Original Research Article

Validation and Comparison of Pre-Operative and Intra-Operative Scoring Systems to Predict Difficult Cholecystectomy

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ABSTRACT

Background
Laparoscopic cholecystectomy represents a significant advancement in the treatment of gallbladder stones and cholecystitis, quickly becoming the preferred method over open surgery. It is one of the most frequently performed procedures by general surgeons. This technique offers benefits such as a shorter hospital stay, quicker recovery, improved cosmetic outcomes, and reduced morbidity. However, it is associated with a higher incidence of bile duct injuries compared to open surgery. A crucial part of planning for laparoscopic cholecystectomy involves assessing the potential difficulty of the procedure and the risk of needing to convert to open surgery.

Methods
This is a prospective observational study done at the Department of General Surgery, Krishna Rajendra Hospital, Mysore over a period of 1 year from September 2022 to September 2023 with a sample size of 100 patients with symptomatic gall stone disease, with informed consent. Pre-operative predictors were recorded, intra-operative predictors were recorded. Difficulty of the surgery was documented. Data was entered and analysed.

Results
100 subjects were studied, 78 females and 22 males. 80 of them had <6 preoperative score and 20 of them had 6-10 score. 30 subjects had <2 intraoperative score, 47 had 2-4 score, 19% had 5-7 score and 4% had >7 score. 61 surgeries were easy, 32 were difficult and 7 extremely difficult. There was 1 bile duct injury and 7 conversions to open. Fischer's exact test used for the two scores found a significant association between the score and the difficulty of laparoscopic cholecystectomy with 71.8% sensitivity and 70.5% specificity for preoperative and 79.5% sensitivity and 73.8% specificity for intraoperative scores (AUC 0.762 and 8.24

respectively p<0.05). History of acute cholecystitis, >4mm wall thickness and pericholecystic collection had significance in predicting difficult laparoscopic cholecystectomy.

Conclusions

Preoperative and intraoperative scores were both significant predictors for difficult surgery. History of acute cholecystitis, >4mm wall thickness and pericholecystic collection were preoperative factors that independently predicted difficult surgery. Application of these scores and noting the significant preoperative factors will aid appropriate planning and management of laparoscopic cholecystectomies.

Keywords: gallbladder surgery, cholelithiasis, cholecystitis, laparoscopic cholecystectomy, prediction of difficult laparoscopic cholecystectomy

INTRODUCTION

Gallstones affect 6% of men and 9% of women, with the majority being asymptomatic. For patients with incidental findings of asymptomatic gallstones, the annual risk of developing symptoms or complications is 1% to 2%. Treatment is generally not required for asymptomatic gallstones found in a normal gallbladder and biliary tree unless symptoms arise. However, about 20% of these asymptomatic gallstones may become symptomatic over a 15-year period. Complications that may develop from these gallstones include cholecystitis, cholangitis, choledocholithiasis, gallstone pancreatitis, and, rarely, cholangiocarcinoma[1].

Cholesterol gallstones primarily form due to excessive cholesterol secretion by liver cells and impaired emptying of the gallbladder. In contrast, pigmented gallstones are associated with conditions that increase heme turnover, leading to elevated bilirubin levels in bile. Excess bilirubin can crystallize and eventually form stones.

Symptoms and complications of cholelithiasis arise when stones obstruct the cystic duct, bile ducts, or both. Temporary obstruction of the cystic duct, such as when a stone lodges there before the duct dilates and the stone returns to the gallbladder, causes biliary pain, but this pain is usually short-lived and is referred to as cholelithiasis. Persistent obstruction of the cystic duct, particularly by a large stone lodged in the neck of the gallbladder, can lead to acute cholecystitis.

A gallstone that passes through the cystic duct and becomes lodged in the common bile duct can cause obstruction and jaundice, a condition known as choledocholithiasis. If stones pass through the cystic duct and common bile duct and become lodged at the ampulla of the distal bile duct, it may lead to acute gallstone pancreatitis due to the backup of fluid and increased pressure in the pancreatic ducts, which triggers in situ activation of pancreatic enzymes. Occasionally, large gallstones may perforate the gallbladder wall, creating a fistula between the gallbladder and the small or large bowel, which can result in bowel obstruction or ileus.

Laparoscopic cholecystectomy is a minimally invasive procedure used to remove a diseased gallbladder. Since the early 1990s, this technique has largely replaced open surgery for routine cholecystectomies. It is now indicated for the treatment of various conditions, including acute and chronic cholecystitis, symptomatic cholelithiasis, biliary dyskinesia, acalculous cholecystitis, gallstone pancreatitis, and gallbladder masses or polyps. Approximately 20 million people in the United States have gallstones. Of these people, there are approximately 300,000 cholecystectomies performed annually[2].

