

## VALIDATION OF A SCORING SYSTEM TO PREDICT DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY: A ONE-YEAR CROSS-SECTIONAL STUDY

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### Abstract

**Background:** Open cholecystectomy is rapidly being replaced with laparoscopic cholecystectomy which could be associated with complications. Preoperative prediction of risk factors helps in assessing the intraoperative difficulties. Various scoring systems are available to predict the intraoperative difficulties in laparoscopic cholecystectomy. However, there is the need to find a consistent and reliable scoring and predictive system.

**Aim:** To validate a preoperative scoring system that will predict difficult laparoscopic cholecystectomy.

**Design of the study:** Non-randomized prospective descriptive study

**Setting:** Department of Medicine, K.L.E. University's Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi 590003, Karnataka, India.

**Methodology:** A preoperative score was given to all the patients (30 patients) based on history, clinical examination, and sonographic findings. A score <5 was predicted as easy, 6–10 as difficult, and 11–15 as very difficult. Intraoperative events such as duration of surgery, bile/stone spillage, and injury to duct/artery were recorded; and surgery was labelled as easy/difficult/very difficult based on these findings. The scores were compared in each patient to conclude the practicality of preoperative predictive score. SPSS version 22 was used to analyze the data.

**Results:** Gender ( $P=0.029$ ), palpable gallbladder ( $P=0.04$ ), thick gallbladder wall ( $P=0.027$ ), and impacted stone ( $P=0.04$ ) were considered as the significant factors that predict difficult laparoscopic cholecystectomy. Sensitivity and specificity of this scoring method were 86.36% and 75%, respectively. The positive predictive value for easy and difficult cases, using this scoring method, was 90.48% and 66.67%, respectively.

**Conclusion:** The preoperative scoring system evaluated in study is reliable and beneficial in predicting the difficulty of laparoscopic cholecystectomy. However, further randomized prospective multicentric studies with large sample size are required to validate the efficiency of the scoring system.

**Keywords:** Cholecystitis, Cholecystectomy, Laparoscopic, Prospective, Scoring system

## **Introduction**

Cholecystectomy is a surgical procedure to remove the gallbladder as a result of stone or inflammation<sup>1</sup>. Laparoscopic cholecystectomy is considered as the gold standard surgical procedure for the management of patients with symptomatic gallstones. It offers many advantages over open cholecystectomy, such as minimal postoperative pain, better cosmesis, shorter hospital stay, and early recovery. However, 2–15 % patients who underwent laparoscopic cholecystectomy were converted to open procedure due to various difficulties encountered during the procedure. The difficulty is considered in cases of dense adhesions at Calot's triangle, history of upper abdominal surgery, acutely inflamed and gangrenous gallbladder, empyema of the gallbladder, Mirizzi's syndrome, previous cholecystostomy, and cholecystogastric or cholecystoduodenal fistula. The specific complications of laparoscopic cholecystectomy were hemorrhage, gallbladder perforation, bile leakage, bile duct injury, perihepatic collection, and others, such as external biliary fistula, wound sepsis, hematoma, foreign body inclusions, adhesions, metastatic port-site deposits, and choledocholithiasis. However, tremendous advances in equipment and surgical expertise has lowered the complication rate in laparoscopic cholecystectomy to about 2–6%.

Preoperative and intraoperative factors, such as male gender, old age, body mass index (BMI), history of abdominal surgery, acute cholecystitis along with fever, leukocytosis, presence of

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gallbladder stones, and certain ultrasonographical findings (distension of the gallbladder, thick gallbladder lining, impacted stone, and pericholecystic fluid collection) are the risk factors that make laparoscopic cholecystectomy cumbersome. A study by Kama et al reported six parameters — advancing age, male gender, history of abdominal surgery, upper abdominal tenderness at the time of surgery, sonographically diagnosed thickened gallbladder wall and the preoperative diagnosis of acute cholecystitis that were significantly associated with the risk of open cholecystectomy.

