Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/14822
DOI URL: http://dx.doi.org/10.21474/IJAR01/14822

RESEARCH ARTICLE

VALIDATION OF G10 CLASSIFICATION IN LAPAROSCOPIC CHOLECYSTECTOMY FOR THE PREDICTION OF OPERATIVE DIFFICULTIES: AN OBSERVATIONAL STUDY

Arindam Acharyya, Chancal Kumar Dalai, Subikas Biswas, Arijit Das and Deblina Sarkar

Manuscript Info

Manuscript History
Received: 31 March 2022
Final Accepted: 30 April 2022
Published: May 2022

Abstract

Introduction: Laparoscopic cholecystectomy which is the gold standard of management of gall bladder pathologies has variability in terms of conversion to open procedure and operative difficulties according to the intraoperative findings.The G10 scoring system is used to predict the diificulty and outcome of surgery.

Aims And Objectives: The study aimed at intraoperative assessment of gall bladder and its anatomy and surgical difficulty in laparoscopic cholecystectomy. Objective is to correlate the following factors :conversion to open procedure, surgical complication, operating time, hospital stay and readmission.

Materials And Methods: All patients undergoing Laparoscopic cholecystectomy in College of Medicine and JNM Hospital, six months from the approval of Institutional Ethical Committee were used as samples.

Result: 13% of difficult and 75% of extremely difficult cases were converted to open.In difficult level, 4.3% had bile duct injury, pericholecystic abcess formation and readmission whereas in extreme difficult level, 25% had bile duct injury, abcess formation and readmission.

Conclusion: The more the G10 score, the more the difficulty level and there is more conversions and complications. Association of conversion,readmission and complications with degree of difficulty is statistically significant i.e. G10 classification remains a valid indicator for operative difficulties.

Introduction:-

Laparoscopic cholecystectomy remains the gold standard approach for Gall Bladder surgery, it is one of the commonest operations performed in both elective and emergency surgery.Surprisingly the procedure has variable outcomes and conversion rates.Though the procedure has numerous advantages over the open counterpart[1] (eg. Less pain, less hospital stay, early return to family and occupation, better cosmesis) it may be difficult to perform in a varied severity or even converted to open procedure owing to the anatomical and surgical factors encountered intraoperatively and these operative factors hold the key to outcome. Numerous publications had been there regarding difficulty in laparoscopic surgery but majority of them emphasized on the preoperative status and the imaging findings and a very few focused on the intraoperative anatomical and surgical parameters which is as important as the preoperative part.

Corresponding Author:- Arijit Das

Laparoscopic cholecystectomy not only is the cornerstone of management of biliary disease and cholecystitis but is one of the commonest operations in both elective and emergency surgery. It is essential therefore that simple metrics can be applied to understanding the course of surgery and its outcome. While completion of the operation laparoscopically is not a proven quality indicator, analysis of surgical performance needs greater scrutiny. Outcomes from cholecystectomy, particularly in terms of operative approaches and findings, use of intra-operative cholangiography, conversion from laparoscopic to open, length of surgery and morbidity, including readmission to hospital, vary. There are many variables in the management of cholecystitis, requiring a tailored approach due in part to the large heterogeneity of the patients and the actual state of the gallbladder at surgery. Interpreting the cause of and reducing this variability is a key to advancing outcomes following laparoscopic cholecystectomy.[2] Conversion to open cholecystectomy is itself not only occasionally a necessity but a safer option than proceeding laparoscopically. Surgeons, with far greater exposure to laparoscopic technique, may opt for different damage control procedures rather than conversion to open, including various forms of bailout techniques [3].

A great number of studies has been performed all through the last three decades to identify risk factors for conversion to open cholecystectomy and for complications and a numerous scoring systems, classifications and guidelines but most of the studies focused on the preoperative factors. The much significant Tokyo guidelines[5] and the AAST Scoring system[4],though are very much effective but lack robust inclusion of the operative findings. On the other hand, intraoperative findings are as important as, or sometimes, more important than the preoperative findings in predicting operative difficulties, complications and conversion and deserve to be very significant for operative outcome and patient safety.Back in 90s Nasser et all published his intraoperative grading system, in 2015 Surgue et al[9] developed a new operative scoring system and the most significant was 10 point gall bladder scoring system (G10) developed by ,again, Surgue et al[7] and established by WSES (World Society Of Emergency Surgery).