Several studies demonstrated the rate of bile duct injury between <1% during open cholecystectomy; Jatzko et al[3] 0.02% (700 cases), Thompson et al[4] 0%(384 cases), Roslyn et al[5] 0.018% (42,474 cases), cox et al[6] 0.1-0.2% (457 cases) compared to 1-2% in laparoscopic cholecystectomy; Smith et al[7] 0.5% (1009 cases; 3% conversion rate), Wilson et al[8] 1.1% (180 cases; 6% conversion rate), Radunovic et al [9] 1.89% (740 cases; 3.91%

conversion), Agarwal et al [10] 6% (100 cases; 6% conversion rate) and Triantafyllidis et al [11] 1.49% (1009 cases; 1.39% conversion rate)
Despite the low risk of bile duct injuries in laparoscopic cholecystectomy, it adds a great deal of economic burden and morbidity to the patient due to the sheer number of surgeries being performed.
Most of the time, the levels of difficulties are hard to assume. Risk stratification for difficult cholecystectomy can help the surgeon in scheduling the surgery, patient counselling, efficient management of hospital resources and possibly opt for bail out procedures or referral, not compromising patient safety.

AIM

This study aims to validate pre-operative and intra-operative scoring system for prediction of difficult laparoscopic cholecystectomy.

OBJECTIVES

to determine the accuracy and compare the accuracy of pre-operative and intra-operative scoring systems in prediction of difficult laparoscopic cholecystectomy

MATERIALS & METHODS

The present Prospective observational study was conducted in Krishnarajendra Hospital, Mysore Medical College, Mysore, Karnataka for a period of 1 year between September 2022 to September 2023 on 100 Patients undergoing laparoscopic cholecystectomy.

Inclusion criteria

Patients undergoing laparoscopic cholecystectomy for symptomatic gall bladder stones, acute and chronic cholecystitis.

Exclusion criteria

Patients undergoing cholecystectomy for proven/suspected malignant gallbladder disease and Patients below 18 years of age

Method of collection of data and statistical analysis

A thorough history taking and clinical examination was done. A preoperative score was given to each patient based on history examination and imaging reports. This preoperative score was introduced by Randhawa and Pujahari[12].

Table 1: preoperative score

Serial number	Pre operative parameter		score
1	Age	<50	0
		>50	1
2	Gender	Female	0
		Male	1
3	h/o cholecystitis	No	0
		yes	4
4	BMI	<25	0

		>25	1
5	h/o previous surgeries	Lower abdominal surgery	1
		Upper abdominal surgery	2
6	GB wall thickness	<4mm	0
		>4mm	2
7	Pericholecystic collection	no	0
		yes	1
8	Palpable GB	No	0
		Yes	1
9	Impacted stone at GB neck	no	0
		Yes	1

<6 easy
6-10 difficult
11-15 very difficult

Intraoperative parameters were noted and another score was provided to each patient. this intraoperative score was based on a similar one used by Sugrue et al.[13].

Table 2: intraoperative score

Serial number	Intra op parameter		score
1	Port access	No difficulty in port placement	0
		Difficult d/t obesity	1
		Difficult d/t adhesions	2
2	adhesions	none	0
		<50% of GB	2
		>50% of GB	3
3	GB size	Normal/contracted	0
		Distended, difficult to grasp/fibrosed	2
4	Pus or bile outside GB	No	0
		yes	3

<2 mild difficulty
2-4 moderate difficulty
5-7 severe difficulty
8-10 extreme difficulty

Outcome was categorized as easy, difficult and very difficult based on time taken for surgery and adverse events.

Table 3: outcome of surgery

Serial number	Parameter	grading
1	Time taken <60 min, no duct injury	Easy
2	Time taken 60-120 min, bile spill	Difficult
3	Time taken >120 min, conversion to open, duct injury	Very difficult

Correlation between the scores and outcome were calculated using Chi-Square tests. Sensitivity and specificity for predicting mortality was calculated using ROC curves.

RESULTS

Out of the 100 subjects, 78% of them were females and 22% of them were males, with a male to female ratio of 3.5:1.

67% of them were under the age of 50 years. 33% were 50 years or older. 61% subjects were under 25 BMI and 39% were 25 or higher.

