

Preoperative Prediction of Difficult Laparoscopic Cholecystectomy using Risk Score for Conversion from Laparoscopic to Open Cholecystectomy: An Observational Study

Bishal Acharya, Saujan Dulal, Bidhyanand Yadav, Shishir Aryal, Soni Kumari Sarraf, Aadesh Subedee, Iswar Chandra Ghimire, Kishor Kumar Tamrakar, Harish Chandra Neupane, Senjisha Lama Gole

Author(s) affiliation

Department of General Surgery,
Surgical Gastroenterology Unit,
Chitwan Medical College and
Teaching Hospital, Chitwan,
Bharatpur, Nepal

Corresponding author

Bishal Acharya, MBBS, MS
bishalacharya3@gmail.com

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ABSTRACT

Introduction

Laparoscopic cholecystectomy requires experts for the best result. Occasionally laparoscopic cholecystectomy becomes difficult, requiring conversion to open cholecystectomy and also endangers patients causing potential biliovascular and bowel injury. This study aims to predict difficult laparoscopic cholecystectomy using RSCLO scoring system.

Methods

A prospective observational study was conducted including 116 diagnosed case of cholelithiasis undergoing elective laparoscopic cholecystectomy from July 2023 to March 2024. Scores were given on history, physical examination and ultrasonographic findings on admission as per the RSCLO scoring system. Intraoperatively, difficult laparoscopic cholecystectomy criteria included: Time taken >60 min or bile/stone spillage or injury to bile duct/artery or conversion to open surgery. The end point of study was the end of surgery.

Results

The mean age was 46.23±15.36 years with female predominance of 69%. Preoperatively, 31.9% patients were predicted to have difficult cholecystectomy and intraoperatively 37.1% had difficulty (pearson chi-square 77.096, p value <0.001). Age >50 years, male gender and prior history of hospitalization because of gallbladder pathology were significantly associated with difficult laparoscopic cholecystectomy. There was no open conversion, no intraoperative biliovascular or bowel injury. Sensitivity and specificity of RSCLO score with cut off value of >6 was 94.6% and 90%, respectively, with AUROC 0.922.

Conclusion

RSCLO scoring system is useful for prediction of difficult laparoscopic cholecystectomy and patients with high risk can be counseled preoperatively about intraoperative difficulty.

Keywords

Cholelithiasis; difficult laparoscopic cholecystectomy; RSCLO score

INTRODUCTION

Gall stone disease is the most common biliary tract disease in Nepal affecting 10% to 15% of adults with an overall incidence of 11.76%.^{1,2} Over few years, laparoscopic cholecystectomy has become the gold standard in the treatment of gall bladder disease worldwide and is the most common minimally invasive procedure performed by general and gastrointestinal surgeons.^{3,4} Although the complications of laparoscopic cholecystectomy may seem small, ranging from 0.1% to 6%, the problem is actually serious and causes many consequences for patients.⁵

It is not easy to predict before surgery whether the cholecystectomy will be difficult or not. ,² Some preoperative variables help to predict complications of surgery for which Randhawa et al. proposed a scoring system "Risk Score for Conversion from Laparoscopic to Open cholecystectomy" (RSCLO) based on history, clinical examination and ultrasound findings for the prediction of difficult laparoscopic cholecystectomy.²

This study aims to predict difficult laparoscopic cholecystectomy preoperatively using RSCLO scoring system.

METHODS

This was a hospital based observational study conducted from July 2023 to March 2024 in department of General Surgery, Surgical Gastroenterology unit of Chitwan Medical College (CMC), Chitwan, Nepal with ethical clearance from Institutional review committee of CMC with reference number CMC-IRC/079/080-234. Consecutive sampling technique was used and all patients, 18 years or older, of any sex, admitted in CMC for elective laparoscopic cholecystectomy for cholelithiasis were considered. They were diagnosed by ultrasonography of abdomen and for inclusion, informed written consent was required. Experienced laparoscopic surgeon who has performed >100 independent laparoscopic cholecystectomies performed the surgery. Patients with common bile duct (CBD) stones, laparoscopic cholecystectomy converted to open due to equipment failure, laparoscopic cholecystectomy with CBD exploration, features of obstructive jaundice, deranged liver function test and carcinoma of gallbladder were excluded. Also, patients not willing for laparoscopic cholecystectomy and if laparoscopic cholecystectomy has been done by surgeon who has not met the eligible criteria were excluded.

