



## Proposed Diagnostic Scoring System to Predict Difficult Laparoscopic Cholecystectomy

Authors

**Dr S.T.Bhondave<sup>1</sup>, Dr Niranjan Dash<sup>2</sup>, Dr Mrs.V.J. Thipse<sup>2</sup>, Dr J.M. Gadekar<sup>3</sup>**

<sup>1</sup>Postgraduate student, Department of General Surgery, DVVPF's Medical College and Hospital, Ahmednagar, Maharashtra, India

<sup>2</sup>Professor, Department of General Surgery, DVVPF's Medical College and Hospital, Ahmednagar, Maharashtra, India

<sup>3</sup>Professor and Head of Department, Department of General Surgery, DVVPF's Medical College and Hospital, Ahmednagar, Maharashtra, India

### Abstract

**Background:** One of the most common laparoscopic surgeries performed by the general surgeons all over the world is laparoscopic cholecystectomy (LC). Due to various intraoperative difficulties, it is important for a surgeon to evaluate it thoroughly pre-operatively.

**Objective:** To study the various risk factors and to predict the level of difficulty of laparoscopic cholecystectomy pre-operatively by the use of proposed scoring system.

**Materials and Methods:** 86 patients fulfilling the inclusion criteria undergoing LC were included in the study. The study was carried out at DVVPF's Medical college and hospital, Ahmednagar between January 1, 2015, to December 1, 2017. Total maximum pre-operative score was 17 based on parameters as age, sex, BMI, prior attack of acute cholecystitis, palpable gall bladder (GB), abdominal scars, total leucocyte count (TLC) and certain ultrasonographic findings i.e. thickened gall bladder wall, distended or contracted gall bladder, pericholecystic fluid collection, impacted stone and altered hepatic echotexture. Score <5 was predicted as easy, 6-10 as difficult and 11-17 as very difficult. Intraoperative findings of LC were recorded and patients were categorized as easy, difficult and very difficult depending on various factors.

**Results:** Sensitivity and Specificity of the Dash, Bhondave & Gadekar scoring method was found to be 95.24% and 73.63% respectively and there were no cases with score above 10. According to the Dash, Bhondave & Gadekar scoring method, 76% cases were predicted to be easy out of which 70% turned out to be easy, while 24% cases were predicted to be difficult out of which 16% turned out to be difficult and 5% to be very difficult. Positive predictive value of this scoring method was 92% and 82% for easy and difficult cases respectively. Parameters like prior attack of acute cholecystitis ( $p < 0.0002$ ), palpable gall bladder ( $p < 0.004$ ) and ultrasonographic findings like thickened GB ( $p < 0.00005$ ), distended or contracted gall bladder ( $p < 0.000001$ ), pericholecystic fluid collection ( $p < 0.0002$ ) and impacted stone ( $p < 0.003$ ) were found to be statistically significant in predicting difficult LC.

**Conclusion:** Various scoring systems are available to predict difficult LC which are cumbersome to implement. We propose Dash, Bhondave & Gadekar scoring system which is easy and statistically reliable to predict difficult cases.

**Keywords:** Cholecystitis, Laparoscopic cholecystectomy, Parameters, Scoring system.

## Introduction

One of the most common problems affecting the digestive tract is the gallstone disease. The prevalence of gallstones disease changes from place to place and depends on various factors as age, gender and ethnic background. Increasing incidence in India is mainly contributed by change in the socioeconomic structure, westernization of diet and availability of ultrasound as investigation [1]. Laparoscopic cholecystectomy (LC) has become the gold standard treatment for gallstone and gallbladder disease. Currently around 80% of cholecystectomies are performed using laparoscopic approach [2].

