Section: General Surgery

Original Research Article

ASSESSMENT OF G 10 SCORING SYSTEM FOR THE PREDICTION OF OPERATIVE DIFFICULTIES DURING LAPAROSCOPIC CHOLECYSTECTOMY

Ritankar Sengupta[1], Rinki Das[2], Dibyendu Datta[3]

[1]*Associate Professor, Department of General Surgery, Deben Mahata Government Medical College, Purulia, West Bengal, India.*
[2]*Associate Professor, Department of General Surgery, IPGME&R, Kolkata, West Bengal, India.*
[3]*Assistant Professor, Department of Anatomy, College of Medicine and Sagore Dutta Hospital, West Bengal, India.*

Received *: 10/07/2025*
Received in revised form *: 29/08/2025*
Accepted *: 17/09/2025*

Corresponding Author:
Dr. Ritankar Sengupta,
Associate Professor, Department of General Surgery, Deben Mahata Government Medical College, Purulia, West Bengal, India.
Email: drritankarsengupta@gmail.com

DOI: 10.70034/ijmedph.2025.3.632

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 3458-3465

ABSTRACT

Background: Laparoscopic cholecystectomy is the gold standard for the management of gall stone disease. Although this is a very common procedure, it has its own complications which may lead to long term morbidities and potential mortality. In difficult situations conversion to open procedure or partial cholecystectomy is needed. A number of scoring systems have been evaluated to predict operative difficulties during laparoscopic cholecystectomy and its conversion to open one. Here, we aimed to assess intra-operative ten point G10 scoring system to predict operative difficulties during laparoscopic cholecystectomy.

Materials and Methods: All patients undergoing laparoscopic cholecystectomy were recruited in the study after fulfilment of inclusion and exclusion criteria. Intra-operative G10 scores were calculated and on the basis of the score laparoscopic cholecystectomy was considered to be easy (score 0-1), moderate (score 2-4), difficult (score 5-7) or extremely difficult (score 8-10). Statistical analyses were performed using IBM SPSS version 21 and Graphpad Prism version 5.

Results: 177 patients undergoing laparoscopic cholecystectomy were recruited in the study including 41 male and 136 female patients. The mean age of our patients was 40.15 ± 12.81 years. The mean G10 score was 3.84 ± 2.63 and the score increased significantly with increasing difficulties. There were 47 easy, 67 moderate, 41 difficult and 22 extremely difficult cases on the basis of G10 score. Overall open cholecystectomy was done in 23 (13%) cases, of which 4 in moderate, 11 in difficult and 8 in extremely difficult group. The mean G10 score of conversion group (6.48 ± 2.25) was significantly higher (p<0.0001) than the laparoscopy group (mean 3.44 ± 2.45). A G10 score of 5 or greater or difficult and extremely difficult group, completely buried gall bladder, inability to grasp without decompression, stone >1 cm impacted in Hartman's pouch, BMI>30, free bile or pus outside GB and fistula are the independent risk factors determining conversion to open procedure. A G10 score of 5 or greater was associated with other complications.

Conclusion: G10 scoring system is an important intra-operative tool to assess operative difficulties during laparoscopic cholecystectomy. A score of 5 or greater is usually associated with significant operative difficulties and intra-operative and post-operative complications. Intraoperative calculation of G10 score is an added precautionary measure for the surgeons to ensure safe cholecystectomy and timely conversion to the open technique.

Keywords: Cholecystitis, G10 score, laparoscopic cholecystectomy, open cholecystectomy, difficult cholecystectomy, Cholecystectomy complications

