Original Research Article

Validation of intra-operative scoring system for difficult laparoscopic cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy is the procedure of choice for most patients with gallbladder disease. The key, as in open surgery, is the identification and safe dissection of Calot's triangle. Surgeons performing laparoscopic cholecystectomy should not think of conversion to open operation as a complication, but rather a sound clinical judgment.
Methods: This is an observational, single center study. The scoring system included five aspects; appearance and adhesion of gall bladder (GB), distension or contracture degree of GB, ease in access, local or septic complications, and time required for cystic artery and duct identification. A score of <2 would imply mild difficulty, 2–4 moderate, 5–7 severe and 8–10 extreme. The scores were compared in each patient to conclude the practicality of intra operative predictive score.
Results: The most common reason for conversion to open surgery was found to be difficulties in dissection of cystic duct and artery in Calot's triangle. The moderate and severe category was found to be statistically insignificant to predict the conversion, therefore, one can consider to merge these 2 categories into a single category to forfeit the prediction for conversion.
Conclusions: The extreme category was found to be statistically significant for prediction of conversion, therefore, the patients falling into this category forfeits the chances of increased risk of injury and therefore, should be converted early.

Keywords: Laparoscopic cholecystectomy, Intraoperative scoring, Gallbladder, Gallstones, Difficult LC

INTRODUCTION

Cholelithiasis is the most common disease of gallbladder and biliary tree, affecting 10% to 15% of the population.[1] Gallstones may remain asymptomatic, being detected incidentally as imaging is performed for other symptoms. If symptoms occur, patients typically complain of right upper quadrant or epigastric pain, which may radiate to the back.[2] Laparoscopic cholecystectomy (LC) is the procedure of choice for majority of patients with gallbladder disease. The key, as in open surgery, is the identification and safe dissection of Calot's triangle.[3]

The advantages of LC over open cholecystectomy have been well documented. These advantages include earlier return of bowel function, less postoperative pain, improved cosmesis, shorter length of hospital stay, earlier return to full activity, and decreased overall cost.[4]

For patients in whom a laparoscopic approach is not indicated or in whom conversion from a laparoscopic approach is required an open cholecystectomy is performed. Surgeons performing LC should not think of conversion to open operation as a complication, but rather a sound clinical judgment, and hence not hesitate to

convert to a traditional open cholecystectomy if the anatomy is unclear, if complications arise, or there is failure to make reasonable progress in a timely manner.[5] The objective of this study is to validate the intraoperative scoring system for difficult laparoscopic cholecystectomy by grading the degree of potential difficulty intraoperative with a score of 1 to 10. Thereby to study the rate of conversion and compare it with the rates predicted as per operative grading system.

METHODS

This is a prospective observational study undertaken at L. N. Medical College and Research Centre, Bhopal after approval was obtained from the institutional ethical committee (LNMC&RC/Dean/2021/Ethics/261). In our study, 100 patients were taken who underwent laparoscopic cholecystectomy, compromising of 69 females and 31 males who fulfilled the inclusion criteria. The intraoperative observational parameters were noted in the pre-approved proforma. Study center: L. N. Medical College and Research Centre, Bhopal. Duration of the study was from June 2018 to June 2020.

The scoring system included five aspects; appearance and adhesion of gall bladder (GB), distension or contracture degree of GB, ease in access, local or septic complications, and time required for cystic artery and duct identification. The new operative scoring system is described in Table 1.

Difficult cholecystectomy is defined by the following points discussed below.[6]

Access related

More than 2 Veress needle attempts or alternate methods like open technique to be used.

Identification of gallbladder

If gall bladder covered with omentum/ bowel loops and adhesions have to be divided (not separable by pulling) by the use of electro-cautery.

Grasping of gallbladder

Need of special instruments (with bigger jaw) for grasping or need of evacuation of gall bladder before grasping required.

Adhesiolysis

Adhesions requiring cutting by electro-cautery. Flimsy/ easily separable adhesions by pulling were not included.

Calot's triangle dissection

More than 20 min time needed for calot's triangle dissection.

