

Simple and Reliable Scoring System to Predict Difficult Laparoscopic Cholecystectomy Preoperatively

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ABSTRACT

Aim and objective: To validate the efficacy of proposed scoring system compared to the Randhawa scoring system in prediction of difficult laparoscopic cholecystectomy (LC) preoperatively.

Materials and methods: A prospective study was conducted including 102 patients who underwent LC for symptomatic cholelithiasis. Preoperatively a score was given to the patient according to both scoring systems. Final outcome was decided on intraoperative findings of operative time, adhesions, and bile spillage. Univariate and multivariate analyses of preoperative factors were done. Receiver operating characteristic (ROC) curves of both the scoring system were compared, and the results were reported as a difference in proportion (95% CI). p value <0.05 was considered as statistically significant.

Results: The specificity and positive predictive value of the modified scoring system were 92 and 95.1% which was higher than Randhawa scoring system, i.e., 76 and 87.5%. Area under ROC curve was also more in modified scoring system. Also, univariate analysis found age >50 years, history of hospitalization, previous endoscopic retrograde cholangiopancreatography, diabetes mellitus, palpable gallbladder, gallbladder wall thickness, and contracted gallbladder on ultrasound to be statistically significant factors.

Conclusion: The proposed modified scoring system significantly increases the specificity and positive predictive value of the Randhawa scoring system. This scoring system is easy to perform, require no additional investigation and can effectively categorize patient where LC will be difficult.

Clinical significance: The proposed scoring system can effectively predict difficult preoperatively which would help in better preoperative preparation by the surgical team for a difficult laparoscopic cholecystectomy. Patients can be optimally counseled preoperatively so that they are well prepared for various outcomes of the procedure.

Keywords: Difficult cholecystectomy, Laparoscopic cholecystectomy, Prediction, Preoperative, Scoring system, Simple.

World Journal of Laparoscopic Surgery (2021): 10.5005/jp-journals-10033-1444

INTRODUCTION

Laparoscopic cholecystectomy (LC) is the most common minimal invasive procedure performed by general surgeons around the globe. Early recovery, shorter hospital stay, and minimal postoperative discomfort after the surgery are among the few reasons which make this surgery a gold standard treatment for symptomatic cholelithiasis. Although the complication rate of LC ranges from 0.1 to 6%, which might look small, the actual number of complications is both large and is a cause of significant morbidity to the patient.¹ Most complications, which are avoidable, are caused due to the lack of adequate preparation for a difficult operation. Randhawa et al. proposed a scoring system for preoperative prediction of difficult LC, which has been validated by many studies with variable results.²⁻⁴ To improve the predictive value of this scoring system, very few modifications have been proposed; these are complicated and too much elaborated.^{5,6} Here we propose a simple modified scoring system that can be done bedside preoperatively and compare its efficacy to the original scoring system.

MATERIALS AND METHODS

A prospective study was conducted between July 2019 and December 2019 enrolling a total 102 patients who underwent LC for symptomatic cholelithiasis. All patients were operated by a single surgeon, with experience of more than five years in laparoscopic surgery. Exclusion criteria had those patients who were unfit for

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How to cite this article: Goyal P, Muthuraman S, Sharma S. Simple and Reliable Scoring System to Predict Difficult Laparoscopic Cholecystectomy Preoperatively. *World J Lap Surg* 2021;14(1):34-38.

Source of support: Nil

Conflict of interest: None

anesthesia, had comorbidity (except diabetes and hypertension), bleeding diathesis, operation which were prolonged due to nontechnical reasons (light or instrument failure), and patient not giving consent for the study. Patients were admitted a day before surgery, and a detailed history and examination were done along with documentation of the investigations. A score was given to each patient preoperatively according to the modified scoring system as well as the Randhawa scoring system (Table 1) to label each patient as easy or difficult LC. In both scoring systems, a score of <5 was considered easy, 6 to 10 was considered difficult, and >11 as need for conversion to open (Table 2).