INTRODUCTION

Laparoscopic cholecystectomy is the gold standard for the management for symptomatic gall stone diseases and is one of the most commonly performed surgical interventions in the community.[1] It offers a significant advantage over open cholecystectomy for both the patients and for the surgeons, reduces the overall cost for the health system and benefits the society at large.[2-3] Although this is a very common procedure, it has its own complications, such as, issues related to pneumoperitoneum, jaundice due to stone slippage in the bile duct, thermal and non-thermal injuries to the cystic and/ or hepatic artery, and/ or common bile duct or hepatic duct, thermal injuries to the adjacent structures, chronic intra-abdominal abscesses related to stone spillage or stump cholecystitis and so on.[4-7] In difficult situations conversion to open procedure or partial cholecystectomy is needed.[8-9] Worldwide, the reported incidence of conversion to open cholecystectomy during a laparoscopic procedure is 3% to 10%.[10] This conversion of laparoscopic to open cholecystectomy could be a consequence of the presence of one or more risk factors, such as operation performed during acute cholecystitis, presence of dense adhesions, anatomic variations and anomalies, biliary pancreatitis, post ERCP status, previous upper abdominal surgery, intraoperative complications such as uncontrolled haemorrhage due to injury to the cystic artery and or the hepatic artery, injury to the common bile duct or hepatic duct, injury to surrounding structures, inability to grasp the gall bladder, large stone impacted at neck, fistulous communication with gall bladder with adjacent gut (stomach, duodenum or colon) and intraoperative technical issues.[11-13] This conversion is associated with various complications, such as, prolonged operation time, delayed extubation, increased risk of surgical site infection, respiratory infection, need for ICU support, extended hospital stays and psychological trauma to both to the patient and the surgical team.[14] Consequently, surgeon should have a very precise per operative decision regarding proper timing of conversion of laparoscopic surgery to open one to prevent these complications and to minimize operative and anaesthesia time.[15] A large number of studies and scoring systems have been evaluated to predict operative difficulties during laparoscopic cholecystectomy and its conversion to open one. But most of these lack operative findings which in many cases seem to be more effective in predicting operative difficulties, complications and conversion to open one. [16-18] Sugrue et al. in 2015 proposed a 10 point intra operative gallbladder assessment system (G10), which was later established by WSES (World Society of Emergency Surgery) for the prediction of intra operative difficulties during laparoscopic cholecystectomy and need for conversion to open technique.[19]

With this background we conducted a prospective observational study using this G10 scoring system during laparoscopic cholecystectomy to predict its usefulness in apprehending operative difficulties and envisage completeness of surgery laparoscopically.

The primary objectives of the study were intra-operative calculation of G10 scoring and its application to evaluate its effectiveness and reliability to predict operative difficulties to ensure safe cholecystectomy.

The secondary objectives of this study were to evaluate this score to correlate with conversion to open procedure, completeness of cholecystectomy, per operative iatrogenic injury, operating time, surgical site infection, and hospital stay.

MATERIALS AND METHODS

We conducted a prospective, non-randomized, observational study in the Department of General Surgery of Deben Mahata Government Medical College & Hospital (DMGMCH), Purulia, a tertiary care teaching hospital during a one-year period from 1st April 2023 to 31st March 2024. This institute serves the population of mainly two districts of West Bengal: Purulia and Bankura. Ethical approval was obtained from the Institutional Ethics Committee (IEC) of DMGMCH before the commencement of this study (vide Ref No.DMGMCH/PUR/IEC/01/01/2023, dated 27/01/2023).

Sample size calculation

In their study, Zainab Alkhalifah et al. reported an overall incidence of intraoperative complications during laparoscopic cholecystectomy as 10.8% [20]. On the basis of this data the estimated sample size of our study was calculated as 154 using the formula for proportions (i.e, Z pq/d^2), with Z set at a 95% confidence level, p representing the proportion of patients with intraoperative complications, q representing the proportion of patients without intraoperative complications and d denoting the relative precision taken as 5%. Considering a 15% nonresponse rate, the final sample size was adjusted to 177.

Inclusion Criteria

All patients between the ages of 12 to 80 years, who underwent laparoscopic cholecystectomy in our hospital during the study period were included in this study after obtaining valid informed consent from them.

Exclusion Criteria

All uncooperative patient or patients not giving proper consent, patients with concomitant common bile duct stones, suspected gall bladder mass, pregnancy and comorbidities limiting laparoscopic cholecystectomy were not included in the study.

Study Procedure

All eligible patients underwent preoperative ultrasonography of whole abdomen, followed by preoperative work up with complete haemogram,

blood biochemistry including liver function tests, serum amylase and lipase levels and renal function tests, electrocardiogram, Chest X ray PA view and 2D echocardiography (as indicated). Patients were selectively subjected to MRCP scan to rule out any CBD stones when indicated by presence of persistent jaundice or elevated liver enzyme levels. Patients with concomitant choledocholithiasis were excluded. Patients were subsequently examined for their fitness to undergo general anesthesia. Those deemed fit for surgery were treated with a standard four-port laparoscopic cholecystectomy. During the interventions, G10 cholecystitis severity score were calculated in each patient as per the below table:

- **G10 cholecystitis severity score**

Appearance	
Adhesion <50% of GB	1
Adhesion >50% but GB buried	2
Completely buried GB	3
Distension/Contraction	
Distended GB or Contracted shrilled GB	1
Inability to grasp without decompression	1
Stone>1cm impacted in Hartman's pouch	1
Access	
BMI>30	1
Adhesions from previous surgery	1
Sepsis & complications	
Free bile or pus outside GB	1
Fistula	1

Total score: 10
<2: Easy
2-4: Moderate
5-7: Difficult
8-10: Extremely difficult

Data were collected using a predesigned structured schedule and with the help of hospital records from the outpatient department (OPD), inpatient department (IPD) and surgical operation theatres.