Duct clipping

Wide/short duct requiring suture rather than clipping or inadequate length to put two proximal and one distal clip.

Dissection from liver bed

Dissection of gall bladder from liver bed requiring more than 20 min. or perforation of gall bladder.

Extraction of gallbladder

Skin incision needs to be increased, piecemeal removal of gall bladder, spillage of stones/ bile during extraction. Time was calculated from Veress needle insertion till port closure. Overall time >60 min was also considered as difficult LC. All surgeries were done under GA by standard four port technique. CO_2 pneumoperitoneum at 12 mmHg was used.

Table 1: Operative grading system for cholecystectomy severity.

| Operative grading system	Score
Gallbladder appearance	
No adhesions	0
Adhesions <50% of gB	1
Adhesions burying gB	3
Maximum	3
Distension/contraction	
Distended gB or contracted shrivelled gB	1
Unable to grasp with a traumatic laparoscopic forceps	1
Stone ≥1 cm impacted in Hartman's pouch	1
Access	
BMI>30	1
Adhesions previous surgery limiting access	1
Severe sepsis/complications	
Bile or pus outside gB	1
Time to identify cystic artery and duct >90 mins	1
Total maximum	10

Data analysis

The data obtained was subjected to statistical analysis with the consult of a statistician. The data so obtained was compiled systematically. A scoring system employed by Sugrue et al was used in this study.[6] A score of <2 would imply mild difficulty, 2–4 moderate, 5–7 severe and 8–10 extreme. The scores were compared in each patient to conclude the practicality of intra operative predictive score. The data obtained was subjected to statistical analysis with the consult of a statistician. The data so obtained was compiled systematically. A master table was prepared and the total data was subdivided and distributed meaningfully and presented as individual tables along with graphs. Statistical test employed in this study include:

Chi–square test, student's t- test, Pearson correlation test, and univariate analysis using linear regression.

RESULTS

The study was done on a total sample of 100 patients of which 31 were males and 69 were females, thus the ratio being 3:1 (Figure 1). The patients of age 18 to 70 years were included in the study in which the maximum proportion fell into the age group of 31 to 40 years followed by 41 to 60 years of age. The mean age being 45.06 and the standard deviation being 13.831 (Figure 2).
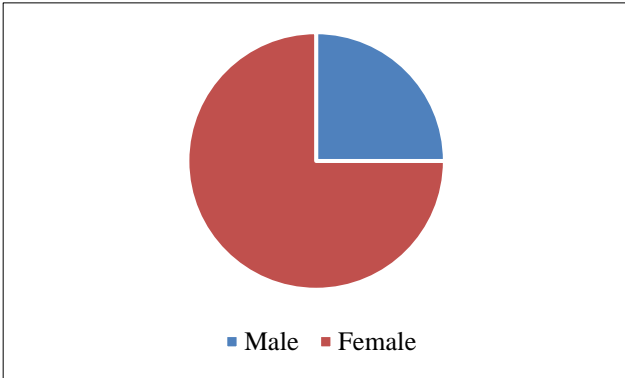
Figure 1: Sex distribution.

Appearance of gallbladder

On entering the peritoneal cavity, the appearance of gallbladder was noted for adhesions less than 50% or adhesions burying the gallbladder. For adhesions less than 50%, it was found in 54 patients, while adhesion burying the gallbladder was found in 41 patients. In 5 patients, no adhesions were found (Table 2) (Figure 3).
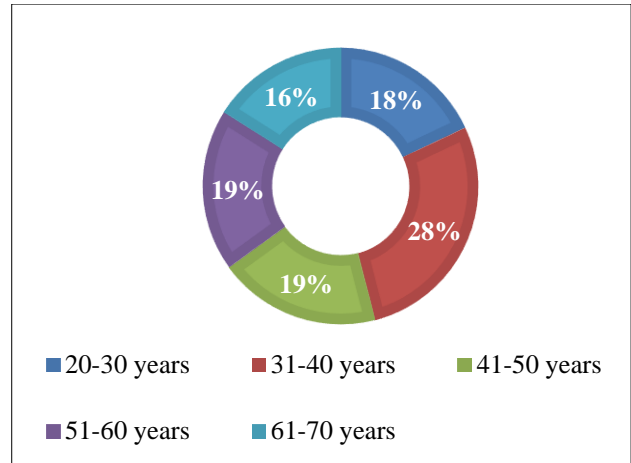
Figure 2: Age distribution.

