

## Original Research Article

# Pre-operative predictors of difficult laparoscopic cholecystectomy: a comparative study between two scoring systems

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**Received:** 09 March 2022

**Revised:** 25 March 2022

**Accepted:** 28 March 2022

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### ABSTRACT

**Background:** Laparoscopic cholecystectomy is considered as the gold standard in treating symptomatic gall bladder disease. It has now become the most common operation performed by general surgeons. At times laparoscopy becomes difficult and may need conversion to open cholecystectomy. Many scoring systems are developed to predict the difficulty of laparoscopic cholecystectomy pre operatively. Our study aims to determine factors predicting difficult cholecystectomy and validate 2 scoring systems i.e., risk score for conversion from laparoscopic to open cholecystectomy (RSCLO) vs. new scoring system (NSS).

**Methods:** Patients presenting to Kempegowda institute of medical sciences from January 2014 to August 2015 with symptoms of gall stone disease were screened for cholelithiasis. 100 patients undergoing laparoscopic cholecystectomy were randomly selected. Every patient was given pre-operative score, after applying their symptoms to the scoring system and these scores were compared with the intraoperative findings and post-operative outcome. Thereby, calculating the sensitivity and specificity of the scoring systems.

**Results:** On univariate and multivariate logistic regression-BMI > 27.5 kg/m<sup>2</sup> (p=0.010), Palpable gallbladder (p=0.022), previous hospitalization for acute cholecystitis (p=0.15), Sonology: wall thickness > 4 mm (p=0.0015), presence of pericholecystic edema, were found statistically significant. RSCLO system was better in predicting easy cholecystectomy i.e., low risk for conversion, while NSS was better in predicting difficult, very difficult cholecystectomies {converted cases}, its sensitivity being 100%.

**Conclusions:** New scoring system can predict difficult cases reliably. Scoring patients preoperatively can decrease intra-op difficulties. Patients can pre-op be informed about possible risk of conversion to open cholecystectomy.

**Keywords:** Difficult laparoscopic cholecystectomy, Predictors, Scoring system

### INTRODUCTION

Gallstones are one of the common gastrointestinal illnesses requiring hospitalization, having a prevalence of 11% to 36% in autopsy reports. The optimal treatment for patients with symptomatic cholelithiasis is cholecystectomy. It forms the procedure of choice for majority of patients.<sup>1</sup> The postulated advantages of cholecystectomy performed laparoscopically are avoidance of large incision, shortened hospital stay and early return to work.

A few factors that play a role in the decision for conversion from laparoscopic to open surgery are, the patient condition, level of surgeon expertise and technical factors, amongst others. One of the leading reasons for conversion is inability to define anatomy and difficult dissection, followed by other complications like bleeding. The conversion rate for elective laparoscopic cholecystectomy is around 5%, whereas the conversion rate in the setting of acute cholecystitis may be as high as 30%. In 1985, the first endoscopic cholecystectomy was performed by Mühe of Böblingen, Germany. Despite

skeptical remarks from the academic surgical community, laparoscopic cholecystectomy (LC) was adopted rapidly around the world and has subsequently been recognized as the new "gold standard" for the treatment of gallstone disease.<sup>2</sup>

In 1992, the national institutes of health (NIH) consensus development conference stated that laparoscopic cholecystectomy provides a safe and effective treatment for most patients with symptomatic gallstones.<sup>3</sup>

The advantages of laparoscopic cholecystectomy over open cholecystectomy were immediately appreciated such as earlier return of bowel function, less postoperative pain, improved cosmesis, shorter length of hospital stay, earlier return to full activity, and decreased overall cost.<sup>4-8</sup>

**Table 1. RSCLO, Turkey.**

| Variables                                 | Variables | Coefficients |
|---|-----------|--------------|
| <b>Age (years)</b>                        | >60       | 5            |
|   | <60       | 0            |
| <b>Sex</b>                                | Male      | 11           |
|   | Female    | 0            |
| <b>Previous upper abdominal operation</b> | Present   | 8            |
|   | Absent    | 0            |
| <b>Abdominal tenderness</b>               | Present   | 9            |
|   | Absent    | 0            |
| <b>Gall bladder wall (sonography)</b>     | Thickened | 13           |
|   | Normal    | 0            |
| <b>Acute cholecystitis</b>                | Present   | 15           |
|   | Absent    | 0            |
|   | Constant  | -20          |