The risk factors which make laparoscopic cholecystectomies difficult include old age, male sex, attack of acute cholecystitis, obesity, previous abdominal surgery, and certain ultrasonographic findings i.e. thickened gall bladder wall, distended gall bladder, pericholecystic fluid collection and impacted stone etc<sup>[3]</sup>. Considering the factors, about 2-15% of attempted LC have to be converted to an open procedure<sup>[4]</sup>. Therefore it would be helpful for surgeons to establish criteria that would assess the risk of conversion preoperatively. This would be useful for informing patients and surgical team to be ready for risk of conversion<sup>[5]</sup>.

Different scoring methods have been suggested using different criteria, further adding to the controversy. Our aim was to prepare a scoring system which could predict difficult LC beforehand.

## Aims and Objectives

To study the various risk factors and to predict the level of difficulty of Laparoscopic Cholecystectomy preoperatively by the use of proposed scoring system.

## Patients and Methods

Between January 1, 2015, to December 1, 2017, eighty six patients were included in the study after prior informed consent, from department of surgery, DVVPF's Medical college and hospital,

Ahmednagar, Maharashtra. Inclusion criteria were patients with symptomatic gall stone disease. Exclusion criteria included patients unfit for anaesthesia, patients with current attack of acute cholecystitis and lap to open conversion due to equipment failure. A preoperative score was given to every patient depending on history, clinical examination and radiological findings ( Table 1). Total maximum score in Dash, Bhondave & Gadekar scoring system was 17 depending on the 12 parameters. A day prior to surgery scores were provided to each patient. 0-5 score was defined as easy, 6-10 as difficult and 11-17 as very difficult. Surgery was performed using CO<sub>2</sub> pneumoperitoneum with 12 mmHg pressure and two standard 10 mm and 5 mm ports. Time was noted from insertion of 1<sup>st</sup> portsite till the closure of last port. Intraoperative events like time required for surgery, stone or bile spillage, injury to cystic artery or duct were recorded and based on these findings surgery was labelled as easy/difficult/ very difficult (Table 2). In all cases postoperative period was uneventful.

**Table 1-** Preoperative score for various patient parameters.

Scoring system (Dash, Bhondave & Gadekar scoring system)

Parameters		Score	Total Max. score
Age	≤50	0	17
	>50	1	
Sex	Male	1	
	Female	0	
BMI	≤30	0	
	>30	1	
Prior attack of acute cholecystitis	Yes	4	
	No	0	
Palpable gall bladder	Yes	1	
	No	0	
Total Leucocyte Count (TLC)	≤12,000	0	
	>12,000	1	
Abdominal scar	Yes	1	
	No	0	
Gall bladder wall thickness	Thick >4mm	2	
	Thin ≤4mm	0	
Distended or Contracted gall bladder	Yes	1	
	No	0	
Pericholecystic collection	Yes	1	
	No	0	
Impacted stone	Yes	1	
	No	0	
Altered hepatic echotexture	Yes	2	
	No	0	

Score 0-5 easy, 6-10 difficult, 11-17 very difficult

**Table 2-** Intraoperative evaluation

Parameters	Classification
Time taken ≤60 mins, No bile spillage and No injury to artery / duct	Easy
Time taken 60-120 mins and/or bile/ stone spillage and/or injury to duct/artery	Difficult
Time taken >120 mins or conversion	Very difficult

The scores were compared in each patient to know whether preoperative score was useful in predicting difficult LC. A p value of ≤ 0.05 was considered as statistically significant. Chi-square test and Fisher’s exact test was used to evaluate whether there was significant association between preoperative and intraoperative outcome.

**Results**

The study included 86 patients which were prospectively evaluated over a period of 2 years.

**Age Distribution of Patients**

**Table 3-**Age wise distribution of patients of cholethiasis

Age group	No. of patients
10-20	2 (2.3%)
20-30	10 (11.6%)
30-40	22(25.6%)
40-50	30 (34.9%)
50-60	18 (20.9%)
60-70	4 (4.7%)

Youngest patient in the present series was 16 years old and the oldest was 68 years of age. Maximum number of patients were in the age group 40-50 around 30 (34.9%). The mean age was 46 years.