Standard four-port LC was performed with pneumoperitoneum of 12 mm Hg. A standard intraoperative protocol was followed in each patient starting with bile duct timeout to visualize the

Table 1: Detailed layout of proposed and Randhawa *et al.* scoring systems

Sl. No.	Preoperative factors	Findings	Proposed scoring system	Randhawa <i>et al.</i> scoring system
History findings				
1.	Age	<50 years	0	0
		>50 years	1	1
2.	Gender	Female	0	0
		Male	1	1
3.	History of hospitalization	Absent	0	0
		Present	4	4
4.	History of ERCP	Absent	0	–
		Present	2	–
5.	History of diabetes mellitus	Absent	0	–
		Present	1	–
Clinical findings				
6.	BMI	<27.5	0	0
		>27.5	2	2
7.	Previous abdominal surgery	Absent	0	0
		Present	1	2
8.	Palpable gallbladder	Absent	0	0
		Present	1	1
Ultrasonographic findings				
9.	Gallbladder wall thickness	<4 mm	0	0
		>4 mm	2	2
10.	Pericholecystic fluid	Absent	0	0
		Present	1	1
11.	Impacted gallbladder calculus	Absent	0	0
		Present	1	1
12.	Contracted gallbladder	Absent	0	–
		Present	1	–
Maximum score			18	15

Table 2: Preoperative prediction according to scoring done by both the scoring system

Sl. No.	Predictive outcome	Score
1.	Easy	1–5
2.	Difficult	6–10
3.	Need for conversion	11–18

structures namely Hartmann’s pouch, common bile duct, cystic duct, and cystic artery or lymph node to get familiar with the anatomy. Then posterior to anterior peritoneal reflection around Calot’s triangle was done clearing all the fat and clipping was done after only two structures are seen entering the gallbladder. LC was labeled as difficult on the basis of three intraoperative parameters, i.e., operative time >1 hour, adhesions around the Calot’s with omentum or adjacent structure including duodenum or transverse colon, and bile/stone spillage (Table 3). A master chart was prepared in the Microsoft Excel sheet including all preoperative and postoperative parameters for statistical analysis.

Table 3: Criteria of final outcome on the basis of intra operative findings

Sl. No.	Criteria	Easy	Difficult	Conversion
1.	Operative time	<1 hour	>1 hour	–
2.	Adhesions	Absent	Present	–
3.	Bile/stone spillage	Absent	Present	–
4.	Need for conversion to open	–	–	Present

Statistical Analysis

Statistical analyses were carried out using statistical software SPSS version 17. The data were presented as no. (%) for continuous variable and median (interquartile ranges) for categorical variable. The preoperative predictive parameters were compared with results for difficult and easy using the Chi-square test for categorical variable. Multivariate receiver operating characteristic (ROC) model was performed to predict the result for difficulty. To analyze the postoperative parameters prediction with the result, ROC analyses were performed. The results were reported as a difference in proportion (95% CI). *p* value <0.05 was considered statistically significant.

RESULTS

Mean age of presentation was 46 years with 63 (62%) patients having age <50 years and 39 (38%) having age >50 years. Surgery was easy in patients with age <50 years (73.4%) compared to patients with age >50 where surgery was difficult (57.9%). This result was found to be statistically significant (*p* value: 0.002). Out of 15 male patients nine (60%) had easy and six (40%) had difficult surgery, which on univariate analysis was not statistically significant (*p* value: 0.812). Hospitalization for a history of acute cholecystitis was the most significant preoperative predictor (*p* value <0.0001). Similarly, history of diabetes mellitus was present in 13 patients (12%) and 11 (84.6%) patients had difficult LC. It was a unique finding of our study where history of diabetes mellitus came out to be a significant preoperative predictor (*p* value: <0.0001). History of hypertension and dyspepsia did not show any significant correlation to the predictability of difficult LC.

