

Evaluation of Preoperative Scoring System for Predicting Difficult Laparoscopic Cholecystectomy

Abstract

Context: Laparoscopic cholecystectomy (LC) is established as the gold standard for benign gallbladder disease. This study was done for the evaluation of preoperative scoring system given by Randhawa and Pujahari considering various preoperative parameters to predict difficulty in LC. **Aims:** Preoperative prediction of difficult LC using a scoring system considering various preoperative factors in elective/interval LC to predict difficult gallbladder. **Settings and Design:** A prospective study of 120 patients admitted for LC from January 2020 to June 2021 was analyzed. **Subjects and Methods:** All the patients were evaluated on the basis of Randhawa and Pujahari scoring system with the following variables: age >50 years, male sex, body mass index 25.1–27.5 and >27.5 kg/m², previous abdominal surgery, prior hospitalization for gallstone disease, palpable gallbladder, gallbladder wall thickening, impacted stone, and pericholecystic collection. Each variable had given a score. Based on these findings, the surgical procedure was defined as easy, difficult, and very difficult. **Results:** One hundred and twenty cases satisfying the inclusion criteria were studied comparing different variables and assigned preoperative scoring. A score >5 was considered significant and compared with intraoperative findings. Out of 53 patients having preoperative scores >5, 40 were difficult gallbladders and 13 were easy to operate. Prediction came true in 93.0% of difficult cases and 83.1% of easy cases. **Conclusions:** From this study, we can conclude that the preoperative scoring system is statistically reliable to predict difficulty in LC in the majority of the cases (area under receiver operator characteristics = 0.935).

Keywords: Laparoscopic cholecystectomy, predictive factors, scoring system

Introduction

Laparoscopic cholecystectomy (LC) has become the procedure of choice for the management of symptomatic gallstone diseases^[1,2] for it being minimal invasive, associated with less postoperative pain and early recovery. Sometimes, LC becomes difficult. It can take a longer time or bile/stone spillage. Occasionally, it may need conversion to open cholecystectomy to control bleeding, avoid organ injury, delineate confusing anatomic relationships, or treat associated conditions. Conversion to open cholecystectomy has been associated with increased overall morbidity, surgical site and pulmonary infections, and longer hospital stays. It is very difficult to predict preoperatively, whether LC is going to be easy or difficult. Therefore, it would be worthwhile to evaluate the possibilities of predicting the chances of difficult LC. Since laparotomy is associated with greater

morbidity and prolonged convalescence compared with laparoscopy, understanding the true risk of the surgery allows the patient to make a better-informed decision, based on a realistic plan and personal preference. It ensures the safety to the patient and also avoids litigation. There have been many attempts to this approach; and various parameters, blood investigations, clinical examinations, and radiological investigations have been analyzed.

The preoperative prediction aims at patient counseling and also guiding the surgeon to decide on conversion, should difficulty arise, and also involve an experienced surgeon in the task and thereby ensure patient safety. 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.

At present, there is no standard scoring system available to predict the degree of

**Munish Trehan,
Vishal Mangotra,
Jaspal Singh,
Sanjeev Singla,
Sumit Singh
Gautam¹,
Ramneesh Garg¹**

*Departments of General Surgery
and ¹Plastic and Reconstructive
Surgery, Dayanand Medical
College and Hospital, Ludhiana,
Punjab, India*

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Address for correspondence:

*Dr. Ramneesh Garg,
Dayanand Medical College and
Hospital, Ludhiana, Punjab,
India.
E-mail: ramneeshgarg@gmail.
com*

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difficulty preoperatively. In this study, we have worked out a scoring system proposed by Randhawa and Pujahari^[3] for predicting the difficulty in LC preoperatively and correlated with our intraoperative degree of difficulty. The study also identifies the factors that can predict difficulty in LC and thus complications can be prevented beforehand.

