

Pre-operative Prediction of Difficult Laparoscopic Cholecystectomy

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ABSTRACT

Introduction: Laparoscopic cholecystectomy (LC) is one of the most common operation performed. Though LC have become safer and easier at times it can be difficult. Difficult cases can result in prolonged operative time, bleeding, bile spillage, conversion to open technique and bile duct injury resulting in unplanned prolonged hospital stay, increase in estimated cost to the patients and for the surgeon it leads to increased stress during operation and time pressure to complete the operative list. Identification of difficult cases has potential advantages for surgeons, patients and their relatives. We aim to develop and validate a scoring system to predict difficult LC preoperatively.

Methods: Prospective study. History, physical examination, abdominal ultrasound and biochemical parameters were included to develop a scoring system. Hundred patients undergoing LC were included and preoperative scores were calculated preoperatively to predict difficult LC which was compared with operative assessment.

Results: Sensitivity and specificity of the preoperative scoring for difficult case was 53.8 % and 89.2 % respectively with PPV of 63.64 % and NPV of 84.62%. Only three parameters (history of acute cholecystitis, gall bladder wall thickness and contracted gall bladder) were statistically significant to predict difficult LC individually. Area under ROC curve was 0.779 (95 % CI, 0.657-0.883).

Conclusions: Preoperative scoring system can be used to predict difficult LC. Surgeons can plan operation based on predicted difficulty. Patients and relatives can be counselled preoperatively for the possibility of difficult operation, prolonged hospital stay and increased cost in predicted difficult case.

Keywords: *Difficult cholecystectomy; Laparoscopic cholecystectomy; Symptomatic cholelithiasis*

INTRODUCTION

Laparoscopic cholecystectomy (LC) is the gold standard treatment for symptomatic cholelithiasis.¹ LC is the most frequently performed operation at our institute. With evolution in biomedical technology and improved quality of instruments LC has become easier and safer operation to perform. However, difficult case results in prolonged operative time, bleeding, bile spillage, conversion and bile duct injury. This leads to unplanned

prolonged hospital stay and increase in estimated cost to the patients and increased stress to the surgeon and pressure to complete the operative list.

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Pre-operative prediction of difficult cases has potential advantages for the surgeons, patients and their relatives.

We conducted the study with an aim to develop and validate a scoring system to predict difficult laparoscopic cholecystectomy pre-operatively.

METHODS

A prospective observational cross sectional study was conducted at Department of Surgery, Kathmandu Medical College Teaching Hospital, Sinamangal, Kathmandu from 15 August 2014 to 31 December 2014. After an informed consent, 100 consecutive patients undergoing elective laparoscopic cholecystectomy for symptomatic

cholelithiasis performed by one of the three experienced surgeons in a single unit were included. Patients who had common bile duct stones, who had additional procedure to be done along with laparoscopic cholecystectomy, patients who had conversion or delay because of anesthetic complications and equipment failure, operations performed by trainee under supervision and those patients who were unwilling to give consent for the study were excluded from the study.

A scoring system was developed which is a modification of scoring system proposed by Randhawa and Pujahari² which included history, clinical and sonography findings. We added biochemical parameters to the scoring system, history of comorbid illness in history and contracted gallbladder in sonography scoring. Table 1

Table 1. Pre-operative Scoring system

History				Score	Maximum score	Clinical				Score	Maximum Score
Age in years	≤ 50	0	1	0	1	Body Mass index	≤ 25	0	2	0	2
	> 50	1					25-27.5	1			
Sex	Female	0	1	0	1		Abdominal Scar	No			
	Male	1				≥ 27.5		2			
History of Acute cholecystitis	No	0	4	0	1	Palpable Gall Bladder		No	0	1	0
	Yes	4					Yes	1			
Co-morbid illness				Biochemical							
Diabetes Mellitus	No	0	4	0	1	White Blood Cell Count Per cu mm	≤ 11000	0	1	0	1
	Yes	1					≥ 11000	1			
Chronic obstructive airway disease	No	0	0	0	1	Total Bilirubin	≤ 1.1	0	1	0	1
	Yes	1					≥ 1.1	1			
Congestive cardiac Failure	No	0	0	0	1	Alanine Transaminase	≤ 45	0	1	0	1
	Yes	1					≥ 45	2			
Other Systemic illness	No	0	0	0	1	Aspartate Transaminase	≤ 45	0	1	0	1
	Yes	1					≥ 45	1			
Sonography				Alkaline phosphatase							
Wall Thickness	Thin ≤ 4mm	0	2	0	1	Alkaline phosphatase	≤ 306	0	1	0	1
	Thick > 4mm	2					≥ 306	1			
Peri-cholecystic Collection	No	0	1	0	1						
	Yes	1									
Impacted stone at neck of Gall bladder	No	0	1	0	1						
	Yes	1									
Contracted Gall Bladder	No	0	1	0	1						
	Yes	1									
Total Maximum Score -25											