**Table 2: Command hospital, Bangalore-new scoring system.**

| Variables                           | Scores               | Total       |   |
|-------------------------------------|----------------------|-------------|---|
| <b>Age (years)</b>                  | <50 (0) >50 (1)      | 1           |   |
| <b>Sex</b>                          | Female (0) Male (1)  | 1           |   |
| <b>H/o previous hospitalization</b> | N (0) Y (4)          | 4           |   |
| <b>Clinical findings</b>            |                      |             |   |
| <b>BMI (Kg/m<sup>2</sup>)</b>       | <25 (0)              | 25-27.5 (1) | 2 |
|                                     |                      | >27.5 (2)   |   |
| <b>Abdominal scar</b>               | N (0) Y (1)          | 2           |   |
| <b>Palpable gallbladder</b>         | N (0) Y (1)          | 1           |   |
| <b>Abdominal ultrasound</b>         |                      |             |   |
| <b>Wall thickness (mm)</b>          | Thin (0) Thick>4 (2) | 2           |   |
| <b>Pericholecystic edema</b>        | N (0) Y (1)          | 1           |   |
| <b>Impacted stone</b>               | N (0) Y (1)          | 1           |   |

A score of 5 is easy, 6-10 is difficult and 11-15 is very difficult cholecystectomy.

Therefore, this study is aimed at determining the predictive factors for a difficult laparoscopic cholecystectomy by comparing and validating the two scoring systems: Risk score for conversion from laparoscopic cholecystectomy to open cholecystectomy {RSCLO} (Table 1). Ankara, turkey 2000, and "new scoring system"-command hospital Bangalore 2013 (Table 2).

Maximum scores are score changes between-20 and 41; the cutoff point for predicting the difficulty of the operation is-3. According to these results RSCLO scores, a score of <-3 will be taken as low risk for conversion and a score of -3 or higher were taken as high risk for conversion.

**Criteria for easy/ difficult cholecystectomy**

For an easy cholecystectomy the criteria are, time taken <60 min, no bile spillage, no injury to duct or artery.

For a difficult cholecystectomy the criteria are, Time taken 60-120 min, bile/stone spillage, injury to duct, artery and no conversion.

For a very difficult cholecystectomy the criteria are, Time taken >120 min and conversion to open.

**METHODS**

This prospective randomized study was conducted between January 2013 and July 2015 at Kempegowda institute of medical sciences hospital (Bangalore, India) after obtaining approval from the hospital's ethical committee. This study included 100 patients (75% female, 25% male) undergoing laparoscopic cholecystectomy. The standard laparoscopic procedure was followed. The surgery and port placement were done according to the American method using two 5-mm and two 10-mm standard ports. The time was recorded from the first port incision until the last port's closure. All intraoperative events were recorded. All cases received standard postoperative care and follow up. All patients were given a score according to their preoperative symptoms and sonography. The details were entered in a proforma and tabulated onto a unique master chart. Univariate analysis of chi-square test, Fischer exact test and odds ratio has been used to find the significant association of risk factors with pre-operative outcome. Scores were then given according to the scoring systems (Table 1 and 2). On the first post operative day, the preoperative score and the intra-op events were compared and conclusions were drawn. SPSS software version 15.0 was used for statistical analysis.