As surgeons practising in both elective and emergency general surgery, we are well aware that the operative findings and difficulty hold the key to outcome. A 10-point operative scoring system of cholecystitis severity has been reported to facilitate a potential benchmark for international analysis[6]. Although there are several scoring[13-16] and grading systems, G10 remains one of the most singnificant ones as it relies solely on intraoperative findings. This study undertook a prospective evaluation of a recently reported intra-operative G10 gallbladder scoring system to determine if it could predict the outcome of surgery, primarily the ability to complete the operation laparoscopically.

Aims And Objectives Of The Project:-

Aims: Intraoperative assessment of anatomical and surgical situation of gall bladder and prediction of surgical difficulties in laparoscopic cholesystectomy and ensuring safe cholecystectomy in a peripheral medical college.

Primary objective:
Application of G10 score in laparoscopic cholecystectomy and assessment of different variables for surgical situations of gall bladder surgery.

Secondary objective:
Using the G10 score correlating the intraoperative situations of gall bladder with the following factors and assessment of severity of cases:
1. conversion to open cholecystectomy,
2. surgical complication (eg: bile duct injury, bleeding, gut injury, etc)
3.operating time,
4. hospital stay
5. readmission

Material And Methods:-

Study design:- Observational and prospective study

Study population:
Patientswith Cholelithiasis admitted for Cholecystectomy,DEPT OF GENERAL SURGERY, COMJNMH,KALYANI,NADIA

Taget population:
Patientsattending Surgery Outpatient department, COMJNMH,KALYANI,NADIA

Inclusion criteria:-
a)Male and female both sexes
b)Age between 12 yrs and 80 yes
c)USG: No lump/ No CBD Stone
d)interval cholecystectomy

Exclusion criteria:-
a) Age <12years, >80years
b) Pregnency
c) USG: Lump around CB/CBD
d) CBD stone
e) Comorbid conditions limiting Laparoscopic Cholecystectomy

Study area-
Indoor patients of College of Medicine and JNMHospital,KalyaniNadia,W.B

Study period:-
Six months from the approval of Institutional Ethical Committee

Sample size and technique:
Universal Sampling. All patients undergoing Laparoscopic Cholecystectomy in Major OT Complex,COMJNMH once a week for Six months from the approval of Ethical Committee had collected as samples (i.e. Universal Sampling technique will be used). Here the sample size was 94.

Sample Size Justification:-
One study found that the incidence of laparoscopic cholecystetomyin patients was 7.2%. So, for this study p= 0.072. Thus the number of patients required for this study was 94.08 ~ 94 with power 87%.
The formula used for sample size calculation was as follows:-

$$n = 4pq / (L^2)$$

Where, n= required sample size,
p= 0.072 (as per the study by **Kanakala V et al**)[83],
q = 1 – p,
L = Loss % (Loss of information)

Calculation:-
Here p= 0.072,
q=1-p = 1- 0.072 = 0.928,
4pq = 4 x 0.072 x 0.928 = 0.2672
L^2 = 0.00284
L= 0.0532
Loss of information percentage = 5.32%
n = $4pq / (L^2)$ = 0.2672/0.00284 = 94.08 = 94

Study group:-
94 patients were taken.

Study Method:-

Patients with cholelithiasis admitted for cholecystectomy in Indoor of COMJNMH,Kalyani are enrolled.Patients were given verbal and written information about the trial. Asked if they wish to participate.Written Consent taken in his/her own language.A scrutiny with history taking, detailed examination, local examination, Investigation, preanaestheticcheckupsdone. Patients not fulfilling the inclusion criteria was excluded. Planned laparoscopic cholecystectomyexecuted in Main OT complex,COMJNMH.Intraopeartivefindings of laparoscopic cholecystectomy documented, captured as photographs and videos. Intraoperative Parameters in study (eg.operative time,

conversion, amount of bledding, bile duct injury, gut or vessel injury etc) to be analyzedduring procedure (And also after procedure, observing from the recorded videos of Laparoscopy).Postoperative complications , postoperative stay and readmission and its cause were documented

G10 Score In Laparoscopic Cholecystectomy:-

Parameters:-		**Score:**
Appearance	Adhesions<50%of GB	1
	Adhesions>50%of GB and GB buried	2
	GB completely buried	3
Distension/Contraction	Distension/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 and complications	Free bile/ pus outside GB	1
	Cholecystoenteric fistula	1

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

Statistical analysis:-

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. One-way analysis of variance (one-way ANOVA) was a technique used to compare means of three or more samples for numerical data (using the F distribution). A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate.