The collected data included the demographic profile of the patients, co-morbidities, the number of stones in the gall bladder (single or multiple), the chronicity of the disease (i.e. whether it was acute or acute-on-chronic or chronic), presence of mucocele or empyema, operative difficulties in terms of G10 score, presence of stone spillage, complications, operative time, intraoperative blood loss, and completeness of surgery by laparoscopy. Reasons for conversion to open procedure were also noted. In the post-operative period the patients were assessed for any post-operative complications including bile leak, biliary fistula, intra-abdominal abscess formation or surgical site infection. ICU and hospital stays were also recorded. Recurrent attacks of biliary colic, with temporary occlusion of cystic duct causing inflammation and scarring of the neck of the gall bladder and cystic duct were considered chronic cholecystitis, whereas acute exacerbations of biliary colic and its progression to a more severe form of cholecystitis were considered as acute cholecystitis as per the Tokyo guideline 2018, and were treated accordingly [20-23].

The outcome parameters included operative difficulties on the basis of G10 score, proportion of patients in whom some sorts of complications were encountered and their association with the G10 score, the association between G10 score and the proportions of patients in whom laparoscopic procedures were converted to open ones or the incidents of partial cholecystectomy and correlation of this score with surgical site infection, ICU admission and prolonged hospital stays.

Statistical Analyses:

For statistical analyses, data were entered in Microsoft excel spreadsheet. Data were summarized as mean and standard deviation for numerical variables and frequency and proportions for categorical variables. All the collected data were then analyzed by SPSS (Statistical Package for Social Sciences), version 21 and Graphpad Prism version 5. T tests were done to compare the means of two groups, ANOVA tests and Tukey HSD post hoc tests were done to compare the means of multiple groups and Chi Square tests were done to assess the difference between two categorical variables. For each variant, *p*- value <0.05 was considered to be statistically significant. ROC curve was plotted to evaluate the correlation between G10 score and the chances for conversion to open cholecystectomy.

RESULTS

Table 1: Patient demographics

Age Group	Male	Female	Total
<20	3(33.33%)	6(66.67%)	9 (5.09%)
20-40	18(25.35%)	53(74.65%)	71(40.11%)
41-60	17(21%)	64(79%)	81(45.76%)
61-80	3(18.75%)	13(81.25%)	16(9.04%)
Total	41(23.16%)	136(76.84%)	177(100%)

In our study 177 patients were included, 41(23.16%) males and 136 (76.84%) females. The mean age of our patients was 40.15 ± 12.81 years. Patient demographics are mentioned in Table 1.

Of the 177 cases of cholecystitis, single stone was present in 34 (19.4%) cases and multiple stones were found in 143 (80.6%) cases. Mucocele was encountered in 27 (15.25%) cases and empyema in 12 (6.77%) cases. Acute cholecystitis was identified in 24 (13.8%) cases, whereas chronic cholecystitis was found in 153 (86.2%) cases.

Table 2: Distribution of patients as per the gender and G10-difficulty groups

G10 score	Male	Female	Total	p-value
Easy	7 (14.89%)	40 (85.11%)	47 (26.55%)	0.12
Moderate	10 (14.92%)	57 (85.08%)	67 (37.85%)	**0.04**
Difficult	15 (36.58%)	26 (63.42%)	41 (23.16%)	**0.02**
Extremely difficult	9 (40.90%)	13 (59.10%)	22 (12.43%)	**0.03**

In spite of the fact that cholecystectomy was indicated more frequently for the females, male patients had higher G10 scores and relatively more male patients were found to belong to the moderately difficult (p= 0.04), difficult (p= 0.02) and extremely difficult (p= 0.0348) groups. Furthermore, male patients had a higher mean G10 score (5.34± 2.83) than female patients (mean 3.38 ± 2.39) and this was statistically significant with p <0.0001. [Table 2, Table 3]