Subjects and Methods

This prospective observational study was carried out on patients admitted in the Department of General Surgery, Dayanand Medical College and Hospital, Ludhiana, over a period of 1½ years. Approval from the ethics committee of the institution was taken before starting the study. A total of 120 patients were included in this study after taking prior informed consent. Inclusion criteria were all the patients who had been clinically and radiologically (ultrasound abdomen) diagnosed with acute or chronic cholecystitis/symptomatic cholelithiasis and planned for LC. Exclusion criteria were patients with common bile duct (CBD) stone, where CBD exploration was required, patients with features of obstructive jaundice, concurrent pancreatitis, and LC performed with other laparoscopic interventions in the same setting.

Data were collected after admission and before surgery in the form of detailed proforma including history, examination, and sonographic findings. Written consent was signed by the participants.

Preoperative scores were given to each patient on the basis of history, clinical examination, and ultrasonographic findings [Table 1]. On the basis of this preoperative score, patients were categorized into easy or difficult if the score ≤ 5 or >5 , respectively. Following evaluation, patients underwent LC and the following intraoperative events were recorded.

Surgery was done using CO₂ pneumoperitoneum with 10–12 mm Hg pressure and using standard two 10 mm

and two 5 mm ports. The timing was noted from the first port site incision till the last port closure. All the intraoperative events were recorded. Operation was conducted under general anesthesia. LCs were performed by different surgeons (with experience of more than 10 years and performed more than 200 independent LC). Intraoperatively, significant data indicating the difficulty of the procedure were recorded such as bleeding per cystic artery, bile spillage, and prolonged time of surgery >60 min, and cases were divided into easy and difficult ones accordingly [Table 2]. Postoperatively, most of the cases were transferred to the ward for 24 h then discharged after the removal of the drain and ensuring no complications. Preoperative score and surgery outcome were compared.

Statistical analysis

The collected data were compiled in a Microsoft Excel sheet. Data were described in terms of range, mean $\pm$ standard deviation ($\pm$ SD), frequencies (number of cases), and relative frequencies (percentages) as appropriate. For comparing categorical data, a Chi-square test was performed and an exact test was used when the expected frequency was <5 . Receiver operator characteristics (ROC) curve was prepared, and the criterion value was estimated depending on the specificity and sensitivity. Area under the curve was measured. A probability value (P value) <0.05 was considered statistically significant. All statistical calculations were done using (Statistical Package for the Social Science) SPSS 21 version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

Results

This study included 120 patients. These were clinically and radiologically (ultrasound abdomen) diagnosed with acute or chronic cholecystitis/symptomatic cholelithiasis admitted for LC in Dayanand Medical College and

Table 1: Parameters of preoperative scoring

Variables	Finding	Score	Finding	Score	Maximum
History					
Age (years)	≤ 50	0	>50	1	1
Sex	Female	0	Male	1	1
History of hospitalization	No	0	Yes	4	4
Clinical					
BMI	<25	0	25-27.5	1	2
			>27.5	2	
Abdominal scar	No	0	Infraumbilical	1	2
			Supraumbilical	2	
Palpable GB	No	0	Yes	1	1
Sonography					
Wall thickness	Thin <4 mm	0	Thick >4 mm	2	2
Pericholecystic collection	No	0	Yes	1	1
Impacted stone	No	0	Yes	1	1
			Maximum score		15

BMI: Body mass index, GB: Gallbladder

Table 2: Categories of degree of intraoperative difficulty

Intraoperative difficult criteria	Score
Easy - Time taken <60 min, no bile spillage, no injury to duct/artery	0-5
Difficult - Time taken 60-120 min, bile/stone spillage, injury to duct, no conversion	6-10
Very difficult - Time taken >120 min, conversion to open surgery	11-15

Table 3: Preoperative score

Preoperative score	0-5	6-10	10-15
Number of cases	67	53	Nil
Prediction	Easy	Diff	Nil

Table 4: Intraoperative outcome

Intraoperative outcome	Number of cases, n (%)
Easy	39 (32.5)
Difficult	77 (64.2)
Converted to open	4 (3.3)
Total	120 (100.0)