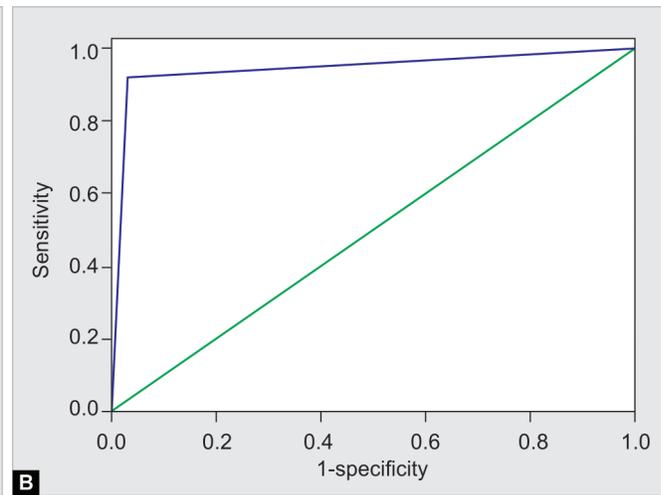
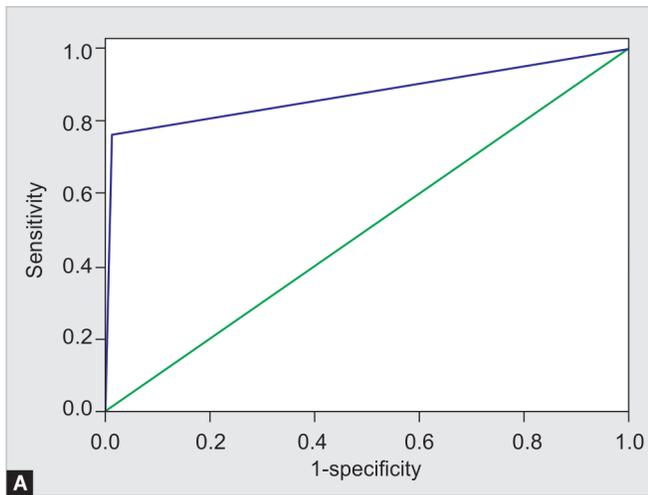
Palpable gallbladder was found in seven patients and all patients had difficult cholecystectomy. Patients who had a history of abdominal surgery were 20 (19%), out of which only three cases (15%) had difficult LC, showing the result as insignificant but it must be noted that most of these cases had infraumbilical scar for tubectomy or cesarean. There were five (4%) patients with a history of endoscopic retrograde cholangiopancreatography (ERCP) and four (80%) had difficult cholecystectomy with *p* value <0.05. Mean BMI was 23.86. BMI >27.5 was a significant preoperative factor with *p* value of 0.03. Murphy’s sign was also found to be predictive with *p* value of 0.03.

All ultrasonographic findings included in the scoring system were significant namely gallbladder wall thickness (*p* value <0.0001), stone size >1 cm (0.002), pericholecystic fluid collection (0.023), and contracted gallbladder (0.06). Common bile duct diameter had no significant predictive value for difficult LC (Table 4).

The ROC curve of multivariate analysis of all significant preoperative predictors showed area under curve of 97%. Positive predictive value and accuracy of Randhawa scoring system was 87.5 and 90.2% whereas that of modified scoring was 94.38 and 95.10%. Sensitivity of both the scoring system was 95% with specificity of modified scoring greater (92%) than that of original scoring (76%) (Fig. 1).