A preoperative scoring system based on history, clinical examination, and sonographic findings compared with the score given based on intraoperative difficulties aids in predicting the difficulty of laparoscopic cholecystectomy. This scoring system helps to decide the surgical approach, counsel the patients, reduce the complication rate, rate of conversion, and overall medical cost. Therefore, the present study was aimed to validate a scoring system to predict difficult laparoscopic cholecystectomy.

#### Patients and Methods

The present one-year (January 2017 –December 2017) non-randomized prospective descriptive study was conducted at the Department of Medicine. Ethical clearance was obtained from Institutional Ethical and Research Committee. An informed written consent was also obtained from the patients before the commencement of the study.

All the patients with acute calculous cholecystitis and chronic calculous cholecystitis who require cholecystectomy were included in the study. Exclusion criteria comprised of patients with jaundice, cholangitis, raised alkaline phosphatase, dilated common bile duct, common bile duct stones, empyema of the gallbladder, and acalculous cholecystitis. Patients with laparoscopic cholecystectomy along with

common bile duct exploration or with other interventions were excluded from the study. The patients with anesthetic complications and comorbid diseases were also excluded.

### **Study procedure**

A scoring system employed by Gupta et al<sup>1</sup> was used in this study. A preoperative score was given to all the patients based on history, clinical examination, and sonographic findings one day before the surgery (Table 1). Patients with scores of 0–5, 6–15, and 10–15 were predicted as easy, difficult, and very difficult cases respectively.

All the surgeons at the Institute with minimum laparoscopic experience of 10 years were involved in the surgery. Surgery was performed using carbon dioxide (CO<sub>2</sub>) pneumoperitoneum with 10 mmHg pressure and two 5 mm and two 10 mm standard ports. Time was noted from 1<sup>st</sup> port site insertion till last port closure. All intraoperative events such as duration of surgery, bile/stone spillage, and injury to duct/artery were recorded, and surgery was labelled as easy/difficult/very difficult based on these findings (Table 2). Intraoperative assessment was compared with preoperative predictive score to determine the usefulness of preoperative predictive score.

### **Statistical Analysis**

Chi-square test or Fisher's exact test were used to find the significant association between findings of the preoperative score and the intraoperative outcome. Area under receiver operating characteristic (ROC) curve was used to find the diagnostic and predictive value of preoperative score for predicting the intraoperative outcome.  $P \leq 0.05$  was considered as statistically significant.

### **Results**

A total of 30 patients were involved in the study. Preoperative characteristics of the study patients were as shown in Table 3. Most of the patients 22 (73.3%) were aged below 50 years, with a female preponderance 24 (80%). Of the 30

**Table 1: Preoperative scoring parameters used for grading the patient**

<b>History</b>	<b>Level</b>	<b>Score</b>	<b>Max score</b>
Age (years)	≤ 50	0	
	> 50	1	1
Gender	Male	1	
	Female	0	1
History of hospitalization for acute cholecystitis	Yes	4	
	No	0	4
<b>Clinical parameters</b>			
Body mass index (kg/m <sup>2</sup> )	< 25	0	
	25 – 27.5	1	2
	> 27.5	2	
Abdominal scar	No	0	2
	Infraumbilical	1	
	Supraumbilical	2	
Palpable gallbladder	Yes	1	1
	No	0	
<b>Sonographic findings</b>			
Wall thickness	Thin < 4 mm	0	2
	Thick ≥ 4 mm	2	
Pericholecystic collection	No	0	1
	Yes	1	
Impacted stone	No	0	1
	Yes	1	



**Table 2: Intra-operative assessment**

<b>Parameters</b>	<b>Grading</b>
Operative time < 60 min; No bile spillage No injury to duct	Easy
Operative time 60–120 min; and/or Bile or stone spillage; and/or Injury to duct	Difficult
Operative time > 120 min or conversion	Very difficult