Table 3: Distribution of mean G10 scores as per the gender and G10-difficulty groups (*significant)

G10 score	Easy	Moderate	Difficult	Extremely difficult	Overall	Male	Female	p-value
Mean± SD	0.83 ± 0.38	3.13 ± 0.81	5.83 ±0.82	8.68 ± 0.65	3.84 ± 2.63	5.34 ± 2.83*	3.38 ± 2.39	**<0.0001**

Table 4: Distribution of mean operative time, per operative bleeding and hospital stay as per the G10- difficulty groups (* significant)

Parameters	Easy	Moderate	Difficult	Extremely difficult	Overall	p-value
Operative time (mins) Mean ± SD	40.11 ± 7.96 *	54.55 ± 12.39 *	78.05 ± 21.88 *	118.64 ± 29.28*	64.12 ± 29.78	**<0.01**
Per operative bleeding (ml) Mean ± SD	22.55 ± 4.36 *	52.09 ± 11.27	69.76 ± 54.48	125 ± 127.46 *	57.40 ± 60.04	**<0.0001**
Hospital stay(days) Mean ± SD	2.36 ± 0.48 *	3.43 ± 0.87	5.02 ± 1.63	12.82 ± 11.09 *	4.68 ± 5.06	**<0.002**

The operative time, peroperative hemorrhage and the duration of hospital stay are mentioned in table 4. In our study operative time, per operative haemorrhage and hospital stay positively correlated with higher G10 scores. [Table 4]

Table 5: Distribution of the conversion rates to open cholecystectomy as per the G10-difficulty groups

Open conversion	Number (%)	*p*-value
Easy	0 (0)	
Moderate	4 (5.97)	0.12
Difficult	11 (26.82)	**0.03**
Extremely difficult	8 (36.36)	**0.004**
Overall	23 (100)	

The commonest per operative difficulty encountered was inability to progress the laparoscopic procedure and hence to convert it into open one. The mean G10 score of laparoscopic group was 3.44± 2.45 and for the conversion group was 6.48 ± 2.25 and the difference was statistically significant (p <0.0001. The distribution of the conversion rates among the G10 difficulty groups are mentioned in Table 5.

Table 6: Distribution of conversions (lap vs open cholecystectomy) as per the G10 score

G10 score	Total no of patients	Operation completed laparoscopically	Operation converted to open procedure	Sensitivity	Specificity
0	8	8	0	0	0
1	39	39	0	0	0
2	18	17	1	100%	73.43%
3	22	21	1	50%	75.29%
4	27	25	2	50%	77.27%
5	18	13	5	55.56%	89.43%
6	12	9	3	25%	93.18%
7	11	8	3	20%	94.29%
8	9	7	2	11.76%	95.24%
9	11	7	4	19.05%	95.45%
10	2	0	2	8.69%	100%
Overall	177	154	23		

Table 7: Distribution of conversions (lap vs open cholecystectomy) as per the individual factors of G10 score

G10 score level	Total no of patients	Operation completed laparoscopically	Operation converted to open procedure	*p*-value
Adhesion <50% of GB	91	82	9	0.32
Adhesion >50% of GB	33	25	8	0.09
Completely buried GB	33	20	13	**0.0002**
Distended/Contracted shrilled GB	92	76	16	0.33
Inability to grasp without decompression	22	12	10	**0.0001**
Stone >1cm impacted in Hartman's pouch	26	16	10	**0.001**
BMI >30	6	3	3	**0.01**
Adhesions from previous surgery	7	5	2	0.24
Free bile or pus outside GB	14	7	7	**0.0002**
Fistula	7	4	3	**0.02**

Of all the parameters of G10 scoring system, completely buried gall bladder (p= 0.0002), inability to grasp without decompression (p=0.0001), stone >1 cm impacted in Hartman's pouch (p= 0.001), BMI>30 (p=0.01), free bile or pus outside gall bladder (p=0.0002), and presence of fistula (p= 0.02) were found to be statistically significant risk factors for predicting operative difficulties and conversion to open cholecystectomy during laparoscopic procedure. [Table 6, Table 7]

Table 8: Distribution of partial cholecystectomy and complications as per the individual factors of G10 score (* significant)