Table 4: preoperative parameters

Ultrasound finding	Frequency	Percentage
Wall thickness		
< 4 mm	91	91.0
≥ 4 mm	9	9.0
Pericholecystic collection		
No	98	98.0
Yes	2	2.0
Impacted stone		
No	95	95.0
Yes	5	5.0
Total	**100**	**100**

It was noted that 31% patients had a previous history of acute cholecystitis. 42% of them had a previous lower abdominal surgery and 4% of them had an upper abdominal surgery.

9% subjects had >4mm gall bladder wall thickness, 2% of them had pericholecystic collection and 5% of them an impacted stone.

Preoperative score was <6 in 80% subjects, 6-10 in 20% of them. None of the subjects had a score >10.

8% subjects had adhesions and 13% had intraabdominal obesity resulting in difficult port access.

58% subjects had adhesions, with 37% covering less than half of its surface and 21% covering more than half its surface.

42% subjects had a distended gall bladder. 10% had pus or bile outside the gallbladder.

Table 5: intraoperative parameters

Intra-operative findings	Frequency	Percentage
Port access		
Easy	79	79.0
Difficult due to obesity	13	13.0
Difficult due to adhesions	8	8.0
Adhesions		
None	42	42.0
< 50%	37	37.0
≥ 50%	21	21.0
Gall bladder size		
Normal/contracted	58	58.0
Distended, difficult to grasp	42	42.0
Pus or bile outside GB		

No	90	90.0
Yes	10	10.0
Total	**100**	**100**

Intraoperative score was <2 in 30% subjects, 2-4 in 47% subjects, 5-7 in 19% subjects. Only 4% had a score >7.

Time taken from port entry to delivery of gall bladder was under 60 mins in 61% of the subjects, between 60 and 120 minutes in 35% and more than 120 minutes in 4% subjects. 28% subjects had bile or stone spillage during surgery.

61% of the surgeries were easy, 32% were difficult and 7% were extremely difficult. Bile duct was inadvertently injured in only 1% subjects and 7% of the cases had to be converted to open cholecystectomy.

Table 6: comparison of preoperative score and difficulty of surgery

Pre-operative difficulty score	**Difficulty of laparoscopic cholecystectomy**			**p-value**
	1	**2**	**3**	
Easy	58	22	0	<0.001
	95.1%	68.8%	0.0%	
Difficult	3	10	7	
	4.9%	31.3%	100.0%	
Total	**61**	**32**	**7**	
	100.0%	**100.0%**	**100.0%**	

Out of the 61 laparoscopic cholecystectomies that were easy, 95.1% (n=58) had preoperative score <6, 4.9% (n=3) had score 5-10

44.3% (n=27) had intraoperative score <2, 49.2% (n=30) had score 2-4, 6.6% (n=4) scores were 5-7 and none of them had intraoperative scores 8-10.

Table 7: comparison of intraoperative score and difficulty of surgery

Intra-operative difficulty score	**Difficulty of laparoscopic cholecystectomy**			**p-value**
	1	**2**	**3**	
Mild difficulty	27	3	0	<0.001
	44.3%	9.4%	0.0%	
Moderate difficulty	30	16	1	
	49.2%	50.0%	14.3%	
Severe difficulty	4	12	3	
	6.6%	37.5%	42.9%	
Extreme difficulty	0	1	3	
	0.0%	3.1%	42.9%	
Total	**61**	**32**	**7**	
	100.0%	**100.0%**	**100.0%**	

Out of the 32 laparoscopic cholecystectomies that were difficult, 68.8% (n=22) had preoperative score <6, 31.2% (n=10) had score 6-10.

9.4% (n=3) had intraoperative score <2, 50% (n=16) had score 2-4, 37.5% (n=12) had score 5-7, 3.1% (n=1) had score 8-10.