Table 5: Correlation between preoperative score and intraoperative outcome

Total score	Intraoperative outcome		Total	χ^2	P
	Easy	Difficult			
<5	64 TN (83.1)	3 FN (7.0)	67	64.866	0.000
>5	13 FP (16.9)	40 TP (93.0)	53		
Total	77 (100.0)	43 (100.0)	120		

TN: True negative, FN: False negative, FP: False positive, TP: True positive

Table 6: Area under the curve test result variable(s): Total score

Area	SE	P	Asymptotic 95% CI	
			Lower bound	Upper bound
0.935	0.024	0.001	0.888	0.983

SE: Standard error, CI: Confidence interval

Hospital, Ludhiana, during the period of January 2020–June 2021.

- Age/sex: In the present study, maximum cases were in the age group of 31–40 years 31 (25.8%), 23 (19.2%) in 41–50 years, 24 (20.0%) in 51–60 years, 25 (20.8%) in >60 years, and 17 (14.2%) in <30 years old. The mean age was 46.47 with SD = 15.07. Out of 120 patients, 77 (64.2%) were females and 43 (35.8%) were males. Sample population was dominated by females
- Past history of hospitalization for acute cholecystitis: In our study, 39 patients had history of hospitalization for prior acute cholecystitis
- Distribution of cases by body mass index (BMI): Almost half of the patients (59, 49.2%) were with BMI of 25–27.5 kg/m². Twenty-eight (23.3%) patients had BMI <25 kg/m² and 33 (27.5%) had >27.5 kg/m²

- Abdominal scar in cases: Among 120 patients, 44 (36.7%) had a history of previous abdominal surgery. Out of which 3 (2.5%) had supraumbilical and 41 (34.2%) had infraumbilical scar
- Palpable gallbladder: In our study, only 11 (9.2%) patients had palpable gallbladder on abdominal examination
- Ultrasonographic findings: Ultrasound was done in all of these patients. Findings of GB wall thickness (>/<4 mm), pericholecystic collection, and impacted stone were noted. Out of 120 patients, 32 (26.7%) had GB wall thickness of more than 4 mm. Only 15 (12.5%) had pericholecystic collection on ultrasonography (USG). Twenty-one (17.5%) patients had impacted stones on USG.

Preoperative evaluation

Out of 120 patients, 67 scored <5 (easy), 53 scored >5 (difficult), and none of them scored very difficult [Table 3].

Intraoperative outcome

Out of 120 patients, 77 cases were easy, 39 were difficult, and 4 were converted to open cholecystectomy from LC.

Out of 120 patients, 4 cases were converted to open cholecystectomy from LC [Table 4].

Comparison of preoperative score and surgical outcome

Out of 67 patients based on preoperative scores 0–5 (predicted easy), 64 were found easy during intraoperative, i.e., true negative. Out of 67 patients based on preoperative scores 0–5 (predicted easy), 3 were found difficult during intraoperative, i.e., false negative [Table 5].

Out of 53 patients based on preoperative scores 5–10 (predicted difficult), 13 were found easy during intraoperative, i.e., false positive. Out of 53 patients based on preoperative scores 5–10 (predicted difficult), 40 were found difficult during intraoperative, i.e., true positive.

ROC analysis was done. Area under ROC curve was 0.935 with 95% confidence interval (0.888–0.983). Scoring system was found to be effective with a sensitivity of 93.02% and specificity of 83.12% at score of more than 5 in predicting difficult LC [Table 6].

Comparison of preoperative scoring factors and surgical outcome

Table 7 shows the univariate analysis of preoperative risk factors with surgical outcomes. Advanced age (>50 years) with $P = 0.001$, previous history of hospitalization for acute cholecystitis ($P = 0.001$), BMI >27.5 kg/m² ($P = 0.001$), and male sex ($P = 0.026$) were found to be significant contributing factors in predicting difficult LC.

Logistic regression was done for the parameters which were found significant on univariate analysis.