**Sex Distribution**

**Table 4-** Sex distribution of patients

Male	32 (38%)
Female	54 (62%)

Among 86 patients in the study, 32 (38%) patients were male and 54 (62%) were female.

**BMI (Body Mass Index)**

BMI≤30	58 (67%)
BMI>30	28 (33%)

In the study among 86 patients, 58 (67%) patients had BMI<30 and 28 (33%) patients had BMI>30.

**Prior attack of acutecholecystitis**

Prior hospitalization was present in 24 (28%) patients for an episode of acutecholecystitis, while 62 (72%) patients had no prior hospitalization.

Palpable gallbladder was present in 8 (9.3%) patients, while 78 (90.7%) patients gall bladder was not palpable.

**Total leucocyte count (TLC)**

Total leucocyte count was >12,000/cmm in 4 (5%) patients and 82 (95%) patients had TLC count ≤12,000/cmm.

Abdominalscar was present in 6 (7%) patients, while 80 (93%) patients did not have any abdominal scar.

**Table 5-**Ultrasonographicfindingsrevealed

USG Findings		No. of patients
Thickened gall bladder wall	Yes	28 (32.6%)
	No	58 (67.4%)
Distended or contracted gall bladder	Yes	18 (21%)
	No	68 (79%)
Pericholecystic fluid collection	Yes	20 (23.3%)
	No	66 (76.7%)
Impacted stone	Yes	6 (7%)
	No	80 (93%)

Mean intraoperative time was 55 ± 10 mins (range 35-90 mins). Cystic artery was injured in 1 case which was promptly controlled with clips. Bile spillage was seen in 12 (14%) cases which was managed with gauze soakage and suction. There were total 4 (4.7%) patients who were converted into open cholecystectomy because of dense adhesions at calot’s triangle. Postoperative hospital stay was 2 ± 1 days.

**Table 6-** Analysis of intraoperative outcome and risk factors

Risk factors		Intraoperative outcome		P value
		Easy no. (%)	Difficult no. (%)	
Age	≤50 years	42 (51.22%)	20 (24.39%)	0.526
	>50 years	12 (14.63)	8 (9.76%)	
Sex	Male	21 (25.61%)	10 (12.20)	0.920
	Female	34 (41.46%)	17 (20.73%)	
BMIwt(kg)/ht(m <sup>2</sup> )	≤30	48 (58.54%)	8 (9.76%)	0.57
	>30	21 (25.61%)	5 (6.01%)	
Prior attack of acute cholecystitis	Yes	6 (7.32%)	18 (21.95%)	0.0002
	No	34 (41.46%)	14 (17.07%)	
Palpable GB	Yes	2 (2.44%)	6 (7.32%)	0.004
	No	55 (67.07%)	19 (23.17%)	

Abdominal scar	Yes	2 (2.44%)	4 (4.88%)	0.149
	No	48 (58.54%)	28 (34.15%)	
Total leucocyte count(/cmm)	≤12,000	62	16	1.00*
	>12,000	3	1	
Thickened GB	Yes	9 (10.98%)	19 (23.17%)	0.00005
	No	42 (51.22%)	12 (14.63%)	
Distended or contracted GB	Yes	4 (4.88%)	14 (17.07%)	0.000001
	No	53 (64.63%)	11 (13.41%)	
Pericholecystic collection	Yes	4 (4.88%)	16 (19.51%)	0.0002
	No	44 (53.66%)	22 (26.83%)	
Impacted stone	Yes	1 (1.2274%)	5 (6.10%)	0.003
	No	56 (68.29%)	20 (24.39%)	

\* p value calculated with Fisher’s exact test; other values are calculated with Chi-square test.