Patients admitted for elective LC who were included in the study were assessed and their history, clinical examination and investigations were reviewed. Based on these findings preoperative risk score was calculated on the basis of above scoring method (Table 1) a day prior to surgery. Patients with scores of 0 to 5 were predicted as easy, patients with scores 6 to 15 and more than 15 were predicted as difficult and very difficult cases respectively. Pre-operative scores and prediction was blinded from operating surgeon.

All the operations were performed by one of the three experienced surgeons of a single surgical unit having more than four years of experience in laparoscopic operations. Surgery was done using carbon dioxide pneumoperitoneum with 14 mm Hg pressure and using one 5 mm and two 10 mm ports. Time taken was noted from first port site incision till last port closure. Duration of surgery, bile/stone spillage, injury to duct/artery and conversion to open procedure were recorded. Per operative objective assessment was done as easy, difficult and very difficult by an independent observer based on the parameters as shown in Table 2.

EASY	Time taken ≤ 45 minutes No bile spillage No injury to duct / artery
DIFFICULT	Time taken 46-90 minutes Bile/stone spillage Injury to duct No conversion to open procedure
VERY DIFFICULT	Time > 120 minutes Conversion to open procedure

Per operative assessment was compared with pre-operative prediction based on the scores to calculate the sensitivity and specificity of the pre-operative scoring system.

All statistical analyses were performed using Statistical Package for the Social Science version 20. p value of <0.05 was accepted as statistically significant. Sensitivity and specificity was calculated for prediction of easy and difficult case using two by two tables. Area under ROC was used to find the predictive value of preoperative score for predicting the difficult case.

Ethical clearance was taken from the Research and Ethic committee of Kathmandu Medical College Teaching Hospital, Sinamangal, Kathmandu, Nepal.

Informed consent was taken from the patients.

RESULTS

Hundred patients were included in the study out of which 71 (71 %) were female and 29 (29 %) were male. Mean age was 42.15 years (14 - 78).

On the basis of preoperative scores 78 (78 %) patients were predicted to be easy, 22 (22 %) were predicted to be difficult and none of the cases were predicted to be very difficult. However, in per operative assessment 74 (74 %) were easy, 24 (24 %) were difficult and 2 (2 %) were very difficult.

Because there was no prediction of very difficult cases based on pre-operative scores and only 2 (2 %) cases were found to be very difficult, difficult and very difficult cases were combined for further analysis.

Table 3 shows the comparison of pre-operative prediction with per operative assessment of difficulty

For easy case, sensitivity and specificity of pre-operative prediction was 89.2 % and 53.8 % respectively whereas positive and negative predictive value was 84.62 % and 63.64 % respectively. Conversely for difficult case prediction, sensitivity and specificity of the scoring system was 53.8 % and 89.2 % respectively whereas negative and positive predictive value was 63.64 % and 84.62 % respectively.

Pre-operative Prediction	Per Operative Assessment		Total
	Easy (Percentage of pre-operative prediction)	Difficult (Percentage of pre-operative prediction)	
Easy	66 (84.61 %)	12 (15.38 %)	78
Difficult	8 (36.36 %)	14 (63.63 %)	22

Association of individual parameters with the prediction of difficult case was assessed using unadjusted binary logistic regression (Table 4). Of all the parameters only history of acute cholecystitis, gall bladder wall thickness and contracted gall bladder were statistically significant in prediction of difficult case.

Table 4. Association of individual parameter with difficult laparoscopic cholecystectomy. Result of Logistic Regression.