Distension/contraction

The second intraoperative parameter taken is the gallbladder distension or contraction which consist of following sub parameter. Each parameter has been given a score of 1.

It consists of: distended or shriveled gallbladder; unable to grasp with atraumatic forceps; and tone ≥1 cm in Hartmann pouch.

Distended or shriveled gallbladder

80 out of 100 cases have distended gallbladder on the intraoperative findings, out of which in 28 cases the surgeon was not able to hold with atraumatic forceps and required to decompress the gallbladder to hold it with atraumatic forceps (Figure 4).

Table 2: Appearance of gall bladder.

Parameters	Laparoscopic	Converted cases	P value
Adhesion <50%	53	1	0.000149
Adhesion burying gallbladder	28	13	0.000021
No adhesions	5	0	
Total	86	14	
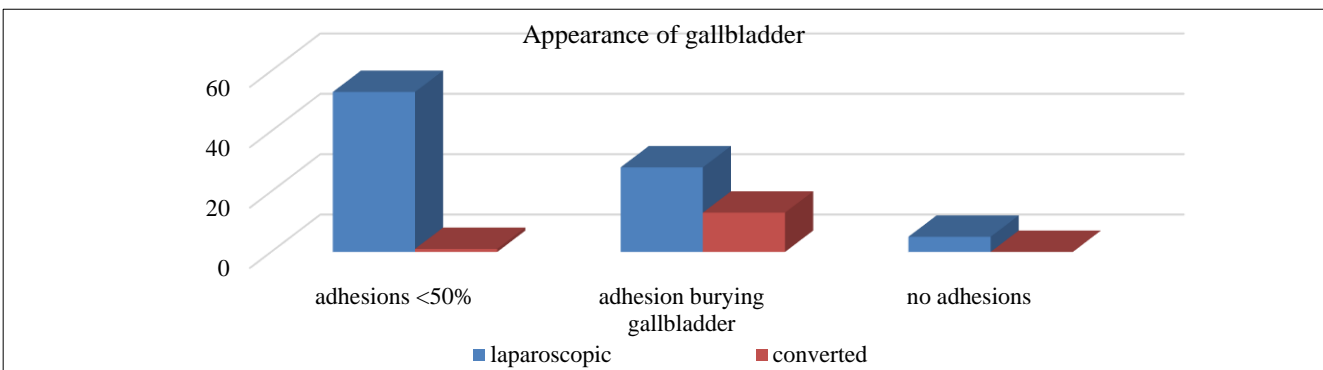
Figure 3: Appearance of gall bladder.
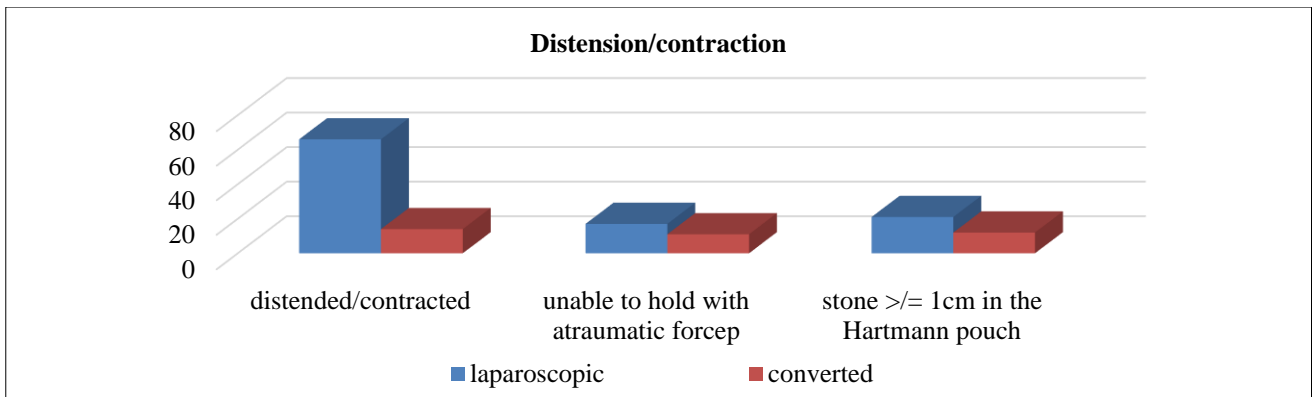
Figure 4: Distension/contraction of GB.