Table 7: Univariate analysis of preoperative scoring factors and surgical outcome*

	Intraoperative outcome		Total	χ^2	P
	Easy	Difficult/very difficult			
Age group					
<30	16 (20.8)	1 (2.3)	17	24.079	0.000
31-40	24 (31.2)	7 (16.3)	31		
41-50	17 (22.1)	6 (14.0)	23		
51-60	11 (14.3)	13 (30.2)	24		
>60	9 (11.7)	16 (37.2)	25		
Age group					
<50	55 (71.4)	14 (32.6)	69	17.059	0.000
>50	22 (28.6)	29 (67.4)	51		
Sex					
Female	55 (71.4)	22 (51.2)	77	4.928	0.026
Male	22 (28.6)	21 (48.8)	43		
History of hospitalization					
No	72 (93.5)	9 (20.9)	81	66.249	0.000
Yes	5 (6.5)	34 (79.1)	39		
BMI score					
0	24 (31.2)	4 (9.3)	28	17.476	0.000
1	41 (53.2)	18 (41.9)	59		
2	12 (15.6)	21 (48.8)	33		
Abdominal scar score					
No scar	50 (64.9)	26 (60.5)	76	5.510	0.064
Infraumbilical	27 (35.1)	14 (32.6)	41		
Supraumbilical	0	3 (7.0)	3		
Palpable GB score					
No	67 (87.0)	42 (97.7)	109	3.767	0.095
Yes	10 (13.0)	1 (2.3)	11		
GB wall thickness score					
<4	53 (68.8)	35 (81.4)	88	2.227	0.136
>4	24 (31.2)	8 (18.6)	32		
Pericholecystic collection score					
No	70 (90.9)	35 (81.4)	105	2.283	0.131
Yes	7 (9.1)	8 (18.6)	15		
Score of impacted stone					
No	65 (84.4)	34 (79.1)	99	0.546	0.460
Yes	12 (15.6)	9 (20.9)	21		
Expected outcome					
Difficult	7 (9.1)	34 (79.1)	41	60.071	0.001
Easy	70 (90.9)	9 (20.9)	79		
Total	77 (100.0)	43 (100.0)	120		

*Merging the final outcome of difficult and very difficult. BMI: Body mass index, GB: Gallbladder

Multivariate analysis of risk factors with surgical outcome

On multivariate analysis, past history of hospitalization with $P = 0.001$, BMI $>27.5 \text{ kg/m}^2$ with $P = 0.002$ (difficulty level increases with increasing BMI), and advanced age (>50 years) with $P = 0.035$ were found statistically significant [Table 8].

Analysis of preoperative risk factors in predicting very difficult outcome

Table 9 shows the comparison of preoperative risk factors and very difficult surgical outcomes. A total of four cases were found very difficult in our study. All these cases were

predicted as difficult on the preoperative scoring system. It shows the scoring system was not able to differentiate between difficult and very difficult outcomes.

Abdominal scar with $P = 0.008$, history of hospitalization with $P = 0.010$, and advanced age (>50 years) with $P = 0.026$ were found to be significantly contributing in predicting the very difficult outcome of surgery.

Discussion

LC is considered the gold standard treatment of symptomatic cholelithiasis.^[1,2] It is important to predict

difficult LC preoperatively so that the operating surgeon is prepared for any expected complication. Many studies have been done in the past in predicting difficult LC. Randhawa and Pujahari^[3] came up with a systemic scoring system to

Table 8: Multivariate analysis of intraoperative outcome with risk factors

	<i>P</i>	Exp(B)	95% CI for EXP(B)	
			Lower	Upper
Age >50	0.035	4.506	1.111	18.285
Sex male	0.666	0.736	0.183	2.960
History of hospitalization	0.000	154.672	23.871	1002.179
BMI score	0.002			
BMI score (1)	0.481	2.013	0.288	14.083
BMI Score (2)	0.002	37.099	3.883	354.437

BMI: Body mass index, CI: Confidence interval

predict the level of difficulty in LC. This scoring system takes into account demographic factors such as age,^[4-7] gender,^[8] hospitalization history for acute cholecystitis,^[9,10] clinical factors such as BMI,^[11] the presence of abdominal scar,^[12] palpability of gallbladder, and sonographic features such as wall thickness,^[13] pericholecystic collection, and impacted stone^[14,15] as the predictors of difficulty.

