptive statistics of patients with gallstone disease who underwent difficult laparoscopic cholecystectomy

Parameters	Mean \pm SD (n=170)
Age (Years)	38.84 \pm 12.22
\leq 35 years	68 (40%)
>35 years	102 (60%)
Gender	
Male	28 (16%)
Female	142 (84%)
Weight (Kg)	67.96 \pm 11.11
Height (Meter)	1.67 \pm 0.11
BMI (Kg/m ²)	24.77 \pm 4.8
SBP (mmHg)	124.97 \pm 10.83
\leq 120mmHg	84 (49%)
>120mmhg	86 (51%)
DBP (mmHg)	73.81 \pm 4.56
\leq 70mmHg	96 (56.5%)
>70mmHg	74 (43.5%)
Stone Size (cm)	0.81 \pm 0.48
Operative time (min)	75.42 \pm 23.14
\leq 75min	65 (38%)
>75min	105 (62%)
Duration of Surgery (min)	70.12 \pm 23.31
\leq 70min	87 (51%)
>70min	83 (49%)
Previous history of acute cholecystitis	
Yes	80 (47%)
No	90 (53%)

Table 3: Comparison of factors responsible for difficult LC with predictive pre-operative factors for difficult LC by scoring system

Parameters	Predictive pre-operative factors for Difficult Laparoscopic Cholecystectomy by Scoring System			P value
	Easy (n=105)	Difficult (n=52)	Very difficult (n=13)	
Obesity				
Yes	17 (10%)	7 (4%)	1 (0.6%)	0.684
No	88 (52%)	45 (27%)	12 (7%)	
Gall bladder bed Dissection				
Easy	105 (62%)	2 (1.2%)	0	<0.001
Difficult	0	50 (29%)	13 (8%)	
Difficult extraction				
Easy	105 (62%)	2 (1.2%)	0	<0.001
Difficult	0	50 (29%)	13 (8%)	
Previous abdominal surgeries				
Yes	34 (20%)	15 (9%)	7 (4%)	
No	71 (42%)	37 (22%)	6 (3.5%)	

study aimed to assess the frequency and classification of predictive pre-operative indicators for difficult laparoscopic cholecystectomy using a scoring system. Out of the total sample size of 105 patients, 62% (n=105) were classified as easy cases, while 30.6% (n=52) were classified as difficult cases. Furthermore, a small subset of thirteen patients, accounting for 8% of the total sample, fell into the category of very difficult cases (Figure 1). The scoring system had a positive predictive value of 89.5% for easy predictions and 94.2% for difficult predictions (Figure 2). The factors responsible for difficult laparoscopic cholecystectomy in obese patients were classified into various categories. Among the participants, 25 individuals (14.7%) experienced challenges related to the dissection of the gall bladder bed and difficult extraction. In terms of gallbladder wall thickness, 89 individuals (52.4%) had findings indicating abnormal thickness, while 86 individuals (50.6%) had calculi of varying sizes. Additionally, 81 patients (47.6%) had a normal common bile duct. Furthermore, 75 patients (44.1%) had a history of previous hospital admissions, and 78 patients (45.9%) had undergone post-endoscopic retrograde cholangiopancreatography (ERCP) procedures (Table 2). In the present study, we examined the association between various risk factors and the difficulty of laparoscopic cholecystectomy (LC). Specifically, we investigated the predictive significance of factors such as gall bladder bed dissection, difficult extraction, age groups, and gender. The results indicated that these factors were statistically significant in predicting difficult laparoscopic cholecystectomy. On the other hand, factors such as obesity, systolic and diastolic blood pressure, previous abdominal surgery, operative time, and duration of surgery were also found to be statistically significant in predicting difficult laparoscopic cholecystectomy, but only in the univariate analysis. These findings were presented in Table 3 and 4.