Access

The ease of access of instrumentation for the surgeon also tends to affect the difficulty in the procedure and thus paramount to the result in predicting the risk score.

It consists of sub-parameters and each given a score of 1 in the operative grading system (OGS): BMI more than 30, and adhesions from previous surgeries limiting access.

In patients with BMI more than 30, it was found that it was difficult to have port access as well as the length of the instrument was found to be inadequate for LC. However, the number of patients that were found to be more than 30 was quite less, that is, in 5 cases. It is thus difficult to see the importance of this parameter in our study, making it a limitation in our study. This was due to the fact that the hospital majorly caters to the low socio-economic strata, and therefore, it is difficult to find substantial number of obese patients for our study.

Also, the number of patients with previous history of upper abdominal surgery were found to be only 13 cases out of 100 patients who underwent LC (Figure 5).

The patients that had pericholecystic collection was found in 27 cases. Such cases were managed intraoperatively on prompt identification and patients with severe intraoperative complication that were not able to be dealt with laparoscopic approach were converted to open (Figure 6).

***Time taken to identify cystic duct and cystic artery more than 90 minutes***

The calot's triangle form an important landmark for LC and 2 and only 2 structures should be clearly identified in the calot's triangle forming the critical view of safety. Therefore, the time taken to identify the cystic artery and duct exceeds beyond 90 minutes, then it constitutes a difficulty parameter in the operative grading system (OGS). Out of 100 cases operated, in 20 cases the time taken to identify these two structures, maybe due to

distorted anatomy, anomalous anatomy, and frozen calot's triangle, exceeded the time of 90 minutes (Figure 7).
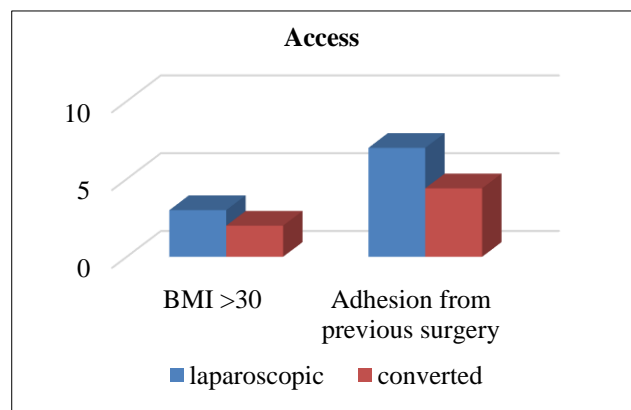
Figure 5: Access.

Pericholecystic collection
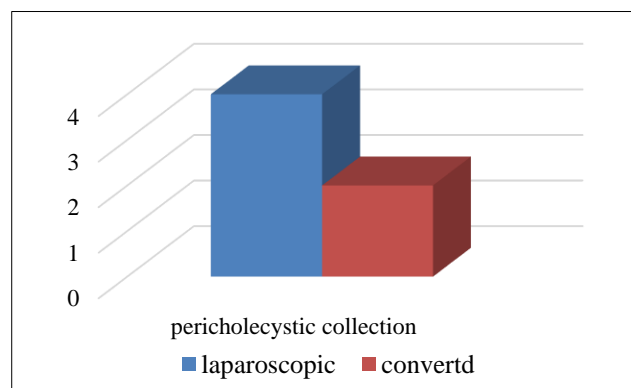
Figure 6: Pericholeycstic collection.