In the present study, we have evaluated this preoperative scoring system considering various preoperative factors in elective/interval LC. We also made an attempt to study the contribution of scoring factors in predicting difficult LC.

Evaluation of the predictive factors for difficult cholecystectomy

The preoperative parameters were analyzed with operative parameters. Initially, univariate analysis was done, and

Table 9: Univariate analysis of preoperative risk factors with surgical outcome (very difficult)

	Intraoperative outcome		Total	χ^2	<i>P</i>
	Easy/difficult	Very difficult			
Age group 1					
<30	17 (14.7)	0	17	7.192	0.207
31-40	31 (26.7)	0	31		
41-50	23 (19.8)	0	23		
51-60	22 (19.0)	2 (50.0)	24		
>60	23 (19.8)	2 (50.0)	18		
Age group					
<50	71 (61.2)	0	71	5.996	0.026
>50	45 (38.8)	4 (100.0)	49		
Sex					
Female	75 (64.7)	2 (50.0)	77	0.361	0.617
Male	41 (35.3)	2 (50.0)	43		
History of hospitalization					
No	81 (69.8)	0 (0.0)	81	8.594	0.010
Yes	35 (30.2)	4 (100.0)	39		
BMI score					
0	28 (24.1)	0	28	1.728	0.422
1	57 (49.1)	2 (50.0)	59		
2	31 (26.7)	2 (50.0)	33		
Abdominal scar					
Infraumbilical	39 (33.6)	2 (50.0)	41	9.643	0.008
No scar	75 (64.7)	1 (25.0)	76		
Supraumbilical	2 (1.7)	1 (25.0)	3		
Palpable GB					
No	105 (90.5)	4 (100.0)	109	0.418	0.518
Yes	11 (9.5)	0	11		
GB wall thickness					
<4	84 (72.4)	4 (100.0)	88	1.505	0.573
>4	32 (27.6)	0	32		
Pericholecystic collection					
No	101 (87.1)	4 (100.0)	105	0.591	0.442
Yes	15 (12.9)	0	15		
Impacted stone					
No	95 (81.9)	4 (100.0)	99	0.878	0.349
Yes	21 (18.1)	0	21		

BMI: Body mass index, CI: Confidence interval

statistically significant factors were found, followed by multivariate analysis.

In the present study, we evaluated the performance of the scoring system and it was found to be 93.02% sensitive and 83.12% specific in predicting difficult LC.

Efficacy of scoring system and significant contributors of difficult outcome

In the present study, the scoring system given by Randhawa and Pujahari was 93.02% sensitive and 83.12% specific in predicting difficult LC with an overall diagnostic accuracy of 86.67%.

In our study, for prediction of difficult cases, past history of hospitalization for acute cholecystitis ($P = 0.001$), BMI $>27.5 \text{ kg/m}^2$ ($P = 0.002$), and advanced age (>50 years) with $P = 0.035$ were significant contributing factors. In our study, this scoring system was not able to identify the very difficult cases on preoperative prediction. This scoring system has missed 5.7% of very difficult cases, thus raising the question mark over the criteria used for differentiation in this scoring system. In our study, for the prediction of very difficult cases, abdominal scar ($P = 0.008$), past history of hospitalization for acute cholecystitis ($P = 0.010$), and advanced age (>50 years) with $P = 0.026$ were significant contributors.

Conclusions

This study demonstrates that the preoperative scoring system is a good, statistically reliable, and useful method to predict difficulty in LC in the majority of cases. It can help surgeons to get an idea of the potential difficulty to be faced in a particular patient. It can help in operative planning and the high-risk patients may be informed accordingly.

Ethical clearance

The study was approved in November 2019, by Institutional Ethics Committee of Dayanand Medical College and Hospital, Ludhiana, with Dr Sandeep Puri as Chairperson of Research Committee and Prof Arvind Malhotra as Chairman Ethics Committee.

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Conflicts of interest

There are no conflicts of interest.

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