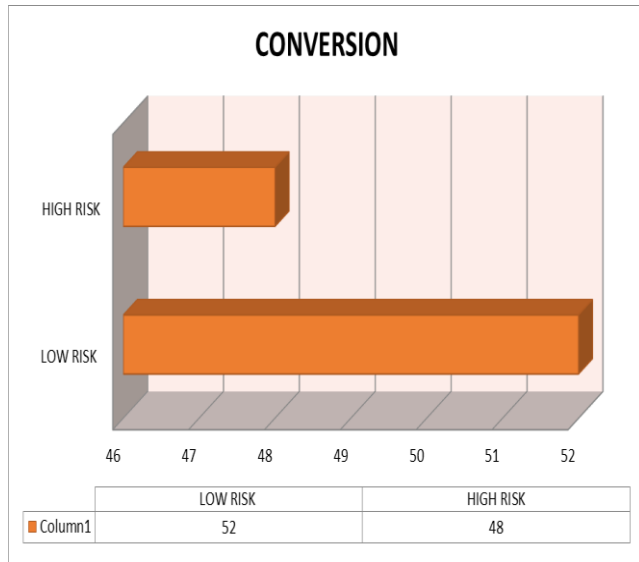
**RESULTS**

The mean age of patients was 46 years (age range: 18 to 76 years). The age group of population more than 50

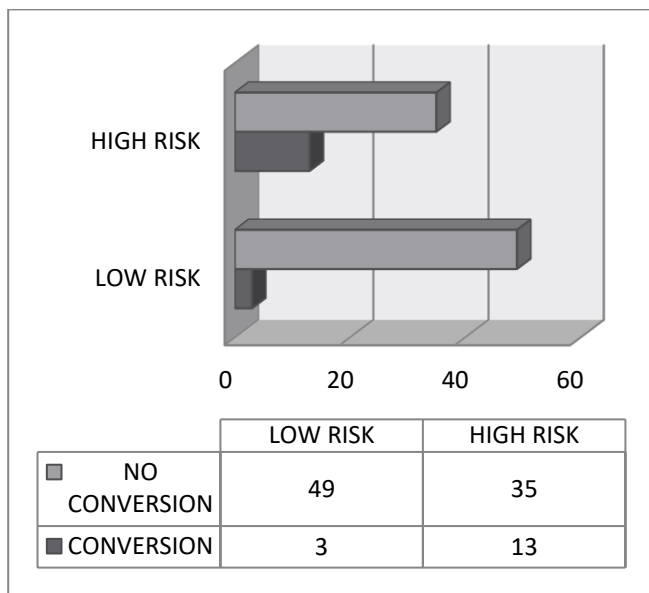
years had a difficult laparoscopic cholecystectomy which was found to be statistically significant with  $p=0.012$ .

**Gender distribution**

Out of 100 cases, were 75 female patients and 25 were male patients.



**Figure 1: Pre operative RSCLO.**



**Figure 2: RSCLO risk conversion.**

Figure 1 shows that out of 100 patients, 52 patients fell into low-risk category and 48 fell into high-risk category. After the surgery of the patients, the preoperative score and intra operative events were matched.

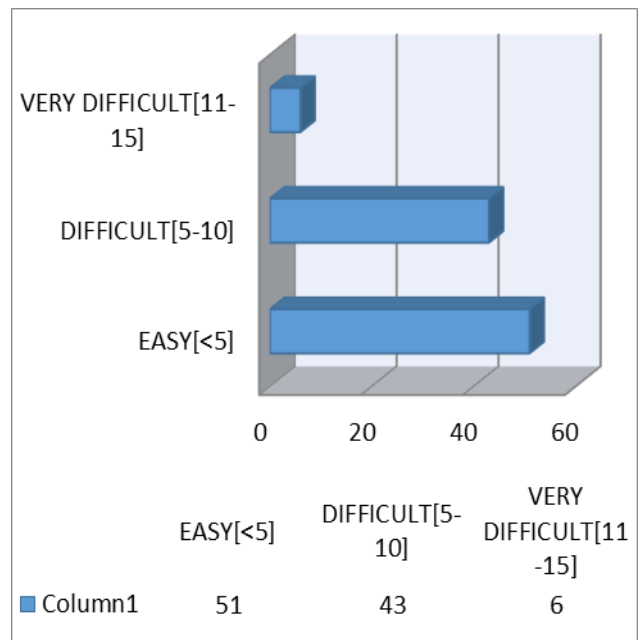
Figure 2 shows that out of 52 patients who fell in the low-risk category-49 patients underwent laparoscopic

cholecystectomy while 3 patients underwent conversion into open cholecystectomy.

Out of 48 patients who fell into high-risk category-35 patients underwent laparoscopic cholecystectomy while only 13 patients underwent conversion to open cholecystectomy.