Discussion:

Laparoscopic cholecystectomy has emerged as an established approach for managing individuals presenting with symptomatic gallstones. An

Table 2: Classification of baseline, demographics and clinical characteristics with gallstone disease who underwent difficult laparoscopic cholecystectomy

Obesity	Frequency [%]
Yes	25 [14.7%]
No	145 [85.3%]
Gall bladder bed dissection	
Easy	107 [62.9%]
Difficult	63 [37.1%]
Difficult extraction	
Easy	107 [62.9%]
Difficult	63 [37.1%]
Post ERCP	
No	92 [54.1%]
Yes	78 [45.9%]
Previous Abdominal Surgeries	
Yes	56 [32.9%]
No	114 [67.1%]
Previous Hospital Admission	
Yes	75 [44.1%]
No	95 [55.9%]
Gall Bladder Wall Thickness	
Present	89 [52.4%]
Absent	81 [47.6%]
Common Bile Duct	
Normal	81 [47.6%]
Diluted	89 [52.4%]
Calculus Size	
Normal	86 [50.6%]
Diluted	84 [49.4%]

Table 4: Comparison of demographics, confounding factors and clinical characteristics with predictive pre-operative factors for difficult LC by scoring system

Parameters	Predictive pre-operative factors for Difficult Laparoscopic Cholecystectomy by Scoring System			P value
	Easy (n=105)	Difficult (n=52)	Very difficult (n=13)	
Age groups				
≤35 years	57 (34%)	10 (6%)	1 (0.6%)	<0.001
>35 years	48 (28%)	42 (25%)	12 (7%)	
Gender				
Male	12 (7%)	14 (8%)	2 (1.2%)	0.048
Female	93 (55%)	38 (22%)	11 (7%)	
Operative time (minutes)				
≤75 minutes	41 (24%)	22 (13%)	2 (1.2%)	0.195
>75minutes	64 (38%)	30 (18%)	11 (7%)	
Surgery time (minutes)				
≤70 minutes	51 (30%)	30 (17.6%)	6 (3.5%)	0.522
>70minutes	54 (31.8%)	22 (12.9%)	7 (4.1%)	
Diastolic BP ≤70mmHg	61 (35.9%)	26 (15.3%)	9 (5.3%)	0.395
Diastolic BP >70mmHg	44 (25.9%)	26 (15.3%)	4 (2.4%)	

observation was made indicating a reduction in post-operative discomfort. This study involved the performance of laparoscopic cholecystectomy on a total of 170 patients, with the aim of analyzing predictive risk variables associated with the difficulty of the procedure. The variables of interest in this study are gender, history of diabetes, a history of post-endoscopic retrograde cholangiopancreatography (ERCP), prior abdominal surgeries, previous hospital admissions, and obesity. The presence of gall bladder wall thickness over 3mm, common bile duct size exceeding 8mm, and calculus size were identified as important risk factors for predicting the difficulty of laparoscopic cholecystectomy. These findings align with previous research reported in the existing literature.⁹⁻¹¹

In the present study, it was observed that 68 individuals, accounting for 40% of the total sample, fell under the age category of 35 years or less. Conversely, 102 individuals, constituting 60% of the sample, belonged to the age group above 35 years. In the current investigation, a noteworthy association was observed between age and the level of surgical difficulty. The male sex has been observed to exhibit a correlation with challenging laparoscopic cholecystectomy.¹² In the current investigation, the sample consisted of 28 male participants and 142 female participants. A notable correlation was identified between the complexity of laparoscopic cholecystectomy and gender distribution, with a majority of males (28 out of 14) experiencing difficulties throughout the procedure. Numerous global research has revealed a correlation between the masculine gender and challenges in laparoscopic cholecystectomy.¹² Obese individuals may encounter challenges during laparoscopic surgery as a result of multiple factors.¹³ The duration of port insertion in obese patients is prolonged as a result of the increased thickness of the abdominal wall. The dissection procedure performed at the Calot's triangle presents technical challenges due to the complex anatomy characterized by an abundance of intraperitoneal fat and the difficulties in maneuvering instruments through a notably thick abdominal wall. In the present investigation, it was observed that there exists