**Table 3: Preoperative characteristics of the study patients**

<b>Patient characteristics</b>	<b>n (%), n = 30</b>
<b>Age (years)</b>	
≤ 50	22 (73.33)
> 50	8 (26.67)
<b>Gender</b>	
Male	6 (20)
Female	24 (80)
<b>History of Hospitalization for Acute Cholecystitis</b>	
Yes	9 (30)
No	21 (70)
<b>Body mass index (kg/m<sup>2</sup>)</b>	
≤ 25	22 (73.33)
25.1–27.5	2 (6.67)
> 27.5	6 (20)
<b>Abdominal scar</b>	
Yes	2 (6.67)
No	28 (93.33)
<b>Palpable gallbladder</b>	
Yes	3 (10)
No	27 (90)
<b>Thick gallbladder wall</b>	
Yes	8 (26.67)
No	22 (73.33)
<b>Pericholecystic fluid collection</b>	
Yes	6 (20)
No	24 (80)
<b>Impacted stone</b>	
Yes	3 (10)
No	27 (90)





**Table 4: Preoperative score and outcome**

<b>Preoperative score</b>	<b>Intraoperative outcome</b>			<b>Total, n (%)</b>
	<b>Easy, n (%)</b>	<b>Difficult, n (%)</b>	<b>Very Difficult, n (%)</b>	
<b>0–5</b>	19 (63.33)	2 (6.66)	0	21 (70)
<b>6–10</b>	3 (10)	5 (16.66)	1 (3.33)	9 (23.33)
<b>11–15</b>	0	0	0	0

**Table 5: Predictive association of preoperative risk factors with intraoperative outcome**

Preoperative Risk factors	Level	Intraoperative outcome		P value
		Easy, n (%)	Difficult, n (%)	
<b>Age (years)</b>	≤ 50	18 (60)	4 (13.33)	0.311
	> 50	4 (13.33)	3 (10)	
<b>Gender</b>	Male	2 (6.67)	4 (13.33)	0.029*
	Female	20 (66.67)	3 (10)	
<b>History of hospitalization for acute cholecystitis</b>	Yes	5 (16.67)	4 (13.33)	0.195
	No	17 (56.67)	4 (13.33)	
<b>Body mass index (kg/m<sup>2</sup>)</b>	≤ 25	17 (56.67)	4 (13.33)	0.347
	25.1–27.5	1 (3.33)	1 (3.33)	
	> 27.5	4 (13.33)	2 (6.67)	
<b>Abdominal scar</b>	Yes	1 (3.33)	1 (3.33)	0.469
	No	21 (70)	6 (20)	
<b>Palpable gallbladder</b>	Yes	1 (3.33)	2 (6.67)	0.04*
	No	21 (70)	5 (16.67)	
<b>Thick gallbladder wall</b>	Yes	2 (6.67)	5 (16.67)	0.027*
	No	20	2 (6.67)	
<b>Pericholecystic fluid collection</b>	Yes	3 (10)	2 (6.67)	0.3
	No	19	5 (16.67)	
<b>Impacted stone</b>	Yes	1 (3.33)	2 (6.67)	0.04*
	No	21	5 (16.67)	

*\*statistically significant*



patients, 9(30%) had a history of hospitalization for acute cholecystitis, 6(20%) had BMI  $>27.5 \text{ kg/m}^2$ , 2(6.67%) had abdominal scar, 3(10%) had palpable gall bladder, 8(26.67%) had thick gallbladder wall, 6(20%) had pericholecystic fluid collection, and 3(10%) had impacted stone.

Comparison of preoperative score and outcome is shown in Table 4. Out of 21 easy predicted cases, 19 had easy and two had difficult laparoscopic cholecystectomies. Out of nine predicted difficult cases, three, five, and one cases had easy, difficult, and very difficult laparoscopic cholecystectomies respectively.

Sensitivity and specificity of this scoring method were 86.36 % and 75 %, respectively for cases predicted to be easy (score 0–5). The positive predictive value was 90.48 % for easy and 66.67% for difficult cases using this scoring method.