Hence, this RSCLO scoring system is a better predictor of easy cholecystectomy i.e., low risk for conversion. The sensitivity of RSCLO in predicting conversion to open cholecystectomy was found to be 27%.

**Pre-operative scoring {new scoring system}**



**Figure 3: Preoperative scoring-new scoring system.**

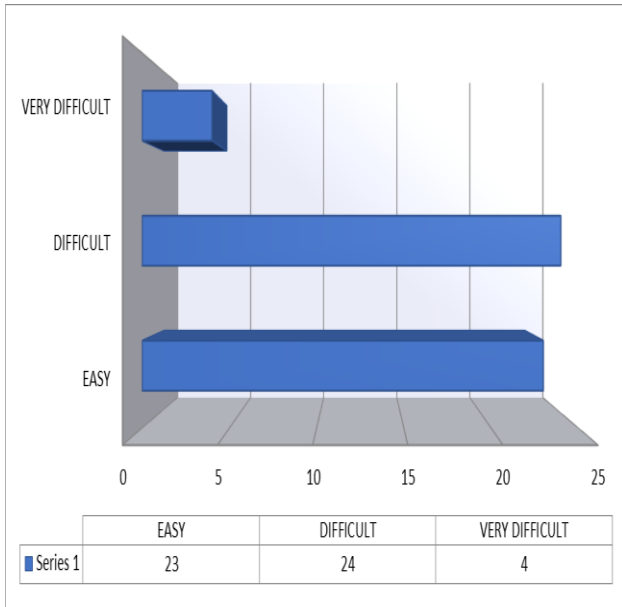
Figure 3 shows that in the preoperative new scoring system 51 were predicted to be easy cholecystectomy, 43 were predicted to be difficult cholecystectomy and 6 were predicted to be very difficult cholecystectomy.

**Outcome of predicted easy cholecystectomy-new scoring system**

Figure 4 shows the outcome of pre operatively predicted easy cholecystectomy.

Out of 51 cases which were predicted to have easy cholecystectomy, only 23 turned out to be easy cholecystectomy, while 24 cases turned out to be difficult cholecystectomy and 4 cases got converted to open cholecystectomy.

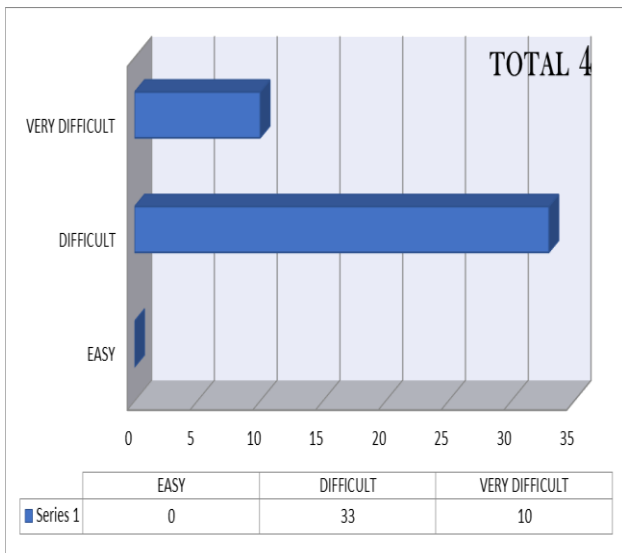
Hence, sensitivity of predicting easy cholecystectomy of new scoring system is around 69.8%.



**Figure 4: Easy cholecystectomy-new scoring system.**

**Outcome of predicted difficult cholecystectomy**

Figure 5 shows the outcome of predicted difficult cholecystectomy, out of 34 predicted difficult cholecystectomy none of the cases had an easy cholecystectomy, 33 cases had a difficult cholecystectomy and 10 cases underwent conversion to open cholecystectomy.