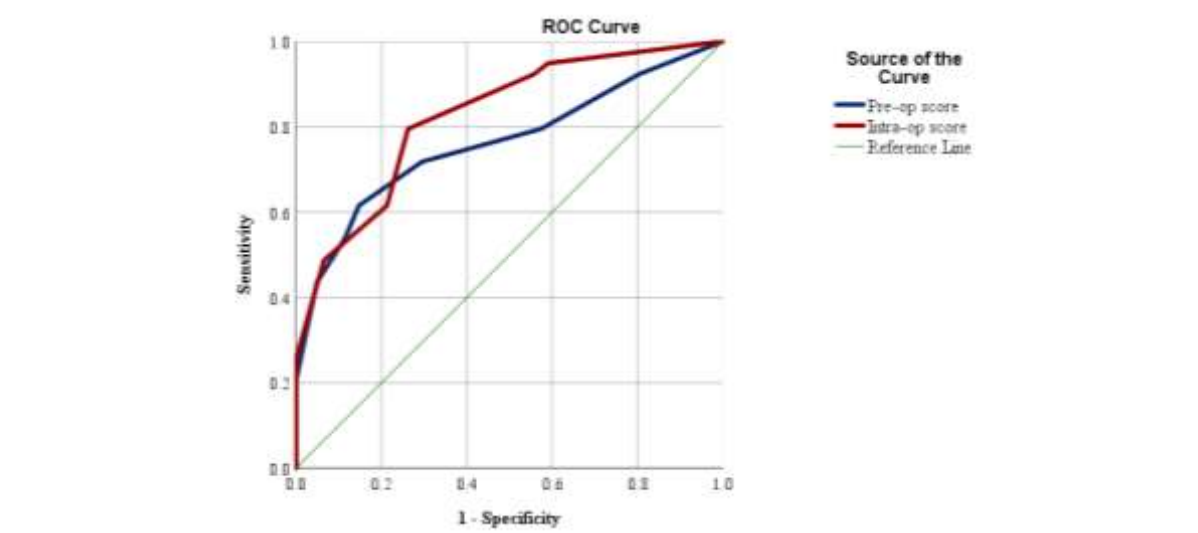
Out of the 7 surgeries that were extremely difficult, none of them had a preoperative score <6, 100% (n=7) had a score 5-10.

None of them had intraoperative score <2, 14.3% (n=1) had score 2-4, 41.9% (n=3) had score 5-7 and 41.9% (n=3) had score 8-10.

Fischer's exact test used for both preoperative and intraoperative scores found there is a significant association between the scores and difficulty of laparoscopic cholecystectomy.

The preoperative score had a sensitivity of 71.8% and specificity of 70.5% at a cut off score of 3 with AUC 0.762 (p<0.001).

The intraoperative score had a sensitivity of 79.5% and specificity of 73.8% at a cut off score of 3 with AUC 0.824 (p<0.001).



Graph 1: ROC curve; pre and intraoperative scores predicting difficulty of surgery

Table 8: sensitivity and specificity of pre and intraoperative scores

Parameter	Area under curve	95 % CI		p value
		Lower bound	Upper bound	
Pre-op score	0.762	0.659	0.866	<0.001
Intra-op score	0.824	0.741	0.907	<0.001
Co-ordinates of the curve				
Parameter	**Value**	**Sensitivity**		**Specificity**
Pre-op score	3.0	71.8%		70.5%
Intra-op score	3.0	79.5%		73.8%

DISCUSSION

There was a clear female preponderance among subjects undergoing laparoscopic cholecystectomy in our study, with a female to male ratio of 3.5:1. 67% subjects were under the age of 50. A study by Agarwal N et al. had a 4:1 ratio [14]. 39% subjects had a BMI over 25. Age, gender and BMI did not have a bearing on the difficulty of surgery in our study.

In our study, 42% subjects had a previous lower abdominal surgery and 4% had a previous upper abdominal surgery. Previous surgical history did not correlate with difficulty of surgery.

There were 31% subjects with previous history of acute cholecystitis, 7% of which had a very difficult surgery, 16% had a difficult surgery and 8% had an easy surgery. Previous acute cholecystitis was accurate in predicting difficulty of cholecystectomy.

9% subjects had wall thickness >4mm on USG, 2% had a very difficult surgery, 5% had difficult surgery and 2% had easy surgery. Wall thickness >4mm was accurate in predicting difficulty of surgery.

2% patients had pericholecystic collection, 1% of which had a very difficult surgery and another 1% had easy surgery. It was a good indicator in predicting difficult surgery.

Study by, also found acute cholecystitis, >4mm wall thickness and pericholecystic collection to be significant factors for predicting difficulty of laparoscopic cholecystitis [15]. Intraoperatively, 28% subjects had bile or stone spillage, rate or bile duct injury was 1% and conversion rate was 4%. Mortality rate was 0%. Several studies have demonstrated similar complication rates [7-11].

Both preoperative and intraoperative scores were significant factors for difficult surgery, with the intraoperative score having slightly higher sensitivity and specificity.

LIMITATIONS

- Limited sample size
- Other known factors that predict difficult surgery like pancreatitis, choledocholithiasis, cholangitis, ERCP and anomalous anatomy are not included in these scores.

CONCLUSION

Preoperative and intraoperative score were good indicators in prediction of difficult laparoscopic cholecystectomy.

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