Explicit expressions that can be used to carry out various t-tests are given below. In each case, the formula for a test statistic that either exactly follows or closely approximates a t-distribution under the null hypothesis is given. Also, the appropriate degrees of freedom are given in each case. Each of these statistics can be used to carry out either a one-tailed test or a two-tailed test.Once a t value is determined, a p-value can be found using a table of values from Student's t-distribution. If the calculated p-value is below the threshold chosen for statistical significance (usually the 0.10, the 0.05, or 0.01 level), then the null hypothesis is rejected in favour of the alternative hypothesis.
p-value ≤ 0.05 was considered for statistically significant

Results:-

In our study, 6 (6.4%) patients were ≤30 years old, 19 (20.2%) patients were 31-40 years old, 43 (45.7%) patients were 41-50 years old, 19 (20.2%) patients were 51-60 years old and 7 (7.4%) patients were 61-70 years old. The mean Age (mean ± s.d.) of patients was 45.8936± 9.2637 yrs. Female population [65 (69.1%)] was higher than the male population [29 (30.9%)].

1. We found that, 26 (27.7%) patients had Easy Level, 37 (39.4%) patients had Moderate Level, 23 (24.5%) patients had Difficult Level and 8 (8.5%) patients had Extremely Difficult Level. 12 (12.8%) patients had Conversion Into Open.
2. It was found that, 3 (3.2%) patients had Bile Duct Injury. 3 (3.2%) patients had Biliary Fistula.2 (2.1%) patients had Vessel Injury. 1 (1.1%) patient had Gut Injury. 4 (4.3%) patients had Abscess Formation. 3 (3.2%) patients had Readmission.

3. We found that the mean G10 (mean ± s.d.) of patients was 3.6383± 2.3319. The mean Time Taken in minutes in (mean ± s.d.) of patients was 65.5851± 27.5608Mins.The mean Bleeding in mililitres (mean ± s.d.) of patients was 52.2892± 44.4568. The mean Hospital Stay in days (mean ± s.d.) of patients was 2.3404± 3.3458.
4. It was found that in Easy Level, 2 (7.7%) patients were ≤30 years old, 8 (30.8%) patients were 31-40 years old, 11 (42.3%) patients were 41-50 years old, 3 (11.5%) patients were 51-60 years old and 2 (7.7%) patients were 61-70 years old. In Moderate Level, 4 (10.8%) patients were ≤30 years old, 7 (18.9%) patients were 31-40 years old, 17 (45.9%) patients were 41-50 years old, 7 (18.9%) patients were 51-60 years old and 2 (5.4%) patients were 61-70 years old. In Difficult Level, 3 (13.0%) patients were 31-40 years old, 11 (47.8%) patients were 41-50 years old, 6 (26.1%) patients were 51-60 years old and 3 (13.0%) patients were 61-70 years old. In Extreme Difficult Level, 1 (12.5%) patient was 31-40 years old, 4 (50.0%) patients were 41-50 years old and 3 (37.5%) patients were 51-60 years old and. This was not statistically significant (p=0.6215).

5. Our showed that in Easy Level, 16 (61.5%) patients were Female and 10 (38.5%) patients were Male. In Moderate Level, 26 (70.3%) patients were Female and 11 (29.7%) patients were Male. In Difficult Level, 16 (69.6%) patients were Female and 7 (30.4%) patients were Male. In Extreme Difficult Level, 7 (87.5%) patients were Female and 1 (12.5%) patients wasMale. Association of Gender with Difficulty Levelwas not statistically significant (p=0.57400)
6. In our study, In Easy Level, 1 (3.8%) patient had Conversion into Open. In Moderate Level, 2 (5.4%) patients had Conversion into Open. In Difficult Level, 3 (13.0%) patients had Conversion into Open. In Extreme Difficult Level, 6 (75.0%) patients had Conversion into Open. Association of conversion with difficulty level was statistically significant (p<0.0001)
7. We found that in Difficult Level, 1 (4.3%) patient had Bile Duct Injury (And biliary fistula) and in Extreme Difficult Level, 2 (25.0%) patients had Bile Duct Injury(and biliary fistula) which was statistically significant (p=0.0023).Association of bile ductinujury with difficulty level was stasistically significant**.**