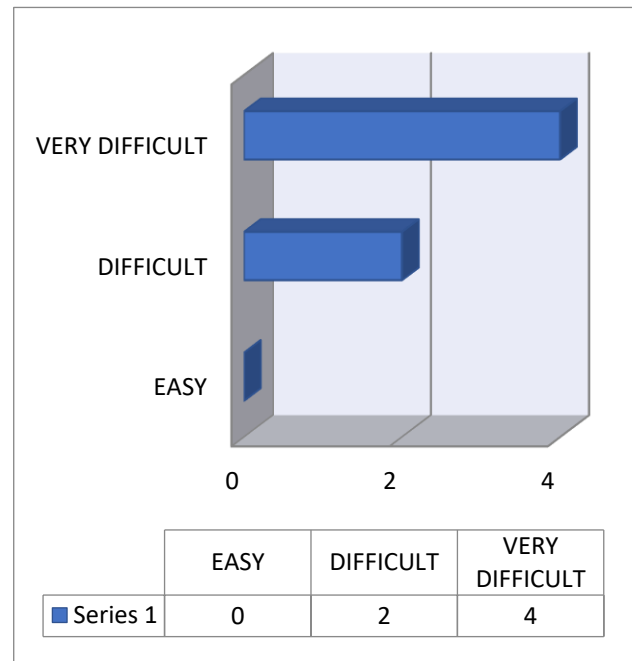


**Figure 5: Difficult cholecystectomy.**

**Outcome of predicted very difficult cholecystectomy**

Figure 6 shows the outcome of predicted very difficult cholecystectomy, out of predicted 6 cases to be very difficult-none had an easy cholecystectomy, 2 cases had a difficult cholecystectomy and 4 cases underwent conversion into open cholecystectomy.

The sensitivity of this scoring system in predicting a difficult + very difficult scoring system is 100%.



**Figure 6: Very difficult cholecystectomy.**

**Parameters which were found to be statistically significant**

*Body mass index*

The 61.9% patients of easy cholecystectomy had BMI <25, 28.5% had BMI between 25-27.5 and 9.5% patients had BMI >27.5. 30.1% of difficult cholecystectomy had BMI <25, 41.2% had BMI between 25-27.5 and 28.5% patients had BMI >27.5. 18.7% of very difficult cholecystectomy patients had BMI <25, 37.5% had BMI between 25-27.5 and 43.7% patients had BMI >27.5.

*Gender*

The 23.8%/5 male patients had easy cholecystectomy. The 22.2%/14 males had difficult cholecystectomy and 37.5%/6 male patients had very difficult cholecystectomy.

The 76.1%/16 female patients had easy cholecystectomy. The 77.7%/49 females had difficult cholecystectomy and 62.5%/10 female patients had very difficult cholecystectomy.

*History of hospitalisation*

Twenty-one patients of easy cholecystectomy did not have any previous hospitalization, whereas 14 patients of difficult cholecystectomy and 6 patients of very difficult cholecystectomy had previous history of hospitalization.

*History of surgery*

The 47.6% of easy cholecystectomy patients had previous of surgery, 50.7% of difficult cholecystectomy and 18.7% of very difficult cholecystectomy also had previous surgical history.

*Palpable gall bladder*

The 4.7%, 7.9% and 31.25% of easy, difficult and very difficult cholecystectomy had palpable gall bladders.

*History acute cholecystitis*

History of acute cholecystitis was seen in 39.6% of difficult cholecystectomy and 75.0% of very difficult cholecystectomy patients. However, no patients of easy cholecystectomy had any previous of acute cholecystitis.

*Gall bladder wall thickness*

The 47.61% and 81.25% of difficult and very difficult cholecystectomy patients had thickened gall bladder wall but no patients of easy cholecystectomy had increased gall bladder wall thickness.

*Peri cholecystic edema*

The 39.6% and 89.25% of patients of difficult and very difficult cholecystectomy showed presence of pericholecystic edema while none of the patients of easy cholecystectomy had pericholecystic edema.

*History of ERCP*

The 12.69% and 6.2% of patients of difficult and very difficult cholecystectomy had history of ERCP while none of the patients of easy cholecystectomy had ERCP done.

The following are the different anatomical variations in the 100 patients who underwent laparoscopic cholecystectomy.

*Anomalous gall bladder:* included mucocele GB, pyocele GB, dense adhesions making gall bladder completely invisible.