Severity wise distribution

After providing each case with a score we categorize the patient into mild, moderate, severe and extreme. With this scoring system, a score of <2 would be considered mild, 2 to 4 moderate, 5–7 very difficult, and 8 to 10, extreme. The maximum number of cases fell into mild category, that is.,

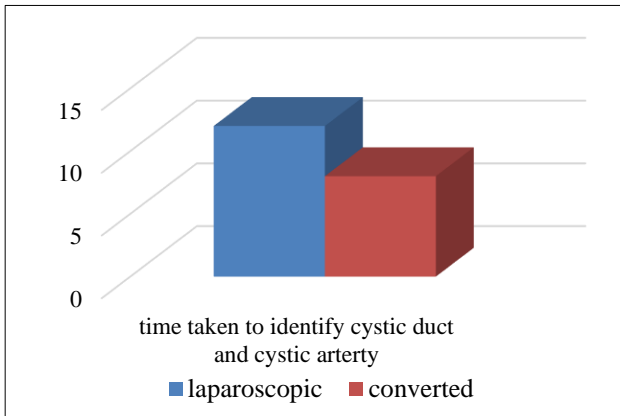48, followed by moderate then severe which is followed by extreme (Figure 8).

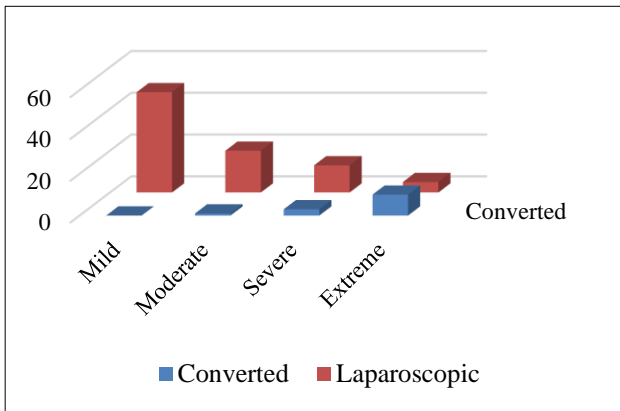**Figure 7: Time taken to identify cystic Artery.**

Figure 8: Severity wise distribution.

Table 3: Severity wise distribution.

Distribution	Laparoscopic	Converted cases	P value
Mild	48	0	0.0001
Moderate	20	1	0.2895
Severe	13	3	0.6931
Extreme	5	10	0.00001
Total	86	14	

DISCUSSION

Laparoscopic cholecystectomy is the most done and accepted procedure for gallstone disease. With the advancement in this field, various scoring and predictive factors have been introduced to make the procedure safe and to give surgeon an idea of when to convert. It is also important to factor in the chances wherein a doctor may give a blind eye to convert the procedure from laparoscopic cholecystectomy to open cholecystectomy when a difficult (cholecystectomy) situation arises. The ability to discard inhibition and ego matters usually solves this problem for the surgeon whilst reducing the chances of morbidity and mortality for the patient.

The present study entails intraoperative parameter of difficult laparoscopic cholecystectomy and thereby predicting the conversion was done at L. N. Medical College and Research Centre, Bhopal which included 100 patients from a period of June 2018 to June 2020. Intraoperative parameters based on operative grading system were noted along with the incidence of conversion were noted. Out of 100 patients, 14 number of patients were converted to open cholecystectomy. The morbidity and complications associated were noted and no mortality was seen. Postoperative period was uneventful in all the patients.

The patients included in this study were patient of cholelithiasis with or without cholecystitis. There were 31 males and 69 females included in the study, thus in the ratio of 3:1, which forms the normal epidemiological prevalence among gallstone diseases. This was in conjugation with similar sex distribution seen in studies by Unisa et al where female had 2.9 times more incidence of gallstone disease, also by Randi et al, had similar result noted in different part of the world.[7,8]