8. It was found that in Extreme Difficult Level, 2 (25.0%) patients had Vessel Injury and this was statistically significant (p<0.0001). InExtreme Difficult Level, 1 (12.5%) patient had Gut Injury. Association of gut and injury and difficulty level wasstatistically significant (p=0.0125).
9. We examined that in Difficult Level, 1 (4.3%) patient had Abscess Formation and inExtreme Difficult Level, 3 (37.5%) patients had Abscess Formation which wasstatistically significant (p<0.0001). In Difficult Level, 1 (4.3%) patient had Readmission and inExtreme Difficult Level, 2 (25.0%) patients hadReadmission which wasstatistically significant (p=0.0023).

Discussion:-

1. In our study, In Easy Level, 1 (3.8%) patient had Conversion into Open. In Moderate Level, 2 (5.4%) patients had Conversion into Open. In Difficult Level, 3 (13.0%) patients had Conversion into Open. In Extreme Difficult Level, 6 (75.0%) patients had Conversion into Open. **Association of conversion with difficulty level was statistically significant (p<0.0001)**
2. We found that in Difficult Level, 1 (4.3%) patient had Bile Duct Injury (And biliary fistula) and in Extreme Difficult Level, 2 (25.0%) patients had Bile Duct Injury(and biliary fistula) which was statistically significant (p=0.0023).**Association of bile duct inujury with difficulty level was stasistically significant.**
3. It was found that in **Extreme Difficult Level**, 2 (25.0%) patients had **Vessel Injury** and this was statistically significant (p<0.0001). In**Extreme Difficult Level**, 1 (12.5%) patient had **Gut Injury**. **Association of gut and injury and difficulty level was statistically significant** (p=0.0125).
4. We examined that in **Difficult Level**, 1 (4.3%) patient had **Abscess Formation** and in**Extreme Difficult Level**, 3 (37.5%) patients had **Abscess Formation** which was**statistically significant** (p<0.0001). In **Difficult Level**, 1 (4.3%) patient **had Readmission** and in**Extreme Difficult Level**, 2 (25.0%) patients had **Readmission** which was**statistically significant** (p=0.0023).

Discussion With Some Important Studies Mentioned In The Review Of Literature:-

Kumar N et al [8](2017) found that the severity score was between 2-4in 63 (61.16%) patients and between 5-7 in 20 (19.41%) patients. Mild to moderate degree of difficulty was encountered in 80(77.66%), severe degree in 20 (19.41%) and extreme degree of difficulty in 03 (2.91%) patients in performing cholecystectomy and conversion to open surgery were done in 08 (7.76%) patients with score between 6 to 8.This scoring system is useful and reliable. If the intraoperative severity score is more, the severity of cholecystitis increases and then it is more difficult to perform laparoscopic cholecystectomy.

In our study we had moderate degree of difficulty in 39.36% patients, difficulty in 24% patients and extreme degree of difficulty in 8.5% .Total 12 cases were converted, which is 12.76% of total cases, conversion rates increased according to difficulty, in moderate group 5.4% were converted which it was 13.04% and 75% for difficult and extremely difficult cases. So, our study also supports the study mentioned above.

Baral S et al [10](2020) found that postoperative bile leak was seen in three patients among which two were grade five GBs and one was grade four. Preoperative WBC, conversion to open, subtotal cholecystectomy, length of surgery, and postoperative bile leak all significantly increased with increasing grades of Parkland Grading Scale which they used.So that scale couldbe applied in patients undergoing laparoscopic cholecystectomy in the rural setting of a developing nation.

So even though the scales and the demographical areas are different in the two studies, our study goes in support with the fact that intraoperative scoring plays a very important role in operative difficulties, conversions postoperativeoutcomes, so they are supportive of each other.

Sugrue M et al [7](2019) found that surgery was performed by consultants in 70% and was elective in (56%) with a mean operative time of 78.7 min (range 15-400). The mean G10 score was 3.21, with 22% deemed to have difficult or extreme surgical gallbladders, and 71/504 patients were converted. The G10 score was 2.98 in those completed laparoscopically and 4.65 in the 71/504 (14%) converted. ($p < 0.0001$; AUC 0.772 (CI 0.719–0.825). The optimal cut-off point of 0.067 (score of 3) was identified in G10 vs conversion to open cholecystectomy. Conversion occurred in 33% of patients with G10 scores of ≥ 5. The four variables statistically predictive of conversion were GB appearance—completely buried GB, impacted stone, bile or pus outside GB and fistula.The G10 operative scores provide simple grading of operative cholecystectomy and are predictive of the need to convert to open cholecystectomy.