*Abnormal artery:* We found a case of abnormally dilated and tortuous artery apart from cystic artery similar to Moynihan’s hump in calot’s-in that cystic artery was clipped after meticulous dissection.

*Abnormal duct:* there were multiple anomalous ducts found in course of this study; most of which was a short cystic duct. One case presented with absent cystic duct for which subtotal cholecystectomy was done.

**Accuracy of both scoring systems in predicting conversion in our study**

Table 3 shows the statistical analysis and chi square test. The interpretation of our study results showed the prediction for conversion into open cholecystectomy was significant for conversion.

**Table 3: Accuracy of RSCLO.**

| Variables                 | Conversion |        | Total   |        |
|---------------------------|------------|--------|---------|--------|
|                           | Yes        | No     |         |        |
| RSCLO                     | >-3        | 13     | 35      | 48     |
|                           |            | 27.1%  | 72.9%   | 100.0% |
|                           |            | 81.3%  | 41.7%   | 48.0%  |
|                           | <-3        | 3      | 49      | 52     |
|                           |            | 5.8%   | 94.2%   | 100.0% |
|                           |            | 18.8%  | 58.3%   | 52.0%  |
| <b>Total</b>              | 16.0%      | 84.0%  | 100.0%  |        |
|                           | 100.0%     | 100.0% | 100.0%  |        |
| <b>Chi square tests</b>   | Value      |        | P value |        |
| <b>Pearson chi square</b> | 8.437      |        | 0.04    |        |

However, we found RSCLO to be a better predictor of easy cholecystectomy.

**Table 4: Accuracy of NSS.**

| Variables                 | Conversion |       | Total   |       |
|---------------------------|------------|-------|---------|-------|
|                           | Yes        | No    |         |       |
| NSS                       | <5         | 5     | 58      | 63    |
|                           |            | 31.3% | 69.0%   | 63.0% |
|                           | 6-10       | 7     | 24      | 31    |
|                           |            | 43.8% | 28.6%   | 31.0% |
|                           | 11-15      | 4     | 2       | 6     |
|                           |            | 25.0% | 2.4%    | 6.0%  |
| <b>Total</b>              | 16         | 84    | 100     |       |
| <b>Chi square tests</b>   | Value      |       | P value |       |
| <b>Pearson chi square</b> | 15.507     |       | <0.001  |       |

Table 4 represents that statistically this scoring system (NSS) is better predictor of a difficult cholecystectomy and converted cases, which correlated well with study.

**DISCUSSION**

The foremost purpose of this study was to find predictive factors of a difficult cholecystectomy and to validate pre-existing scoring systems. A comparison between an international scoring system RSCLO (risk score from conversion from laparoscopic to open cholecystectomy) and an Indian scoring system NSS (new scoring system) has been done.

Various risk factors for conversion have been obtained in this study such as age above 50 years was significant (p<0.012) possibly because of previous repeated attacks of cholecystitis as well as diabetes mellitus which is consistent in previous studies as well.<sup>9-11</sup>



Higher rates of conversion and mortality were observed in male patients. However, our findings were not significant ( $p=0.56$ ). But 6 out of 16 converted cases were male patients. The tendency of male patients to have cholecystitis of greater severity must remind surgeons of the need to inform patients about the higher conversion rates among them, in turn reduce the disappointment of a large laparotomy wound or prolonged recovery period. Hence, symptomatic male patients are positively counselled to undergo surgery.

A BMI of  $>27.5 \text{ kg/m}^2$  was found to be a significant predictor of difficult cholecystectomy ( $p<0.01$ ). Increased body mass index has been a main contributor of difficult laparoscopic cholecystectomy mainly contributing to increased operating time and technical difficulty like port insertion and closure.<sup>11,15,16</sup>

In the early period of laparoscopic cholecystectomy development, acute cholecystitis was considered an absolute contraindication for the procedure because of the increased technical difficulty and due to the inflammatory process. Therefore, the accepted policy has been to employ the classic schedule of medical treatment followed by delayed cholecystectomy to preserve the advantages of laparoscopic cholecystectomy in patients with acute cholecystitis.<sup>9-14</sup>

History of an acute attack of cholecystitis requiring hospitalisation has made surgery difficult in our study as they have higher risk of conversion to open, higher risk of CBD injury ( $p=0.015$ ). Our study found acute cholecystitis to be a significant factor for prediction for acute cholecystitis.<sup>9,13,16</sup> Although many studies conclude there is no difference in difficulty where surgery is performed within 72 hours of attack or an interval cholecystectomy.