The male gender was found to be associated with a more difficult cholecystectomy and with a higher rate of conversion as compared to female patients. Yol et al suggested that men with symptomatic gallstones are more susceptible to inflammation and fibrosis.[9] In our study it was found that 6.45% (2 out of 31) males and 17.39% (12 out of 69) females were converted and the difference was found to be insignificant (p: 0.144). Tokyo guidelines 2013 for acute cholecystitis also entails that the male gender has increased rate of conversion of laparoscopic cholecystectomy to open cholecystectomy.[10]

The mean age of presentation was found to be 45.06 years in our study which was in accordance with Unisa et al, Everhart et al and Singh et al which was 50 years, 42.69 years, and 44.11 years respectively.[7,11,12] Maximum number of patients (i.e., 28 out of 100 patients) were found to be falling in the age group of 31 to 40 years with equal distribution of 19 patients found in both 40s and 50s age group. The maximum conversion was found to be in the age group of 40-49 years i.e., 6 out of 19 cases falling in this age group were converted and was found to be statistically significant (p: 0.014). 42.85% of total converted cases were found to be in this age group. However, the other age groups were found to be statistically insignificant for the conversion, thus, not complying with the fact the rate of conversion increased with the increasing age.

The operative grading system defines various intraoperative parameters that helps in predicting difficult cholecystectomy and predicts the conversion to open cholecystectomy. Adhesions and distorted Calot's triangle were found to be one of the commonest reasons was abandonment of laparoscopic cholecystectomy and conversion to open cholecystectomy. In our study, it was found to that gallbladder with adhesion less than 50%, 1

out of 54 laparoscopic cholecystectomy was converted to open cholecystectomy. However, in laparoscopic cholecystectomy with adhesion burying gallbladder, 13 cases out of 28 cases (46.42%) were converted to open cholecystectomy. Frozen Callot's triangle prevents the exposure of critical view of safety, thereby, increasing the risk of injury. Lal et al reported that the most common reason for conversion to open surgery was difficulties in dissection of cystic duct and artery in Callot's triangle.[13] In study done by Orhan et al, the most common difficulty type was class I difficulty which is mainly characterized by adhesions to the fundus of the gallbladder.[14] In our study, adhesion burying the gallbladder, it was found to be statistically significant factor for conversion into open cholecystectomy. SAGES guidelines for safe laparoscopic cholecystectomy also marks adhesion as one of the factors for difficult cholecystectomy.[15]

Distension or contracted gallbladder appearance of this study has 3 parameters i.e., distended, or contracted gallbladder, unable to hold with atraumatic forcep and stone more than or equal to 1cm in the Hartmann pouch. Gallbladder due to stone impaction will lead to distension of the gallbladder with bile, and long retention will lead to mucocele formation. the radiological findings that collaborate to the diagnosis of acute cholecystitis includes thickening of the gallbladder wall ($\geq$4 mm), enlargement of the gallbladder (long axis $\geq$8 cm, short axis $\geq$4 cm), however, it is difficult to assess such parameters univocally in the operative field.[16] Therefore, intraoperatively, the ability to hold the distended gall bladder helps to give evidence of difficult gallbladder due to distension. Contracted gallbladder occurs as a result of repeated attacks of inflammation to the gallbladder and resulting to fibrosis and shriveled appearance of the gallbladder, and predicts the fibrotic adhesion of gallbladder to its bed, thus, making it a reason for difficulty. Distended or contracted gallbladder were found in 66% of our cases and out of which 14 cases i.e., were converted to open cholecystectomy. Univariately considering this single factor is insignificant using linear regression but can be add on factor for difficult cholecystectomy. The conversion rate for distended or shriveled gallbladder was found to be 1.4%, 0.11% and 1.72% in the studies done by Singh et al, Genc et al and Sugrue et al.[17-19]

Gupta et al does define one of the factors of difficult cholecystectomy as "need of special instruments (with bigger jaw) for grasping or need of evacuation of gall bladder before grasping required" which was found to be a statistically significant factor.[6] In our study unable to hold gallbladder with atraumatic forcep was found to be in 17% of total cases. Out of 17 cases, 11 cases (64.7%) were converted to open cholecystectomy, which was statistically found to be significant (p: 0.00001). The conversion rate for unable to hold gallbladder with atraumatic forcep was found to be 21.8% by Sugrue et al and 20% cases had difficult cholecystectomy in the study

by Gupta et al which is comparable to 11% found in our study.[6,19]