Association of preoperative risk factors with intraoperative outcome is shown in Table 5. Gender ( $P=0.029$ ), palpable gallbladder ( $P=0.04$ ), thick bladder wall ( $P=0.027$ ), and impacted stone ( $P=0.04$ ) were significantly associated with intraoperative outcome.

## **Discussion**

In this study laparoscopic cholecystectomy was performed in 30 patients and predictive risk factors for difficult laparoscopic cholecystectomy were analysed. Gender, palpable gallbladder, thickened gallbladder wall, and impacted stone were the significant risk factors that predict difficult laparoscopic cholecystectomy, which were similar to other studies in the literature.

The preoperative score of 6–10 points indicates difficult surgical approach, according to Gupta scoring system and other studies of

similar interest. This scoring system aids in the conversion of difficult laparoscopic cholecystectomy to open cholecystectomy.

Advancing age has been considered as a significant risk factor to predict difficult laparoscopic cholecystectomy in various studies. However, in the present study, age did not affect the prediction of difficult laparoscopic cholecystectomy. Gender had been shown to be a significant risk factor for difficult surgery. Similarly, in this study, gender was observed as a significant risk factor in the prediction of difficult laparoscopic cholecystectomy whereas a study by Gupta et al reported that gender did not affect the prediction of difficult laparoscopic cholecystectomy. Also patients with history of hospitalization for repeated attacks of acute cholecystitis had been shown to have high chances of difficult laparoscopic cholecystectomy due to dense adhesions at Calot's triangle and gallbladder fossa. However, this was not a significant factor in this study, which is consistent with a study conducted by Gupta et al.

Clinical findings such as BMI, abdominal scar, and palpable gallbladder had been shown to be significant risk factors in the prediction of operative difficulties. However, in this study palpable gallbladder was the only significant risk factor in the prediction of a difficult surgery. Palpable gallbladder might be due to a thick-walled gallbladder, mucocele gallbladder, distended gallbladder, or due to adhesions between the gallbladder and the omentum. Similarly, studies conducted by Gupta et al. and Randhawa et al found a significant association between palpable gallbladder and intraoperative difficulty. Body mass index (BMI) and abdominal scar in this study were not associated with difficulty at surgery which was in keeping with other studies.

Increased gallbladder thickness was another

significant risk factor shown to predict difficult laparoscopic cholecystectomy because it could limit the extent of anatomical definition and could make dissection difficult at the gallbladder bed and Calot's triangle. In this study, a significant association was observed between gallbladder wall thickness and difficult laparoscopic cholecystectomy similar to other studies in the literature. Stone impacted at the neck of the gallbladder is another important risk factor. Impacted stone had been shown to distend the gallbladder and make dissection difficult similar to the thickened gallbladder. In this study, we found a significant association of impacted stone with difficult laparoscopic cholecystectomy, which was in concordance with other studies. Another important ultrasonographic finding—the pericholecystic fluid collection was also a predictor of difficult laparoscopic cholecystectomy. However, in this study, pericholecystic fluid collection did not affect the prediction of difficult laparoscopic cholecystectomy.

The sensitivity and specificity used in our study at score 5, for the prediction of easy cases, were 86.36 % and 75 %, respectively. And the prediction has come true in 90.48 % easy and 66.67 % difficult cases. A similar study conducted by Gupta et al on this scoring method had sensitivity and specificity of 95.74 % and 73.68 %, respectively with positive predictive values for easy and difficult as 90 % and 88 %, respectively.

Limitation: The small sample size was the main drawback in our study. Therefore, multi-institutional studies with larger sample size are required to validate this scoring system in predicting difficult laparoscopic cholecystectomy cases.

Conclusion: The preoperative scoring system

evaluated in study is reliable and beneficial in predicting the difficulty of laparoscopic cholecystectomy. However, further randomized, prospective, multicentric studies with large sample size are required to validate the efficiency of the scoring system.

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