Clinically palpable gallbladder was found to be a predictor of difficult cholecystectomy with a significant  $p$  value ( $p<0.01$ ). Palpable gall bladder in patients with right hypochondrium pain is likely to be mucocele or carcinoma gallbladder or peri ampullary carcinoma.

Upper abdominal surgery is reported to have high rate of conversion of 37.5% and attributed to dense adhesions around the gall bladder but in our study, it was not statistically significant ( $p=0.596$ ). With increasing experience on adhesiolysis and advanced laparoscopic surgery, conversion is less often seen. Three factors i.e., past history of upper abdominal surgery, past history of acute cholecystitis or acute pancreatitis and greater thickness of the GB wall, were associated with difficulty in defining the anatomy. Although in our study we didn't find it statistically significant.<sup>10,11,13,16-19</sup>

Sonography is the investigation of choice for gall bladder wall thickness and gall stones. Thick-walled GB is one of the predictors of conversion, significant factor ( $p<0.01$ ). Gall bladder wall thickness on pre-operative sonography

$>4 \text{ mm}$  signifies acute cholecystitis and hence, a predictor of difficult cholecystectomy  $p<0.001$ . We found gall bladder neck stones to be better predictors of difficulty. We consider sub-total cholecystectomy for gall bladder neck stones with frozen calot's triangle. The conversion rate was 16/100 (16%) due to anomalous ducts, pyocele gall bladder, mucocele gall bladder which were not detected on ultrasonography.<sup>10,11-22</sup>

Pericholecystic collections/edema was found to be statistically significant predictor of difficulty ( $p<0.01$ ). Pericholecystic edema-fluid around gall bladder indicates acute cholecystitis.<sup>17,20</sup>

Previous history of endoscopic procedures like ERCP is supposed to have a difficult laparoscopic cholecystectomy. Although in our study since sample size is low, we didn't find a statistical significance in predicting a difficult cholecystectomy. Literature says difficulty level increases in patients who undergone endoscopic sphincterotomy compared to patient who undergo plain ERCP.<sup>10,11</sup> Nine cases out of 100 underwent interval cholecystectomy after ERCP out of 9 cases, 7 were difficult and 1 case was very difficult needing conversion into open cholecystectomy.<sup>10,11</sup>

Others significant factors which positively correlated in predicting difficult cholecystectomy were history of uncontrolled diabetes mellitus, pre operative sonography showing contracted gall bladder and sonological murphy sign.<sup>10,11,19-23</sup>

Out of 16 cases which were converted to open cholecystectomy, 15 were diabetics with uncontrolled sugars with HbA1c  $>8.5$ .

Finally, RSCLO was better in predicting cases which had low risk for conversion for open cholecystectomy i.e., easy cholecystectomy. NSS was better in predicting difficult and very difficult cholecystectomy. The combined together {difficult +very difficult} sensitivity of NSS was found to be 100%.

## CONCLUSIONS

This study may be helpful to determine the risk of conversion of laparoscopic cholecystectomy to open cholecystectomy beforehand.

This study may allow patients to be better prepared for surgery and anticipate risk of conversion to open. Also, such prediction may allow a surgeon to be better prepared, to take extra precautions and reduce intra-operative complications and to convert to open cholecystectomy at an earlier stage.

The sensitivity in predicting difficult and very difficult cholecystectomy is 100%. The need for conversion to laparotomy is neither a failure nor a complication, but an attempt to avoid complications.

### Limitations

This study was conducted in a single centre with a small sample size. Hence, the study results derived may not represent the whole community. The study was conducted over a short time period. These were the limitations of this study.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

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**Cite this article as:** Santharaj S, Marahanumaiah S. Pre-operative predictors of difficult laparoscopic cholecystectomy: a comparative study between two scoring systems. Int Surg J 2022;9:960-6.