Consecutive sampling technique was used. All patients planned for laparoscopic cholecystectomy were admitted and their demographic detail was documented in preformed proforma. After

preoperative workup, score was given one-day prior to surgery on admission as per the RSCLO scoring system.² Maximum score was 15 and score ≤ 5 was taken as easy and ≥ 6 was taken as difficult cholecystectomy. Intraoperatively, presence of any one of the following findings like, time taken >60 min, bile/stone spillage during gall bladder dissection, injury to bile duct/ artery and conversion to open surgery was considered difficult cholecystectomy.⁶

Pneumoperitoneum was created using carbondioxide gas with 10 mm Hg pressure. Standard two 5 mm and two 10 mm ports were created. Time from the first port site incision till the last port closure was documented. Relevant intraoperative event was recorded and all the cases were shifted to postoperative ward for postoperative care. The end point of survey was at the end of surgery.

SPSS statistical software version 20 was used for analysis of data. Categorical predictor variables were analyzed using χ^2 test. p value < 0.05 was considered statistically significant. ROC curve was plotted and sensitivity and specificity of RSCLO score at the time of admission to predict difficult laparoscopic cholecystectomy was calculated.

RESULTS

Total of 203 patients were included in the study out of which 116 patients met the inclusion criteria and data were available for final analysis. Eighty seven patients were excluded because of deranged LFT (23 patients), laparoscopic cholecystectomy with CBD exploration (7 patients), CBD stones who underwent ERCP followed by laparoscopic cholecystectomy (9 patients) and laparoscopic cholecystectomy done by surgeons not meeting the eligible criteria (48 patients). Mean age was 46.23 years (SD: 15.36) with female predominance of 69%. Maximum patients had BMI between 25-27.5 kg/m² (69.8%) (Table 1)

Table 1. Demographic features of the patients

| Characteristics | Number (%) |
|--------------------------|------------|
| Age (years) | |
| <50 | 67 (57.8) |
| >50 | 49 (42.2) |
| Sex | |
| Female | 80 (69) |
| Male | 36 (31) |
| BMI (kg/m ²) | |
| <25 | 28 (24.1) |
| 25-27.5 | 81 (69.8) |
| >27.5 | 7 (6) |

Table 2. Clinical characteristics of the patients

| Characteristics | Number (%) |
|--|------------|
| Prior h/o hospitalization due to gallbladder pathology | |
| No | 61 (52.6) |
| Yes | 55 (47.7) |
| Abdominal scar | |
| No | 99 (85.3) |
| Infraumbilical | 17 (14.7) |
| Supraumbilical | 0 (0) |
| Palpable gallbladder | |
| No | 114 (98.3) |
| Yes | 2 (1.7) |

History and clinical examination revealed 47.4% patients had previous hospital admission for gallbladder disease, 14.7% patients had undergone previous abdominal surgeries and 1.7% had palpable gallbladder. (Table 2)

Preoperative ultrasonographic evaluation of the patient showed that maximum patients has thin walled gall bladder without pericholecystic collection or impacted stones. (Table 3)

Preoperatively, 37 patients (31.9%) were expected to have difficult laparoscopic cholecystectomy with RSCLO score ≥ 6 . Mean preoperative score was 3.87.

Intraoperatively, 29.3% patients had duration of surgery more than sixty minutes and 22.4% patients had bile or stone spillage. Patients who had prolonged surgery along with bile or stone spillage accounted for 14.7% of the cases. There was no injury to the bile duct or artery and none of the cases had open conversion.

Preoperatively, thirty-seven (31.9%) patients were predicted to have difficult laparoscopic cholecystectomy and intraoperatively forty-three (37.1%) had difficulty (pearson chi-square 77.096, p value <0.001). Hence, RSCLO score helps to predict difficult laparoscopic cholecystectomies preoperatively. (Table 4)

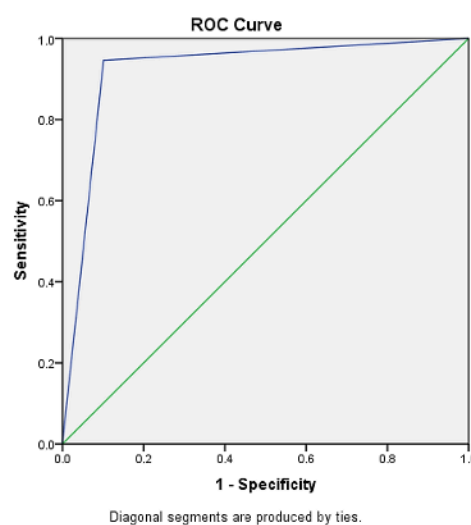
Preoperative variables were analysed separately

Table 3. Radiological features of gall bladder

| Characteristics | Number (%) |
|----------------------------|------------|
| Wall thickness | |
| Thin (<4mm) | 108 (93.1) |
| Thick (>4mm) | 8 (6.9) |
| Pericholecystic collection | |
| No | 114 (98.3) |
| Yes | 2 (1.7) |
| Impacted Stones | |
| No | 109 (94.0) |
| Yes | 7 (6.0) |

to predict difficult laparoscopic cholecystectomy. Age ≥ 50 years, male sex and prior history of hospitalization due to gallbladder pathology were significantly associated with difficult laparoscopic cholecystectomy. (Table 5)

The ROC curve shows that the RSCLO score has very good predicting ability of difficult laparoscopic cholecystectomy with AUC 0.922 (95% confidence interval, 0.865 to 0.980) with sensitivity of 94.6% and specificity of 90%.