Table 4: Univariate analysis of preoperative factors compared to the final outcome of the surgery

Preoperative factors	Findings	Result		p value	Odds ratio
		Easy	Difficult		
Age	Age <50 years	47 (46.1%)	16 (15.7%)	0.002	3.801 (1.625–8.89)
	Age >50 years	17 (16.7%)	22 (21.6%)		
Gender	Female	55 (53.9%)	32 (31.4%)	0.812	1.146 (0.373–3.516)
	Male	9 (8.8%)	6 (5.9%)		
H/o acute cholecystitis	Absent	60 (58.8%)	10 (9.8%)	<0.0001	42 (12.11–145.612)
	Present	4 (3.9%)	28 (27.5%)		
H/o dyspepsia	Absent	26 (25.5%)	11 (10.8%)	0.236	1.679 (0.710–3.97)
	Present	38 (37.3%)	27 (26.5%)		
Diabetes mellitus	Absent	62 (60.8%)	27 (26.5%)	<0.0001	12.630 (2.62–60.88)
	Present	2 (2.0%)	11 (10.8%)		
Hypertension	Absent	48 (47.1%)	30 (29.4%)	0.65	0.80 (0.305–2.09)
	Present	16 (15.7%)	8 (7.8%)		
Previous abdominal surgery	Absent	47 (46.1%)	35 (34.3%)	0.022	0.237 (0.064–0.872)
	Present	17 (16.7%)	3 (2.9%)		
Previous ERCP	Absent	63 (61.8%)	34 (33.3%)	0.043	7.41 (0.796–68.97)
	Present	1 (1.0%)	4 (3.9%)		
BMI	<27.5	46 (45.1%)	16 (15.7%)	0.003	3.51 (1.51–8.16)
	>27.5	18 (17.6%)	2 (1.6%)		
Murphy's sign	Absent	36 (35.3%)	10 (9.8%)	0.003	3.60 (1.50–8.63)
	Present	28 (27.5%)	28 (27.5%)		
Palpable gallbladder	Absent	64 (62.7%)	31 (30.4%)	<0.0001	NA
	Present	0 (0%)	7 (6.9%)		
USG: gallbladder wall thickness	<4 mm	62 (60.8%)	23 (22.5%)	<0.0001	20.21 (4.28–95.35)
	>4 mm	2 (2.0%)	15 (14.7%)		
Pericholecystic fluid	Absent	64 (62.7%)	35 (34.3%)	0.023	NA
	Present	0 (0%)	3 (2.9%)		
USG: impacted stone	Absent	52 (51.0%)	20 (19.6%)	0.002	3.90 (1.59–9.53)
	Present	12 (11.8%)	18 (17.6%)		
USG: contracted	Absent	63 (61.8%)	32 (31.4%)	0.006	11.81 (1.36–102.36)
	Present	1 (1.0%)	6 (5.9%)		
	Count	23 (28.8%)	16 (20.0%)		



Figs 1A and B: ROC curves of Randhawa et al. scoring system (A) showing with the area under the curve of 87.4% whereas the area under curve of proposed scoring system (B) is 94.5%

DISCUSSION

Cholelithiasis is a benign disease of the gallbladder where most cases are asymptomatic or have mild symptoms. LC is the gold standard procedure of choice for cholelithiasis and conducting a safe operation becomes the utmost priority for the operating surgeon. Much work has been done to improve intraoperative outcomes by following safe cholecystectomy protocol but not much literature is available on the safe preoperative protocol. Difficult LC requires preparation in form of operative skill, on floor senior support, logical surgical steps, bailout procedures, and most importantly a well-informed patient and attendants. Wrong selection of cases can result in devastating results both for the patient as well as for the operating surgeon. This justifies the importance of preoperative prediction of a difficult LC.

Lee et al. and Hussain et al. in their study found age >50 years as a risk factor for difficult LC.^{7,8} Rothman et al. also concluded in a meta-analysis that there is association of higher rate of conversion in patients with age >60 years.⁹ Similarly, age >50 years was a significant preoperative risk factor in our study (p value – 0.01). In studies done by Kanakala et al. and Rothman, male patients had higher rate of conversion to open but it was not found to be associated with difficult LC in our study.^{9,10} Many studies which studied preoperative risk factors for difficult LC did not find male gender as an independent risk factor.¹¹ History of hospitalization for acute cholecystitis, palpable gallbladder, and BMI >27.5 is among the most significant clinical parameters for predicting difficult LC preoperatively.^{2,3,12,13} In our study also these factors showed strong preoperative association in univariate analysis. Though Murphy sign was significant preoperative factor in univariate analysis, it did not show significant association in multivariate analysis. Therefore, it was not considered as a risk factor for preoperative prediction.