**Table 7-** Statistically significant risk factors and the associated score

Risk factors	Score (Dash, Bhondave & Gadekar scoring system)	P value
Prior attack of acute cholecystitis	4	0.0002
Palpable GB	1	0.004
Thickened GB ( thickness>4 mm)	2	0.00005
Distended or contracted GB	1	0.000001
Pericholecystic collection	1	0.0002
Impacted stone	1	0.003

Evaluation of intraoperative outcome with risk factors was carried out which showed that the above mentioned factors (Table 7) were statistically significant in preoperative prediction of difficult laparoscopic cholecystectomy i.e., prior attack of acute cholecystitis, palpable gall bladder (GB), thickened gall bladder, distended or contracted gall bladder, pericholecystic fluid collection and impacted stone.

**Table 8-** Comparison of pre-operative score and outcome.

Pre-operative score	Easy (no. of patients)	Difficult (no. of patients)	Very difficult (no. of patients)	Total
0-5	60 (70%)	5 (6%)	-	65 (76%)
6-10	3 (3%)	14 (16%)	4 (5%)	21 (24%)
11-17	-	-	-	-
Total	63 (73%)	19 (22%)	4 (5%)	86 (100%)

The number of cases predicted to be easy pre-operatively were 65 (76%) patients, out of which 60(70%) patients turned out to be easy and 5 (6%)

patients were found to have difficult laparoscopic cholecystectomy. The number of cases predicted to be difficult pre-operatively were 21 (24%) patients, out of which 3(3%) patients turned out to be easy, 14(16%) patients turned to be difficult and 4 (5%) patients were found to have very difficult laparoscopic cholecystectomy.

**Discussion**

Laparoscopic cholecystectomy (LC) is recognized as gold standard for treatment of gallstone disease. Erich Muhe of Boblingen, Germany performed the first endoscopic cholecystectomy in 1985. Thereafter, surgeons in France and United States coupled a CCD video camera with a laparoscope to allow entire team to view the operative field. The advantages of LC are faster achievement of bowel function, less postoperative pain, good cosmesis, shorter hospital stay, earlier return to routine activities and overall economically convenient [6].

Complication rate in LC is around 2-6%, which has tremendously reduced due to recent advances in the equipment and the available expert surgeons [7]. Difficult predictive risk factors for difficult laparoscopic cholecystectomy were analysed in our study of 86 cases. Age, sex, BMI, prior history of acute cholecystitis, abdominal scar, palpable GB, TLC count, ultrasonographic findings like thickened GB, distended or contracted GB, pericholecystic collection, impacted stone and altered hepatic echotexture were the risk factors included in the study.

In Lee et al. and Hussain A., old age (>50 years) has been found to be a significant risk factor for difficult laparoscopic cholecystectomy [8,9]. High rate of conversion to open cholecystectomy has been found in old age. In our study, old age was not significant risk factor (p=0.526) probably because of small sample size of study population and also there was unequal distribution of patients in different age groups.

Male sex has been associated with difficult LC in studies done worldwide [10]. In Agarwal et al., there was no statistical difference in total time taken for

LC between the two sexes<sup>[11]</sup>. In N. Gupta et al. gender did not affect the procedure of laparoscopic cholecystectomy ( $p=0.265$ )<sup>[12]</sup>. In our study, sex has not been found to be significant risk factor ( $p=0.920$ ).

Obesity is a risk factor considered for difficult laparoscopic cholecystectomy<sup>[13]</sup>. However certain studies claim that BMI does not have any effect on difficult laparoscopic cholecystectomy. Nikhil Gupta et al. showed that BMI did not have significant effect on LC and outcome were same in easy and difficult cases ( $p=0.454$ ). Acharya A. et al. evaluated that  $BMI > 25 \text{ kg/m}^2$  was responsible for conversion to open cholecystectomy in which 1 score was given<sup>[14]</sup>. In Randhawa et al. study  $BMI > 27.5 \text{ kg/m}^2$  was related to difficult LC in which 2 score was given. In our study BMI did not affect the outcome where 1 score was given to  $BMI > 30 \text{ kg/m}^2$  ( $p=0.57$ ).