As in our study also we have 12 conversions out of 94, out of which 9 were cases with G10 >_5 which again supports operative difficulties and necessity to convert to open procedure in cases with higher G10 score, amounting 13% and 75% cases of the difficult and extremely difficult group. So the increasingdifficulty and need for conversion with increasing G10 score supports each other

Mazni Y et al [12](2020) found that there was a significant and positive correlation between the G10 score with the bailout procedure (2 indicate subjects at high risk of bailout procedure (72.2% vs. 20.98%).This study showed that the G10 score has good accuracy in predicting a bailout procedure. The use of G10 scores intraoperatively is "essential" to provide valid and objective assessment in determining the difficulty of surgery. When the G10 score is 1 or 2, it's safe to perform the CVS technique. Whereas, if the G10 score is three or greater, surgeon should consider bailout procedures.

Conclusion:-

In our study, 6 (6.4%) patients were ≤30 years old, 19 (20.2%) patients were 31-40 years old, 43 (45.7%) patients were 41-50 years old, 19 (20.2%) patients were 51-60 years old and 7 (7.4%) patients were 61-70 years old. Majority of the patients were female.

In our study, 26 (27.7%) patients had Easy Level, 37 (39.4%) patients had Moderate Level, 23 (24.5%) patients had Difficult Level and 8 (8.5%) patients had Extremely Difficult Level.

In our study, 12 (12.8%) patients had Conversion into Open.

In our study, 3 (3.2%) patients had Bile Duct Injury, 3 (3.2%) patients had Biliary Fistula, 2 (2.1%) patients had Vessel Injury, 1 (1.1%) patients had Gut Injury, 4 (4.3%) patients had Abcess Formation, 3 (3.2%) patients had Readmission. The mean G10 (mean±s.d.) of patients was 3.6383± 2.3319.

We found that Conversion into Open was more in Extreme Difficult followed by difficult, moderate and easy patient respectively which was statistically significant.

Bile Duct Injury was more in Extreme Difficult patients which was statistically significant.

Biliary Fistula and Vessel Injury were more in Extreme Difficult patients which were statistically significant.

Readmission was more in Extreme Difficult patients which was statistically significant.
Gut Injury and Abcess Formation were more in Extreme Difficult patients which were statistically significant.

It was found that the mean Time Taken was significantly higher followed by difficult, moderate and easy patient respectively.

Bleeding was significantly higher followed by difficult, moderate and easy patient respectively.
It was found that Hospital stay was significantly higher followed by difficult, moderate and easy patient respectively.

To summarize, the association of difficulty levels (expressed as per G10 scoring system)was statistically significant with conversion to open procedure, intraoperative complications (i.e. bile duct injury, vessel or gut injury, increased blood loss), increased operative times, postoperative complications (i.e. biliary fistula, increased postoperativestay and readmission) was significant.

We concluded that the G10 operative scores provide simple grading of operative cholecystectomy and are predictive of the need to convert to open cholecystectomy. We also conclude that the score can be correlated with surgical complications, increased oprating time, increased hospital stay and readmission. G10 Classification In Laparoscopic Cholecystectomy Turns Out To Be A Reliable And Valid Indicator For Prediction Of Operative Difficulties.