Parameters	Easy (Percentage within the parameter)	Difficult (Percentage within the parameter)	OR(95% CI)	P Value
Age				
≤ 50 years	52 (74.3 %)	18 (25.7 %)	.952 (.361 – 2.513)	.921
> 50 years	22 (73.3 %)	8 (26.7 %)		
Sex				
Female	56 (78.9 %)	15 (21.1 %)	.438 (.171 – 1.124)	.0086
Male	18 (62.1 %)	11 (37.9 %)		
History of Acute Cholecystitis				
Absent	66 (82.5 %)	14 (17.5 %)	.141 (0.049 - .410)	.000
Present	8 (40.0 %)	12 (60.0 %)		
Diabetes				
Absent	70 (74.5 %)	24(25.5 %)	.686 (.118 – 3.984)	.674
Present	4 (66.7 %)	2 (33.3 %)		
CCF				
Absent	73 (73.7 %)	26 (26.3 %)	1.00	1.00
Present	1 (100 %)	0(0.0 %)		
Other Illness				
Absent	58 (76.3 %)	18 (23.7 %)	.621 (.228 – 1.687)	.350
Present	16 (66.7 %)	8 (33.3 %)		
BMI				
≤ 25	35 (81.4 %)	8 (18.6 %)	.610 (.132 – 2.824)	.527
25 – 27.5	31 (67.4 %)	15 (32.6 %)		
> 27.5	8 (72.7 %)	3 (27.3 %)		
Abdominal Scar				
Absent	62 (74.7 %)	21 (25.3 %)	1.00	1.00
Infraumbilical	11 (68.8 %)	5 (31.2 %)		
Supraumbilical	1 (100.0 %)	0 (0.0 %)		
Palpable Gallbladder				
Absent	73 (74.5 %)	25 (25.5 %)	.342 (.21 -5.681)	.455
Present	1 (50.0 %)	1 (50.0 %)		
WBC				
≤ 11000 / cu mm	72 (74.5 %)	24 (25.0 %)	.333 (.044 – 2.497)	.285
> 11000 / cu mm	2 (50.0 %)	2 (50.0 %)		
Total Bilirubin				
≤ 1.1 mg %	67 (74.4 %)	23 (25.6 %)	.801 (.191 – 3.357)	.762
> 1.1 mg %	7 (70.0 %)	3 (30.0 %)		
AST				
≤ 45 IU/L	68 (77.3 %)	20 (22.7 %)	.294 (.085 1.013)	.0052
> 45 IU/L	6 (50.0 %)	6 (50.0 %)		
ALT				
≤ 45 IU/L	67 (76.1 %)	21 (23.9 %)	.439 (.126 – 1.523)	0.196
> 45 IU/L	7 (58.3 %)	5 (41.7 %)		
ALP				
≤ 45 IU/L	68 (73.1 %)	25 (26.9 %)	2.206 (.253 – 19.244)	.474
> 45 IU/L	6 (85.7 %)	1 (14.3 %)		
Gall Bladder Wall Thickness				
≤ 4 mm	72 (78.3 %)	20 (21.7 %)	.093 (.17 - .494)	.005
> 4 mm	2 (25.0 %)	6 (75.0 %)		
Pericholecystic fluid				
Absent	73 (73.7 %)	26 (26.3 %)	1.00	1.00
Present	1 (100.0 %)	0 (0.0 %)		
Impacted stone at neck				
Absent	61 (75.3 %)	20 (24.7 %)	.710 (.239 – 2.115)	.539
Present	13 (68.4 %)	6 (31.6 %)		
Contracted Gall bladder				
Absent	68 (79.1 %)	18 (20.9 %)	.199 (.061 - .646)	.007
Present	6 (42.9 %)	8 (57.1 %)		

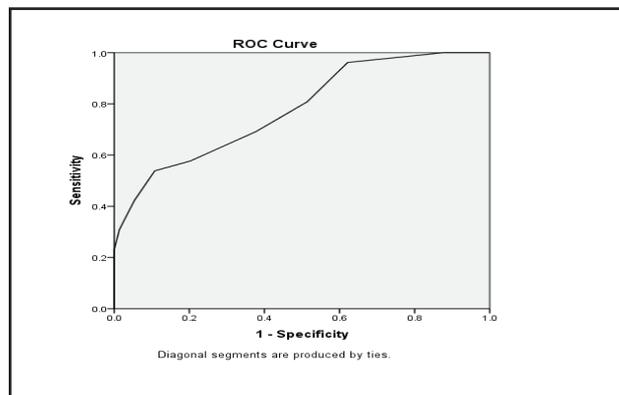


Figure 1. Area under curve was .779 ($p < .001$, 95% CI - .675 - .883) which is significant.

DISCUSSION

Pre-operative prediction of difficult laparoscopic cholecystectomy has potential advantages for surgeons, patients and their relatives.²⁻⁴ Surgeons may plan the operative list for the day based on the predicted difficult cases, to avoid time pressure if there is prolonged operative time in a difficult case and avoid unexpected conversion. This may help assign difficult case to an experienced surgeon with an equally experienced assistant. It is particularly applicable in places where most of the surgeons practice individually. Surgeon can seek for an experienced assistant or a senior colleague to accompany in a predicted difficult case. Hence the overall operative performance is not stressful to the surgeons and patients.