no statistically significant association between body mass index (BMI) and the complexity of surgical procedures. According to the Gupta scoring system and other relevant research,^{14,15} a pre-operative score ranging from 6 to 10 points suggests a challenging surgical approach. The utilization of this rating method facilitates the transfer of challenging laparoscopic cholecystectomy procedures to open cholecystectomy.¹⁴ In this particular study, the researchers found that gender played a noteworthy role as a risk factor in predicting the difficulty of laparoscopic cholecystectomy. This finding aligns with a previous study conducted by Gupta et al.,⁹ which also indicated that gender had an impact on the prediction of difficult laparoscopic cholecystectomy. Furthermore, it has been demonstrated that patients who have a medical history of being hospitalized multiple times for acute cholecystitis are more likely to experience challenges during laparoscopic cholecystectomy. This is mostly attributed to the presence of thick adhesions at Calot's triangle and the gallbladder fossa.¹⁶ Previous studies have demonstrated that certain clinical indicators, including body mass index (BMI), presence of an abdominal scar, and the ability to palpate the gallbladder, are noteworthy risk factors in accurately predicting the likelihood of encountering operating challenges.¹⁶ Nonetheless, the present investigation on Gall bladder bed dissection revealed that age groups and gender were the sole significant risk factors in predicting the likelihood of encountering difficulties during the surgical procedure. The presence of a palpable gallbladder can be attributed to various factors, including a gallbladder with a thickened wall, a swollen gallbladder, a mucocele gallbladder, or adhesions between the gallbladder and the omentum.¹⁰ In a similar vein, Gupta et al.⁹ and Randhawa et al.¹¹ conducted investigations that revealed a noteworthy correlation between the presence of a palpable gallbladder and the occurrence of intraoperative challenges. The lack of association between body mass index (BMI) and abdominal scar in this study aligns with other research findings,¹⁰⁻¹³ indicating that these factors do not contribute to surgical difficulty. Several investigations, such as

the one conducted by Rademaker BM and Joris J, have indicated that patients who have laparoscopic cholecystectomy may encounter significant post-operative pain.^{17,18}

Post-operative discomfort referred to the shoulders is a commonly observed adverse effect of laparoscopic surgery, with a prevalence ranging from 35% to 80%. This pain is mostly caused by abdominal distention resulting from the presence of carbon dioxide (CO₂) during the procedure.¹⁹ The management of this particular form of pain presents challenges, with a significant proportion of cases, around 80%, necessitating the use of drugs.²⁰ The aforementioned outcomes lead to an extended period of hospitalization and recovery, resulting in a substantial rise in expenses.^{21,22} The duration of discomfort appears to exhibit a direct correlation with the length of the surgical procedure.⁶ Research findings have demonstrated that employing low pressures, namely within the range of 8-10 mmHg, during laparoscopic cholecystectomy procedures is linked to a reduced occurrence and severity of post-operative pain in comparison to the utilization of standard pressures (12-15 mmHg) or high pressures above 15 mmHg.²³⁻²⁵

In a separate investigation carried out by Lohana et al., it was revealed that the incidence of gall bladder cancer among individuals undergoing surgical intervention for cholelithiasis is documented at a rate of 4%.²⁶ The study conducted by Naqvi et al., revealed that the incidence of gall bladder cancer in patients with cholelithiasis was found to be 5.9%.²⁷ In a separate investigation conducted by Iqbal M et al.,²⁸ it was observed that the prevalence of gall bladder cancer amounted to 3.97%. In a separate investigation carried out by Burghari et al., it was observed that the prevalence of gall bladder cancer in gall bladder specimens was determined to be 6.39%.²⁹ Zia et al. conducted a retrospective analysis which revealed a frequency of 7.1%.³⁰ A study conducted by Ferrarese AG et al., in 2013 examined the diagnosis of incidental gall bladder cancer and determined that the incidence rate was 1.38%.³¹ According to a study conduct-

ed by Panebianco et al., in 2013, the prevalence of incidental gall bladder cancer in cholecystectomy tissues was found to be 0.5%.³¹

Conclusion:

In conclusion, the preoperative scoring method utilized in this study demonstrates reliability and usefulness in predicting the level of difficulty associated with laparoscopic cholecystectomy. Out of a total of 170 samples, the frequency of difficult laparoscopic cholecystectomy was determined based on the postoperative score of the major result. Among these samples, 105 (61.8%) were categorized as easy, 52 (30.6%) as difficult, and only 13 (7.6%) as very difficult. The scoring system had a positive predictive value of 89.5% for easy predictions and 94.2% for difficult predictions. The evaluation of the outcomes of laparoscopic cholecystectomy in patients who undergo the procedure reveals a very positive outcome. This suggests that the use of laparoscopic cholecystectomy can be recommended for regular clinical practice in order to enhance the safety and efficacy of the procedure.

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Role and contribution of authors:

Sana Ejaz, collected the data, references and did the initial writeup.

Razi Gul, critically review the article and made final changes

Anum Zohra, collected the data and helped in introduction writing

Shakila Jhatal, collected the references and helped in discussion writing.

Sadia Lateef, collected the data, references and helped in interpretation of data

Muhammad Khurram Zia, went through the article and made final changes.

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