**Figure 1.** ROC curve predicting difficulty in laparoscopic cholecystectomy**Table 4.** Comparison of preoperative and intraoperative difficulty in cholecystectomy

| Preoperative classification | Intraoperative findings | | Total | p value |
|-----------------------------|-------------------------|------------|------------|---------|
| | Difficult | Easy | | |
| Difficult | 35 | 2 | 37 (31.9%) | <0.001 |
| Easy | 8 | 71 | 79 (68.1%) | |
| Total | 43 (37.1%) | 73 (62.9%) | | |

Table 5. Association of independent variables with difficult laparoscopic cholecystectomy

| Characteristics | Group | Intraoperative findings | | p value |
|---|----------------|-------------------------|------|---------|
| | | Difficult | Easy | |
| Age (years) | <50 | 19 | 48 | 0.02 |
| | >50 | 24 | 25 | |
| Sex | Female | 22 | 53 | 0.02 |
| | Male | 21 | 20 | |
| Prior h/o hospitalization due to GB pathology | No | 7 | 54 | <0.001 |
| | Yes | 36 | 19 | |
| BMI (Kg/m ²) | <25 | 9 | 19 | 0.43 |
| | 25-27.5 | 30 | 31 | |
| | >27.5 | 4 | 3 | |
| Palpable GB | No | 41 | 73 | 0.14 |
| | Yes | 2 | 0 | |
| Abdominal scar | No | 36 | 63 | 0.79 |
| | Infraumbilical | 7 | 10 | |
| Wall thickness | <4mm | 38 | 70 | 0.12 |
| | >4mm | 5 | 3 | |
| Impacted stone | No | 41 | 68 | 0.48 |
| | Yes | 2 | 5 | |
| Pericholecystic collection | No | 42 | 72 | 0.61 |
| | Yes | 1 | 1 | |

DISCUSSION

In 1985, first laparoscopic cholecystectomy was performed by Fillipi, Mall and Roosma in animal model⁷ which was initially rejected by German Surgical Society, but now, has become the surgical procedure of choice for gallstone disease.⁸ Due to technological advancement and expertise, the complications of laparoscopic cholecystectomy has decreased these days, but difficulties can be encountered intraoperatively, for which preoperative prediction scores have come into existence. For patient safety and surgical planning, it is important to predict difficult laparoscopic cholecystectomy preoperatively, hence Randhawa et al. developed a scoring system and validated it in prediction of difficult laparoscopic cholecystectomy.²

In this study, mean age of the patients who underwent cholecystectomy was 46.23±15.36 years. B. Ghadban et al. reported the mean age 43.5 years which is similar to this study.⁹ In the present study, age ≥50 years was found to be a significant predictor of difficult laparoscopic cholecystectomy (p=0.02), which is similar to study conducted by Hussain A.¹⁰ Contrary to this, N. Gupta et al. did not find age as a significant predicting factor.¹¹

In the present study female accounted for 69%, which is similar to other studies stating more prevalence of gall stone disease in females.¹² As reported in multiple studies, male laparoscopic cholecystectomy is more difficult than female.^{10,13}

The reason being multifactorial; psychologically, male seek lesser medical advise than female and have more pain threshold, so present after the advancement of disease, also pathophysiologically female are more sensitive to inflammatory process and some hormonal and anatomic influence may also be present.¹³ In this study sex was found to be a significant predictor for difficult laparoscopic cholecystectomy, male cholecystectomy being difficult than female (p=0.02). However, other studies found no significant relationship between difficult laparoscopic cholecystectomy and sex which might be due to their small sample size.¹² Similar finding was shown by Gupta et al.¹¹

Prior history of hospitalization due to recurrent gall bladder pathology causes adhesion and fibrosis at and around calot's triangle and porta hepatis causing anatomical distortion.¹⁴ This causes difficulty during laparoscopic cholecystectomy resulting in significant bile duct injury and open conversion as a bailout procedure.¹⁴ Multiple prior hospitalization due to gallbladder pathology is a significant predictor of difficult laparoscopic cholecystectomy and one of the common risk factors for open conversion.¹⁵ Although there were no cases which had open conversion in this study, multiple prior hospital admission due to gall bladder pathology was associated with difficult laparoscopic cholecystectomy (p<0.001). Similar result was shown in study by Gupta et al.¹¹