Lal et al stated that large calculus at neck region is associated with distention of gall bladder and multiple stones are associated with difficulty in gall bladder extraction through small incision of LC and hence may lead to perforation of gall bladder with spillage of bile and gall stones.[13] This study has 21% cases in which stone of 1 cm or more at the level of Hartmann pouch, out of which 12 cases (57.14%) were converted into open cholecystectomy. It was found not only statistically significant (p:0.00001) but also to be an independent risk factor for conversion in the univariate analysis using linear regression. The conversion rate for stone of 1cm or more was found to be 10.95% and 2% by Sugrue et and Chand et al which is comparable to 12% found in our study.[19,20]

The access for laparoscopic cholecystectomy has 2 parameters: BMI >30 and adhesion from previous surgery. An increased BMI makes laparoscopic cholecystectomy challenging due to its technical difficulty but has no effect on the rate of conversion.[21] In this study, it was found that the 3 cases had BMI >30 and the conversion was seen in 2 cases. However, due to small group of patients falling in this category, it was no sufficient to analyse the data and is the limitation of this study. This was largely configured due to the study hospital majorly catering to patients of low and middle socioeconomic strata, thus not providing adequate number of patients with increased BMI. The conversion rate of patients with BMI >30 was 2% and 23.4% in the study done by Matteo et al and Sugrue et al respectively which is comparable to 2% found in our study.[19,21]

Previous upper abdominal surgery poses a difficulty to access the site of dissection due to increased rate of intra-abdominal adhesion, and thereby increasing the operative time. In our study, 7% of cases had previous abdominal surgery and about 6 cases were converted into open, which was found to be statistically significant (p:0.000341). In the study conducted by Bouasker et al and Sugrue et al, the conversion rate was found to be 2.1% and 5.7% respectively which is comparable to 6% found in this study.

The major parameter for predicting difficult cholecystectomy and thereby rate of conversion is pericholecystic collection. Pericholecystic collection impairs the surgical field of dissection, thereby creating technical difficulty for dissection of gallbladder.[22] Pericholecystic collection which is usually diagnosed preoperatively by ultrasonography forms a part of diagnostic criteria for acute cholecystitis according to the Tokyo guidelines and results into difficult cholecystectomy.[23] The conversion rate for pericholecystic collection was found to be 3.88% and 36.4% in the study done by Nidoni et al and Sugrue et al, at increased the operation time.[19,24] In this study, 10 cases had pericholecystic collection, out of which 9 patients had

conversion, which was statistically significant (p: 0.00001). Univariate analysis by linear regression finds pericholecystic collection to be a significant and to play an independent variable responsible for conversion.

The operative findings were objectively graded as difficult or easy laparoscopic cholecystectomy according to the following criteria: more than 90 minutes taken for laparoscopic cholecystectomy from insertion of the Veress needle or trocar (in open method of port insertion) until the extraction of the gallbladder, was considered a difficult laparoscopic cholecystectomy.[13] In this study, the number of cases with time taken to identify cystic duct and cystic artery >90 minutes were 12 cases, out of which the converted cases were 8, which was found to be statistically significant (p:0.00017). This factor was found to be independent variable for conversion of laparoscopic cholecystectomy to open cholecystectomy in this study. This is comparable to conversion rate found 5% and 0.83% found for this parameter in the study conducted by Ahmed et al and Sanar et al respectively.[25,26]

The five key aspects of operative grading system include: gallbladder appearance and number of adhesions, degree of distension/contracture of the gallbladder, ease of access, local/septic complications, and, time taken to identify the cystic artery and duct. Holding all other variables constant, stone more than or equal to 1 cmin Hartmann pouch, pericholecystic collection and time taken >90 minutes to identify cystic duct and artery has a statistically significant positive relationship with conversion.