Reference:-

1. Lombardo S, Rosenberg J, Kim J, Erdene S, Sergelen O, Nellermoe J, Finlayson S, Price R. Cost and outcomes of open versus laparoscopic cholecystectomy in Mongolia. J Surg Res. 2018;229:186–191. doi: 10.1016/j.jss.2018.03.036. [PubMed] [CrossRef] [Google Scholar]
2. Sutcliffe R, Hollyman M, Hodson J, Bonney G, Vohra R, Griffiths E, Fenwick S, Elmasry M, Nunes Q, Kennedy D, Khan R. Preoperative risk factors for conversion from laparoscopic to open cholecystectomy: a validated risk score derived from a prospective UK database of 8820 patients. J HepatobiliaryPancreat Sci. 2016;18(11):922–928. [PMC free article] [PubMed] [Google Scholar]
3. Wakabayashi G, Iwashita Y, Hibi T, Takada T, Strasberg S, Asbun H, Endo I, Umezawa A, Asai K, Suzuki K, Mori Y. Tokyo Guidelines 2018: surgical management of acute cholecystitis: safe steps in laparoscopic cholecystectomy for acute cholecystitis (with videos) J HepatobiliaryPancreat Sci. 2018;25(1):73–86. doi: 10.1002/jhbp.517. [PubMed] [CrossRef] [Google Scholar]
4. Hernandez M, Murphy B, Aho J, Haddad N, Saleem H, Zeb M, Morris D, Jenkins D, Zielinski M. Validation of the AAST EGS acute cholecystitis grade and comparison with the Tokyo guidelines. Surgery. 2018;163(4):739–746. doi: 10.1016/j.surg.2017.10.041. [PubMed] [CrossRef] [Google Scholar]
5. Yokoe M, Takada T, Strasberg S, Solomkin J, Mayumi T, Gomi H, Pitt H, Gouma D, Garden O, Büchler M, Kiriyama S. New diagnostic criteria and severity assessment of acute cholecystitis in revised Tokyo Guidelines. J HepatobiliaryPancreat Sci. 2012;19(5):578–585. doi: 10.1007/s00534-012-0548-0. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
6. Sugrue M, Sahebally S, Ansaloni L, Zielinski M. Grading operative findings at laparoscopic cholecystectomy- a new scoring system. World J Emerg Surg. 2015;10:14. doi: 10.1186/s13017-015-0005-x. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
7. Sugrue M, Coccolini F, Bucholc M, Johnston A. Intra-operative gallbladder scoring predicts conversion of laparoscopic to open cholecystectomy: a WSES prospective collaborative study. World Journal of Emergency Surgery. 2019 Dec;14(1):1-8.
8. Kumar N, Sahu SK, Bedi KS. Assessment of Degree of Difficulty in Laparoscopic Cholecystectomy using Intraoperative Scoring System. J Clin Diagnostic Res. 2017 Oct 1;11.
9. Sugrue M, Sahebally SM, Ansaloni L, Zielinski MD. Grading operative findings at laparoscopic cholecystectomy-a new scoring system. World Journal of Emergency Surgery. 2015 Dec;10(1):1-8.
10. Baral S, Chhetri RK, Thapa N. Utilization of an Intraoperative Grading Scale in Laparoscopic Cholecystectomy: A Nepalese Perspective. Gastroenterology Research and Practice. 2020 Nov 24;2020.
11. Mir G, Bhat S, Khan T, Wani M, Mailk A, Wani K. Conversion of laparoscopic cholecystectomy to open cholecystectomy: an analysis in a high risk group of patients. J Univ Surg. 2017;5:19.

12. 12.Mazni Y, Jeo WS. External Validation Of 10 Points Intraoperative Gallbladder Scoring System (G10) In Laparoscopic Cholecystectomy at RSUPN dr.CiptoMangunkusumo. The New Ropanasuri Journal of Surgery. 2020;5(2):3.
13. Vera K, Pei K, Schuster K, Davis K. Validation of a new American Association for the Surgery of Trauma (AAST) anatomic severity grading system for acute cholecystitis. J Trauma Acute Care Surg. 2018;84(4):650–654. doi: 10.1097/TA.0000000000001762. [PubMed] [CrossRef] [Google Scholar]

14. Bharamgoudar R, Sonsale A, Hodson J, Griffiths E, CholeS Study Group, West Midlands Research Collaborative. The development and validation of a scoring tool to predict the operative duration of elective laparoscopic cholecystectomy. SurgEndosc 2018; 32(7):3149–3157. [PMC free article] [PubMed]
15. Sutcliffe R, Hollyman M, Hodson J, Bonney G, Vohra R, Griffiths E, Fenwick S, Elmasry M, Nunes Q, Kennedy D, Khan R. Preoperative risk factors for conversion from laparoscopic to open cholecystectomy: a validated risk score derived from a prospective UK database of 8820 patients. J HepatobiliaryPancreat Sci. 2016;18(11):922–928. [PMC free article] [PubMed] [Google Scholar]
16. Madni T, Leshikar D, Minshall C, Nakonezny P, Cornelius C, Imran J, Clark A, Williams B, Eastman A, Minei J, Phelan H. The Parkland grading scale for cholecystitis. Am J Surg. 2018;215(4):625–630. doi: 10.1016/j.amjsurg.2017.05.017. [PubMed] [CrossRef] [Google Scholar].