Among the ultrasonographic findings, gallbladder wall thickness showed significant relation in our study, similar to studies done by Nachnani et al. and Randhawa et al. where wall thickness of >4 mm had intraoperative difficulty in dissection of Calot's due to adhesions and difficulty in grasping gallbladder.^{2,14} Pericholecystic fluid is found significant in our study with a higher incidence of adhesions intraoperative. This is probably due to the fact that pericholecystic fluid is found in cases of acute cholecystitis. Similarly impacted stones had a direct relation to difficult LC by creating difficulty in grasping the gallbladder which caused bile spillage. Finding of the contracted gallbladder in ultrasonography (USG) was independent significant variable for difficult LC in our study and was associated with adhesions intraoperatively. Rothman et al. also found contracted gallbladder to be associated with higher rate of conversions in their meta-analysis.⁹ Therefore, this factor was added to the scoring system proposed by the authors.

Other two factors which were added are history of ERCP and history of diabetes. Reinders et al. found in their study that history of previous ERCP is a significant risk factor for a difficult LC.¹⁵ Fibrous adhesions around the Calot's triangle due to the stent placed after ERCP cause disruption in the plane of dissection posing risk of bile duct injury, even in the hands of an experienced surgeon. These patients also have a contracted gallbladder intraoperatively which further increases the complexity of an otherwise simple procedure. Timing of LC after ERCP has been found significant in a study by Aziret et al., showing early LC within 48 hours after ERCP leading to significant reduction in difficulty.¹⁶ Diabetes mellitus was a strong predictor for difficult LC in a study done by Aldachal et al.¹⁷ Most

of these patients had delayed presentation due to neuropathy; therefore, more association with intraoperative adhesions was encountered. In our study, we also found diabetes to be a strong preoperative predictor of difficult LC.

Previous studies which have been done on the Randhawa et al. scoring system concluded that it was more sensitive, less specific, and had 85–90% positive predictive value for the difficult cases preoperatively.^{3,13} Our study also found similar results however prediction done using a modified scoring system showed that the specificity increased and positive predictive value also increased to 95%. This shows that simple modification can significantly increase the accuracy of the original scoring system. We found this scoring system to be a simple bedside tool, which accurately predicted difficult LC preoperatively in our setting.

This study had its limitation as it was a single-center study and validation in different hospital settings and populations may be required for a further recommendation of this scoring system. A systemic review and meta-analysis of all the available scoring methods would be the best way to remove these limitations.

CONCLUSION

Preoperative prediction helps in better preparation of the challenges associated with difficult LC. An accurate and reliable scoring system, therefore, comes handy for a surgical team in this situation. The scoring system that is proposed by the authors significantly increases the specificity and positive predictive value of the Randhawa et al. scoring system which has been validated by many studies previously. The proposed scoring system is simple, easy to perform, requires no special investigation and can effectively categorize patients, so that the best expertise is available when required and the patient is adequately counseled so that they are also prepared for various outcomes of otherwise a simple procedure. Further evaluation in different clinical settings may be required to validate the findings of this study.

CLINICAL SIGNIFICANCE

The most important goal of a surgeon while performing a procedure is to give the best and safest treatment to the patient. LC is the gold standard treatment for patients with gallbladder disease but the difficulties related to the procedure require both expertise in laparoscopic skills and the correct choice of bailout procedure to prevent any major complication. The proposed scoring system can effectively predict difficult LC preoperatively which would help in better preparation for a difficult scenario preoperatively. Patients can be optimally counseled preoperatively so that they are well prepared for various outcomes of the procedure.

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