Obesity has been associated with difficult laparoscopic cholecystectomy.¹⁶ However other studies have not found obesity as a significant predictor.^{11,17} In the present study BMI was not associated with difficult laparoscopic cholecystectomy ($p=0.43$)

Following prior abdominal surgery, there is adhesion of bowel or omentum at the scar site causing high risk of bowel injury during insertion of port and difficulty in pneumoperitoneum creation leading to higher chance of open conversion.¹⁰ In current study, there were 17 patients with prior abdominal surgery and none had supraumbilical scar. History of prior abdominal surgery was not associated with difficult laparoscopic cholecystectomy in this study ($p=0.79$) probably due to small sample size and no patients had supraumbilical scar of previous surgery. In study by N. Gupta et al. and A. Khetan et al., previous abdominal surgery was not associated with difficult laparoscopic cholecystectomy.^{11,12}

Palpable gallbladder has been associated with difficult laparoscopic cholecystectomy.^{2, 11} When there is mucocele or empyema of gall bladder, it is usually palpable and is difficult to hold by grasper during laparoscopic cholecystectomy and frequently needs aspiration causing leakage of gallbladder contents in intraperitoneal cavity, also, there is possibility of adhesion at Callot's triangle leading to difficulty in Callot's dissection.¹¹ In the present study 2 out of 116 cases had palpable gallbladder and both had difficult laparoscopic cholecystectomy, but, it was not statistically significant ($p=0.14$).

Thickened gallbladder wall has been shown to be significantly associated with difficult laparoscopic cholecystectomy.¹⁸ In the present study, 8 patients had thickened gall bladder wall but this was not associated with difficult laparoscopic cholecystectomy ($p=0.12$). E. Carmody et al. concluded that there is no ultrasonographic features differentiating unsuccessful, difficult, or uneventful laparoscopic cholecystectomies.¹⁹ Impacted stones and pericholecystic collection were not statistically significant predictors in this study which may be due to small population with impacted stones (7 patients) and pericholecystic collection (2 patients). Randhawa and Pujahari also did not find the statistical significance of impacted stones and pericholecystic collection in predicting difficult laparoscopic cholecystectomy.²

RSCLO score proposed by Randhawa and Pujahari was used in this study to predict difficult laparoscopic cholecystectomy.² ROC curve for cutoff value of ≥ 6 in RSCLO score was calculated which showed that the RSCLO score has very good predicting ability of difficult laparoscopic cholecystectomy with AUC 0.922 with sensitivity of 94.6% and specificity of 90%. Study by Randhawa and Pujahari found sensitivity and specificity of 75% and 90.24%

respectively with area under ROC curve 0.82.² Similarly, with cutoff score of 5, N. Gupta et al. found the sensitivity and specificity to be 95.74% and 73.68% respectively with AUROC 0.86.¹¹

In this study, we did not encounter any biliovascular injury and none had open conversion. Intraoperatively 29.3% patients had duration of surgery more than sixty minutes and 22.4% patients had bile or stone spillage. Bile and stone spillage was managed with normal saline irrigation, suction and laparoscopic forceps removal of stones as required.

Although the score is titled "Risk Score for Conversion from Laparoscopic to Open cholecystectomy", it is a difficulty prediction score and one of the parameters of difficult cholecystectomy is conversion to open cholecystectomy, which does not necessarily mean difficult cholecystectomy must have open conversion as in our study, no cases had open conversion.

This study was conducted in single institute within nine months duration and less sample size, so multicentric study with more sample size has to be conducted for approval. Surgeon's factor is one of the major bias that can be encountered intraoperatively, so to minimize that, experienced laparoscopic surgeon who has performed more than 100 independent laparoscopic cholecystectomies have performed the surgery. Operating surgeon's threshold for open conversion can be a potential bias. Instrument failure can prolong the surgical duration, so surgical duration only cannot justify the difficulty in laparoscopic cholecystectomy. To minimize this bias, every case with prolonged duration of surgery due to instrument failure can be excluded from the study.

CONCLUSION

RSCLO scoring system is useful tool for preoperative prediction of difficult laparoscopic cholecystectomy and patients with high risk can be counseled prior to the surgery about possibility of open conversion and intraoperative difficulty. We also recommend large multicentre study to validate this result.

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CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

AUTHOR CONTRIBUTIONS

Study concept and design: BA, HCN, JNY, KT, IC; Data collection, analysis and interpretation: BA, AS,

SK, SA, BY, SD, SG; Manuscript preparation: BA, HCN, JNY, KT, IC, AS, SK, SA, BY, SD, SG; All author read approved the final manuscript.

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