A difficult laparoscopic cholecystectomy can result in conversion to open procedure. Advantages of laparoscopic operation such as less pain, early recovery and return to work, less hospital stay and better cosmetics etc. are lost if operation is converted to open procedure. Conversion to open procedure is dependent on the patient's factors as well as experience of the surgeon and team. So the proper assignment of predicted difficult case to an experienced surgeon and team will definitely results in lesser conversion and higher benefits to such patients which has also been shown by Takegami et al.⁵ A predicted easy case can be operated as day care surgical case and can be offered a newer technique such as single incision laparoscopic surgery (SILS) and natural orifice transluminal endoscopic surgery (NOTES).⁴

Patients may be counseled preoperatively about the possible difficult operation, prolonged hospital stay and possibility of conversion beforehand so that they are mentally prepared for that. Patient's relatives can also

plan accordingly in a predicted difficult case keeping in mind the possibility of prolonged hospital stay and increased expenses.

Preoperative scoring can be an objective method to predict difficult case and could be better than the subjective guesswork. Various factors such as male sex, old age, upper abdominal tenderness, previous upper abdominal surgery, thick walled gall bladder and history of acute cholecystitis has been identified as a risk factors for conversion to open procedures.⁶⁻⁸ Similarly, elevated white blood cell counts, deranged liver function tests, low albumin level, co morbid illness such as diabetes mellitus, chronic obstructive airway disease, congestive cardiac failure and myocardial infarction has also attributed to difficult cholecystectomy.⁸⁻¹⁰

Randhawa and Pujahari have described a scoring system to predict a difficult laparoscopic cholecystectomy.² They have developed a scoring system based on history, clinical examination and sonological findings to predict difficult cases with a total score of 15. The pre-operative score from 0 – 5, 6 – 10 and more than 10 predicted easy, difficult and very difficult cases respectively. The prediction was true in 88.8 % and 92 % in easy and difficult cases respectively with a sensitivity and specificity of 75% and 90.24 % respectively. The same scoring system was validated in a prospective study and found that the sensitivity and specificity of the scoring system was 95.74 % and 73.68 % respectively with positive predictive value for easy and difficult cases of 90 % and 88 % respectively.³

We modified the scoring system proposed by Randhawa and Pujahari by adding biochemical parameters, history of co-morbid illness and contracted gall bladder to the scoring system because these factors are also known to be responsible for difficult cholecystectomy.^{6,7,9} The parameters used in the scoring system does not incur any additional cost to the patient because these are based on history, physical examination and routinely done investigations for laparoscopic cholecystectomy.

For an easy case this scoring system had sensitivity of 89.2 % which was comparable to 88.8 % of Randhawa et al² and 95.74 % of Gupta et al.³ However for a difficult case the sensitivity of the scoring system in this study was 53.8 % with specificity of 89.2 % which was less than above two studies (92 % and 90.24%).^{2,3} Area under curve for the prediction of the scoring system was .779 which is comparable to .81 and .86 in above two studies.^{2,3} Logistic regression showed that only three parameters (history of acute cholecystitis, gall bladder wall thickness and contracted gall bladder) were individually statistically significantly associated with prediction of difficult laparoscopic cholecystectomy.

However, the scoring methods which incorporates all the known factors for difficult cholecystectomy does provide a definite, objective and reliable prediction of difficult case.

Recently a study suggested a risk score based on the history, physical examination and ultrasound of abdomen. ⁴ They found that the level of difficulty correlated with the subjective perception of difficulty by operating surgeon ($p < .0001$, $r = .915$), length of procedure ($p < .01$, $r = .757$). They used subjective perception of difficulty and operative time for assessing per-operative difficulty. However, in our study we used objective parameters to assess the difficulty which was adapted and modified from the system suggested by Randhawa and Pujahari. ²

This is a single center study and the results may not be generalized. Results need to be validated in different centers and set up. Although the operating surgeons were blinded from the pre-operative score and prediction, performance bias cannot be ruled out.

CONCLUSIONS

Pre-operative prediction of difficult laparoscopic cholecystectomy is possible using a scoring method with a reasonable accuracy. Pre-operative prediction does have potential advantages for the surgeons, patients and patient's relatives.

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