Parameters	Easy	Moderate	Difficult	Extremely difficult	Overall	p-value
Partial Cholecystectomy N (%)	0 (0)	0 (0)	**8 (19.51)***	**6 (27.27)***	14 (7.9)	**<0.03**
Complications						
GB perforation ± Stone spillage N (%)	2 (1.13)	1 (0.56)	**8 (19.51)***	**5 (22.72)***	16 (9.04)	**0.03**
Cystic artery injury N (%)	0 (0)	0 (0)	2 (1.13)	**3 (1.69)***	5 (2.82)	**0.01**
Bile duct injury/Biliary fistula N (%)	0 (0)	0 (0)	1 (0.06)	**2 (1.13) ***	3 (1.69)	**0.04**
Gut injury N (%)	0 (0)	0 (0)	0 (0)	1 (0.06)	1 (0.06)	0.07
Intra-abdominal abscess N (%)	0 (0)	0 (0)	2 (1.13)	**4 (2.26)***	6 (3.39)	**0.003**
Surgical site infection N (%)	2 (1.13)	4 (2.26)	2 (1.13)	1 (0.06)	9 (5.08)	>0.05

The second common per operative difficulty we faced in our study was inability to identify Calot's triangle and as a consequence partial cholecystectomies were undertaken [Table 8].

The other common complications included iatrogenic perforation of gall bladder during dissection with or without stone spillage, accidental injury to cystic artery, bile duct injury detected preoperatively or identified postoperatively as biliary fistula, accidental gut injury (in a case of undiagnosed cholecysto-colic fistula which was managed by open conversion and repair of transverse colon rent), and postoperative intraperitoneal abscesses or surgical site infections [Table 8]. Incidents of partial cholecystectomy, GB perforation, cystic duct injury, injuries to the bile duct and the occurrences of post cholecystectomy intraperitoneal abscesses were all associated with higher G10 scores [Table 8].

Altogether, we encountered 40 complications in our study of which 24 (60%) were in male patients and 16 (40%) in female patients reflecting a male preponderance (p=0.006) of complications. [Table 8] We also plotted the receiver operating characteristics (ROC) curve producing an area under the curve (AUC) of 0.817 with CI 0.739-0.896 and p=0.000 reflecting a very good correlation of G10 score predicting conversion to open cholecystectomy. [Figure 1]

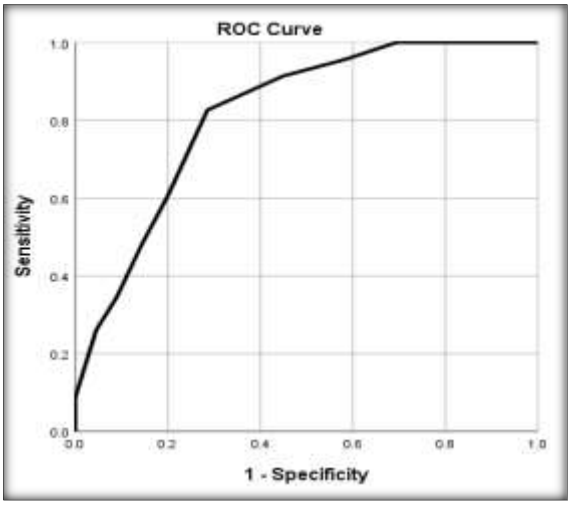

Figure 1: ROC curve with an AUC of 0. 817 (p=0.000) for the correlation of G10 score and laparoscopic to open conversion rates

DISCUSSION

Laparoscopic cholecystectomy is the gold standard for gall stone disease. A number of scoring systems have been described to predict a difficult cholecystectomy of which G10 score is a per-operative scoring system and is easy to calculate.

In this study 177 patients were recruited for assessment of G10 scoring system to predict operative difficulty during laparoscopic cholecystectomy. We observed relatively more male patients in the difficult (1:1.73; p= 0.02) group and in the extremely difficult (1:1.44; p=0.03) group. Also, male patients had higher G10 score (mean 5.34 ± 2.83) than female group (mean 3.38 ± 2.39) and this was found to be statistically significant (p <0.0001). Furthermore, male patients had overall more complications than the females. Adem Akcakaya et al. in their study in 2013 also documented that laparoscopic cholecystectomy in male patients is associated with statistically significant increased operative time (p <0.001) and higher conversion to open approach (p <0.05). [24]

Of the 177 patients recruited in the study, cholecystectomy by laparoscopic procedure could be achieved in 154 patients (87%), while 23 patients (13%) required conversion to the open procedure. This conversion rate increased with increasing operative difficulty (predicted by G10 score) with statistically significant higher conversion rate in difficult (p= 0.0279) and extremely difficult (p=0.0043) groups (Table 6).