The current scoring system proposed is based on the severity of cholecystitis and degree of potential difficulty with a score from 1 to 10. The key aspects of the score include access to the gallbladder including patient body mass index (BMI), the degree of pericholic and right upper quadrant adhesions particularly in patients who have had previous abdominal surgery, the presence of complicated cholecystitis and the time taken by the surgeon to achieve the triangle of safety with identification of the cystic artery and duct. With this scoring system a score of <2 would be considered easy, 2 to 4 moderate, 5–7 very difficult, and 8 to 10, extreme.[27] The number of cases is 48, 21, 16 and 15 falling into mild, moderate, severe and extreme category respectively. The number of cases converted to open cholecystectomy are: no case in mild category, 1 case (4.76%) in moderate category, 3 cases (23.07%) in severe category and 10 cases (66.66%) in extreme category. The mild and extreme category are found to be statistically significant. Therefore, the predictability of difficult cholecystectomy and thereby predicts conversion into open cholecystectomy for mild and extreme category. Moderate and severe category are not found to be statistically significant to predict conversion. However, other outcome parameters such as hospital stay, and post-operative complications, were not considered to predict the difficulty of the procedure as the study was more focused on predicting the conversion.

Inflammation, adhesions, and anatomic difficulty continue to challenge the use and safety of laparoscopic approach in a small number of patients but it's multiple advantages over the open method have made it the treatment of choice in all cases of symptomatic cholelithiasis. Conversion is not to be considered as a failure or complication but is a better and safer alternative to ensure completion of the procedure without occurrence of any of the real complications of laparoscopic cholecystectomy namely biliary or visceral injury, haemorrhage, and gall-bladder perforation. The willingness and ability of surgeons to convert timely to open cholecystectomy continues to be important to the safety of this operation. Parameters such as increased BMI was limitation of this study as the number of patients with increased BMI were less as the study hospital caters to low and middle socioeconomic strata, therefore giving us inadequate sample to prove it otherwise.

CONCLUSION

Gallstone disease has a female predilection, with the ratio of male: female corresponding to 3:1. The male gender was found to be associated with a more difficult LC, and with a higher chance of converting the procedure to open. The mean age of presentation for the study was found to be 45.06 years, however in our study it was found to be statistically insignificant with the fact that the rate of conversion increased with increasing age. The most common reason for conversion to open surgery was found to be difficulties in dissection of cystic duct and artery in Calot's triangle. Intraoperative parameters such as distended or contracted gallbladder, pericholecystic collection and dense adhesions corresponds to the diagnosis of acute or chronic cholecystitis, which renders the procedure to be difficult to perform and bags the chances of conversion. Distended gallbladder in our study was considered with the ability to not hold the gallbladder with atraumatic forceps which asks for "need of special instruments (with bigger jaw) for grasping or need of evacuation of gall bladder before grasping required. A large calculus with the size of ≥1 cm impacted in the Hartmann pouch is associated with distension of the gallbladder and difficulty in gallbladder extraction, increasing chance of GB perforation. It was found to be an independently significant factor for conversion. Pericholecystic collection impairs the surgical field of dissection and results in difficulty. Pericholecystic collection was found to be an independent factor responsible for conversion. Out of 100 patients taken in this study, the conversion rate was found to be 14%. The operative variables were divided into mild, moderate, severe, and extreme corresponding to 48%, 21%, 16% and 15% of total number of cases. No conversion was seen in mild cases and therefore it was found to be statistically significant to predict negative conversion. The moderate and severe category was found to be statistically insignificant to predict the conversion, therefore, one can consider to merge these 2 categories into a single category to forfeit the prediction for conversion. The extreme

category was found to be statistically significant for prediction of conversion, therefore, the patients falling into this category forfeits the chances of increased risk of injury and therefore, should be converted early. This operative grading system avails the surgeon to make a measured decision for conversion of the procedure at the time of surgery with acceptable sensitivity, specificity, and positive predictive value. It also provides a universal platform to compare different operative fields at different center performed by different surgeons, hence making it a tool in research projects. The timely conversion of the procedure prevents the chance of any major trauma and decreases the associated morbidity and mortality associated with it. Thus, this operative tool helps the surgeon to take this timely decision.

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