Prior attacks of acute cholecystitis carries more risk of difficult LC due to dense adhesions at Calot's triangle and gall bladder fossa<sup>[15,16]</sup>. In N. Gupta et al. it was significant predictor for difficult laparoscopic cholecystectomy ( $p=0.031$ ). In Agarwal et al. there was strong significant correlation between previous history of hospitalization and difficult LC<sup>[17,18]</sup>. In our study, prior attacks of acute cholecystitis was significant predictor of difficult LC where 4 score was given ( $p=0.0002$ ).

Previous abdominal surgery may have caused adhesions between the viscera and omentum or abdominal wall. During the insertion of first port there may be chances of injury to these structures<sup>[19,20]</sup>. In N. Gupta et al. abdominal scar was not found to be significant confounding factor to difficult LC<sup>[21]</sup>. In our study, scars over abdomen was statistically not significant and did not contribute to difficult LC ( $p=0.149$ ).

In Randhawa et al. palpable gall bladder was given 1 score which was correlated with intraoperative difficulty which had a significant association<sup>[22]</sup>. N. Gupta et al. case series of 210 patients operated for laparoscopic cholecyste-

ctomy also showed significant association of palpable gall bladder with intraoperative difficulty ( $p=0.0037$ )<sup>[23]</sup>. In our study, there was significant association of palpable gall bladder and intraoperative difficulty ( $p=0.004$ ). Score 1 was given in our study also. Palpable gall bladder is found in patients with distended gall bladder due to empyema or mucocele. It is difficult to catch hold gall bladder which results in prolonged intraoperative time.

Total leucocyte count (TLC)  $> 12,000/\text{cm}^3$  has predictivity for difficult LC. Ravindra Nidoni et al. has shown TLC to be significant predictor of difficult LC<sup>[24]</sup>. In our study TLC count did not show any statistically significant association with difficult LC ( $p=1.00$ ). This may be due to as we did not operate any acute cholecystitis.

Gall bladder wall thickening detected on ultrasonography is associated with difficult dissection of GB from its bed<sup>[25]</sup>. It limits the extent of anatomical definition and makes the dissection of Calot's triangle and GB bed difficult. Majeski James and N. Gupta et al. found GB wall thickening to be associated with difficult LC<sup>[26]</sup>. But Carmody E et al. and Agarwal et al. did not find any significant association between them<sup>[27]</sup>. Randhawa et al. gave 2 score while Acharya A. gave 2 score to gall bladder wall thickness more than 4 mm and 3 mm respectively. In our study 2 score was given to GB wall thickening  $> 4$  mm which was associated with difficult LC ( $p=0.00005$ ).

Another important finding on ultrasonography is pericholecystic collection. In Ravindra Nidoni et al. and Agarwal et al. pericholecystic collection was significantly associated with difficult LC<sup>[28]</sup>. Our study also showed significant association of difficult LC with pericholecystic collection to which 1 score was given. There was no case with altered hepatic echotexture in our study.

At pre-operative score of 5, sensitivity and specificity of this scoring method was 95.24% and 73.63% respectively. In N. Gupta et al. sensitivity and specificity of the scoring method at pre-

operative score of 5 was 95.74% and 73.68% respectively<sup>[29]</sup>.

Conversion rate of difficult LC to open cholecystectomy has been reported to be 7- 35% in the literature<sup>[30]</sup>. In our study it was 4.6% due to dense adhesions between gall bladder and surrounding tissue.

### Conclusion

To conclude, Dash, Bhondave & Gadekar scoring system could be standard criteria to predict difficult laparoscopic cholecystectomies pre-operatively. Prior history of hospitalization, palpable gall bladder and ultrasonographic findings are important predictors of difficult laparoscopic cholecystectomies. Still it deserves a large scale study to verify the scoring method and establish its efficacy.

**Conflict of interest-** None

**Funding-** None.

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