Sugrue M et al. in 2019 documented a G10 score of 4.65 in the conversion group compared to the laparoscopy (2.98) group (p <0.0001). The overall conversion rate was 14%, however for patients with G10 score of 5 or greater, the conversion to open procedure was 33% with AUC 0.772 (CI 0.719-0.825). They also found completely buried gall bladder, stone >1 cm impacted in Hartman's pouch, free bile or pus outside GB and fistula are the independent risk factors determining conversion to open procedure. [19] Our study documented that 14 (7.9%) patients underwent partial cholecystectomy or bailout procedure. There was no case of coversion in the easy and moderate group with G10 score up to 4, but with a G10 score of 5 or greater the rate of partial cholecystectomy was 22.22% and it was statistically significant (p=0.002). [19]

Mazni Y et al. in 2020 published a study to determine the correlation between intraoperative G10 score and bailout procedure. They found that G10 score up to 2 is safe to perform CVS technique and they recommended to consider bailout procedure when a score of 3 or more. [27]

Our data has been supported by the study of Suman Baral et al. in 2024. In their study the overall mean G10 score was 2.32 ± 1.5 and this score increased with increase in the severity of disease with a mean value of 5.5 ± 0.51 in difficult cases (p =0.0001). The mean G10 score for the patients in whom the operation was completed laparoscopically was 2.1 ± 1.4 which was significantly lower than conversion group with a mean value of 3.71 ± 1.4 (p=0.0001). 18 patients with G10 score more than 5 were associated with a conversion rate of 27.7%, whereas, the overall conversion rate was 13.6%. They also found free bile or pus outside the gall bladder (p =0.02) and fistula (p=0.01) as significant risk factors for conversion. [25]

N. Shrestha published a study in 2022 to validate the G10 scoring system to predict the surgical difficulty during laparoscopic cholecystectomy in terms of conversion to open procedure. It was found that there was a significant positive correlation between G10 score and conversion to open procedure (p <0.001) and for a score of 5 or greater, surgeon should judiciously consider conversion to open procedure depending on the local constraints and personal abilities to complete the procedure laparoscopically. [26]

Additionally, we found that the incidences of iatrogenic intra-operative gall bladder perforation with or without spillage of stone and complications such as injury to cystic artery, bile duct or postoperative biliary fistula, intra-operative gut injury, and the frequencies of intra-abdominal abscess to be more common with higher G10 (5 or greater) scores (p ≤ 0.04).

CONCLUSION

The study demonstrated that G10 scoring system is a valid tool with good accuracy for the prediction of operative difficulties during laparoscopic cholecystectomy. Intra-operative difficulties and intra-operative and post-operative complications increase with increase in G10 score. A score of 5 or greater is associated with significant complications including conversion to open procedure and partial cholecystectomy. Seemingly, it is safe to proceed for laparoscopic cholecystectomy with a score less than 5 and surgeons should have low threshold for

conversion to open procedure with a score of 5 or more.

Ethical approval and consent to participate:

The entire study was conducted only after achieving ethical clearance from institutional ethics committee where the study was conducted and on availability of valid consent from all human participants or their legal guardian. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to publish

The authors give the consent that this manuscript can be published in print and online form.

Conflict of Interest

The authors have no conflict of interest with any third party.

Funding

There was no involvement of any third party while conducting this study. No grants were taken from any institute or organization in the research process of this study.

Authors' Contributions

Dr. Ritankar Sengupta: Concept, study design, operative interventions, data collection, data analyses, manuscript preparation and manuscript editing.

Dr. Rinki Das: Concept, study design, data analyses, manuscript editing.

Dr. Dibyendu Datta: Concept, manuscript editing.

REFERENCES

1. Schirmer BD, Edge SB, Dix J, Hyser MJ, Hanks JB, Jones RS. Laparoscopic cholecystectomy. Treatment of choice for symptomatic cholelithiasis. Ann Surg. 1991 Jun;213(6):665-76; discussion 677. doi: 10.1097/00000658-199106000-00018. PMID: 1828141; PMCID: PMC1358601.
2. Manzia TM, Quaranta C, Filingeri V, Toti L, Anselmo A, Tariciotti L et al. Feasibility and cost effectiveness of ambulatory laparoscopic cholecystectomy. A retrospective cohort study. Ann Med Surg (Lond). 2020 May 12;55:56-61. doi: 10.1016/j.amsu.2020.04.036. PMID: 32461804; PMCID: PMC7240280.
3. Lombardo S, Rosenberg JS, Kim J, Erdene S, Sergelen O, Nellermoe J et al. Cost and outcomes of open versus laparoscopic cholecystectomy in Mongolia. J Surg Res. 2018 Sep; 229:186-191. doi: 10.1016/j.jss.2018.03.036. Epub 2018 Apr 30. PMID: 29936988.
4. Brunt LM, Deziel DJ, Telem DA, Strasberg SM, Aggarwal R, Asbun H et al; Prevention of Bile Duct Injury Consensus Work Group. Safe cholecystectomy multi-society practice guideline and state-of-the-art consensus conference on prevention of bile duct injury during cholecystectomy. Surg Endosc. 2020 Jul;34(7):2827-2855. doi: 10.1007/s00464-020-07568-7. Epub 2020 May 12. PMID: 32399938.
5. Lee VS, Chari RS, Cucchiaro G, Meyers WC. Complications of laparoscopic cholecystectomy. Am J Surg. 1993 Apr;165(4):527-32. doi: 10.1016/s0002-9610(05)80955-9. PMID: 8480896.
6. Gavriilidis P, Catena F, de'Angelis G, de'Angelis N. Consequences of the spilled gallstones during laparoscopic cholecystectomy: a systematic review. World J Emerg Surg. 2022 Nov 2;17(1):57. doi: 10.1186/s13017-022-00456-6. PMID: 36324150; PMCID: PMC9632095.
7. Smith EB. Complications of laparoscopic cholecystectomy. J Natl Med Assoc. 1992 Oct;84(10):880-2. PMID: 1404466; PMCID: PMC2571793.
8. Matsumura M, Seyama Y, Takao M, Okinaga H, Ogawa R, Nemoto S et al. Body-first approach of laparoscopic cholecystectomy for minimizing vasculobiliary injury: Initial experience. Asian J Endosc Surg. 2023 Jul;16(3):362-367. doi: 10.1111/ases.13164. Epub 2023 Jan 17. PMID: 36650019.
9. Strasberg SM, Pucci MJ, Brunt LM, Deziel DJ. Subtotal Cholecystectomy-"Fenestrating" vs "Reconstituting" Subtypes and the Prevention of Bile Duct Injury: Definition of the Optimal Procedure in Difficult Operative Conditions. J Am Coll Surg. 2016 Jan;222(1):89-96. doi: 10.1016/j.jamcollsurg.2015.09.019. Epub 2015 Oct 9. PMID: 26521077.
10. Liu CL, Fan ST, Lai EC, Lo CM, Chu KM. Factors affecting conversion of laparoscopic cholecystectomy to open surgery. Arch Surg. 1996 Jan;131(1):98-101. doi: 10.1001/archsurg.1996.01430130100022. PMID: 8546587.
11. Rattner DW, Ferguson C, Warshaw AL. Factors associated with successful laparoscopic cholecystectomy for acute cholecystitis. Ann Surg. 1993 Mar;217(3):233-6. doi: 10.1097/00000658-199303000-00003. PMID: 8452401; PMCID: PMC1242774.
12. Tang B, Cuschieri A. Conversions during laparoscopic cholecystectomy: risk factors and effects on patient outcome. J Gastrointest Surg. 2006 Jul-Aug;10(7):1081-91. doi: 10.1016/j.gassur.2005.12.001. PMID: 16843880.
13. Reddick EJ, Olsen D, Spaw A, Baird D, Asbun H, O'Reilly M et al. Safe performance of difficult laparoscopic cholecystectomies. Am J Surg. 1991 Mar;161(3):377-81. doi: 10.1016/0002-9610(91)90601-9. PMID: 1825761.
14. Soper NJ. Laparoscopic cholecystectomy. Curr Probl Surg. 1991 Sep;28(9):581-655. doi: 10.1016/0011-3840(91)90041-m. PMID: 1831416.
15. Nassar AHM, Zanati HE, Ng HJ, Khan KS, Wood C. Open conversion in laparoscopic cholecystectomy and bile duct exploration: subspecialisation safely reduces the conversion rates. Surg Endosc. 2022 Jan;36(1):550-558. doi: 10.1007/s00464-021-08316-1. Epub 2021 Feb 2. PMID: 33528666; PMCID: PMC8741693.
16. Vaccari S, Cervellera M, Lauro A, Palazzini G, Cirocchi R, Gjata A et al. Laparoscopic cholecystectomy: which predicting factors of conversion? Two Italian center's studies. Minerva Chir. 2020 Jun;75(3):141-152. doi: 10.23736/S0026-4733.20.08228-0. Epub 2020 Mar 4. PMID: 32138473.
17. Wevers KP, van Westreenen HL, Patijn GA. Laparoscopic cholecystectomy in acute cholecystitis: C-reactive protein level combined with age predicts conversion. Surg Laparosc Endosc Percutan Tech. 2013 Apr;23(2):163-6. doi: 10.1097/SLE.0b013e31826d7fb0. PMID: 23579511.
18. Kim MS, Kwon HJ, Park HW, Park JY, Chung EC, Park HJ et al. Preoperative prediction model for conversion of laparoscopic to open cholecystectomy in patient with acute cholecystitis: based on clinical, laboratory, and CT parameters. J Comput Assist Tomogr. 2014 Sep-Oct;38(5):727-32. doi: 10.1097/RCT.0000000000000116. PMID: 24887577.
19. Sugrue M, Coccolini F, Bucholc M, Johnston A; Contributors from WSES. Intra-operative gallbladder scoring predicts conversion of laparoscopic to open cholecystectomy: a WSES prospective collaborative study. World J Emerg Surg. 2019 Mar 14;14:12. doi: 10.1186/s13017-019-0230-9. PMID: 30911325; PMCID: PMC6417130.
20. Yokoe M, Hata J, Takada T, Strasberg SM, Asbun HJ, Wakabayashi G et al. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholecystitis (with videos). J Hepatobiliary Pancreat Sci. 2018 Jan;25(1):41-54. doi: 10.1002/jhbp.515. Epub 2018 Jan 9. PMID: 29032636.
21. Okamoto K, Suzuki K, Takada T, Strasberg SM, Asbun HJ, Endo I et al. Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. J Hepatobiliary Pancreat Sci. 2018 Jan;25(1):55-72. doi: 10.1002/jhbp.516. Epub 2017 Dec 20. Erratum in: J Hepatobiliary Pancreat Sci. 2019 Nov;26(11):534. doi: 10.1002/jhbp.686. PMID: 29045062.

22. Wakabayashi G, Iwashita Y, Hibi T, Takada T, Strasberg SM, Asbun HJ et al. Tokyo Guidelines 2018: surgical management of acute cholecystitis: safe steps in laparoscopic cholecystectomy for acute cholecystitis (with videos). J Hepatobiliary Pancreat Sci. 2018 Jan;25(1):73-86. doi: 10.1002/jhbp.517. Epub 2018 Jan 10. PMID: 29095575.
23. AlKhalifah Z, Alzahrani A, Abdu S, Kabbarah A, Kamal O, Althoubaity F. Assessing incidence and risk factors of laparoscopic cholecystectomy complications in Jeddah: a retrospective study. Ann Med Surg (Lond). 2023 May 3;85(6):2749-2755. doi: 10.1097/MS9.0000000000000720. PMID: 37363534; PMCID: PMC10289568.
24. Akcakaya A, Okan I, Bas G, Sahin G, Sahin M. Does the Difficulty of Laparoscopic Cholecystectomy Differ Between Genders? Indian J Surg. 2015 Dec;77(Suppl 2):452-6. doi: 10.1007/s12262-013-0872-x. Epub 2013 Jan 31. PMID: 26730044; PMCID: PMC4692907.
25. Baral S, Thapa N, Babel S, Poudel S, Chhetri RK. Assessment of G10 Intraoperative Scoring System for Conversion in Patients Undergoing Laparoscopic Cholecystectomy: A Cross-Sectional Study From Nepal. Cureus. 2024 Mar 2;16(3):e55392. doi: 10.7759/cureus.55392. PMID: 38562316; PMCID: PMC10984243.
26. Shrestha N. Use of 10-point operative scoring system (G10 score) in predicting conversion of laparoscopic cholecystectomy to open. HPB. 2022; 24(Suppl1): S506. doi:/10.1016/j.hpb.2022.05.1088
27. Mazni, Yarman; Jeo, Wifanto Saditya; and -, Rony (2020) "External Validation Of 10 Points Intraoperative Gallbladder Scoring System (G10) In Laparoscopic Cholecystectomy at RSUPN dr. Cipto Mangunkusumo,"The New Ropanasuri Journal of Surgery: Vol. 5 : No. 2, Article 3. DOI: 10.7454/nrjs.v5i2.1068.