International Surgery Journal
Singh AK et al. Int Surg J. 2024 Mar;11(3):398-404
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20240572

Original Research Article

A prospective observational study of predictive factors for conversion of laparoscopic to open cholecystectomy

Ajeet Kumar Singh[1], Partha Sarathi Nayak[2]*, Komal Prasad Dewangan[3]

[1]Department of General Surgery, The Calcutta Research Institute, Kolkata, West Bengal, India
[2]Department of General Surgery, Ramakrishna Mission Seva Pratisthan and Vivekananda Institute of Medical Sciences, Kolkata, West Bengal, India
[3]Department of General Surgery, Chhattisgarh Institute of Medical Sciences (CIMS), Bilaspur, Chhattisgarh, India

Received: 16 January 2024
Revised: 14 February 2024
Accepted: 23 February 2024

***Correspondence:**
Dr. Partha Sarathi Nayak,
E-mail: parthpriya.nayak1@gmail.com

ABSTRACT

Background: Cholelithiasis affects about 10 to 15% of general population. LC became the procedure of choice for management of symptomatic gallstone disease for its minimally invasive nature, minimal pain and earlier recovery.
Methods: This study was carried out on 300 consecutive patients who underwent LC for gall stone disease (patients falling under inclusion criteria) in the Department of General Surgery, The Calcutta Medical Research Institute, Kolkata.
Results: In this study 9% patient were converted to open cholecystectomy while 91% of the patient underwent successfully LC. Increased wall thickness of gall bladder (p=0.01), pericholecystic fluid collection (p=0.04), stone impaction at gall bladder neck (p=0.001), pain abdomen (acute cholecystitis, recurrent acute cholecystitis) (p=0.03), previous abdominal surgery (p=0.001), pre-operative jaundice (p=0.005) were found significant in this study for conversion to open surgery. Increased TLC, total bilirubin, alkaline phosphatase, alanine transaminase and aspartate transaminase ($p<0.05$) were also risk factors for conversion to open surgery.
Conclusions: We conclude that LC is the gold standard treatment for gall stone disease. Identification and safeguarding the bile ducts and arteries is of utmost importance while performing LC.

Keywords: Laparoscopic cholecystectomy, Open cholecystectomy, Gall bladder, Gall stone disease, Total leucocyte count

INTRODUCTION

Cholelithiasis affects about 10 to 15% of general populations.[1] Laparoscopic cholecystectomy has become the procedure of choice for management of symptomatic gallstone disease for its minimally invasive nature, less pain and early recovery.[2] India is included along with countries with a low incidence of gallstones.[3] Worldwide sometimes; it takes longer time even with bile/stone spillage and occasionally requires to be converted to an open procedure. Difficult laparoscopic cholecystectomy is defined as the procedure which takes longer duration and/or that is converted to open procedure (with significant factors increasing operating time such as previous abdominal surgery, multiple, large calculi, very thick gall bladder, anomalous vessels, large and distended gall bladder cystic artery and duct injury, hollow organ injury). Severity of inflammation, age >50 yr, gender (male), increased WBC Count, raised total bilirubin, increase liver enzymes have been found to be preoperative risk factors for difficult laparoscopic cholecystectomy.[4] Difficult laparoscopic

cholecystectomy may or may not be associated with serious operative and post operative complications which increase hospital stay and also add extra financial burden. In spite of increasing expertise and advances in technology conversion rate is still 1.5-19% in different centre.[5] Conversion to open surgery is not visualized as a complication, rather a matter of sound surgical judgment as patient safety is of foremost importance. Laparoscopic cholecystectomy may need conversion in the following conditions (unclear anatomy, Failure to progress in dissection, Injury to major blood vessel, Injury to abdominal viscous Injury to bile duct, Doubtful pathology).[6] Severe jaundice is suggestive of common bile duct stones or obstruction of the bile ducts by severe pericholecystic inflammation secondary to impaction of a stone in the infundibulum of the gallbladder that mechanically obstructs the bile duct (Mirizzi's syndrome). Different scoring methods and predictive factors have been suggested in past but my study included more parameter at a time. This study was undertaken to determine the predictive factors for conversion to open cholecystectomy in our hospital which is a tertiary hospital in eastern India. Various clinical and ultrasonological parameters that may help to predict the difficulty level pre-operatively will be analyzed in this study. Preoperatively such prediction may help the patient as well as the surgeon in being better prepared for the intra-operative challenges to save operative time and also decreases cost of surgery.

METHODS

Study design, location, population and duration

A prospective observational study was done at the Calcutta medical research institute Kolkata, a tertiary hospital. Laparoscopic cholecystectomy is the most common operations performed here. Subjects from in patient department of General Surgery ward in the Calcutta medical research institute Kolkata. Patients of ages >18 yrs and both genders were included in the study. This study was conducted from January 2016 to June 2017.

Sample size

As per study by Bhar et al, p=22.32 for this study. The formula for sample size calculation as follows;

$$n = z2p(1-p)/e2$$

Where p is proportion, e is precision, z =1.96 p=22.32 e=5%, n=required sample size, z=standard normal deviation (considering 95% confidence interval), q= (100-p).[7] Thus sample size was calculated to be 266.44~266. However, during my study period, we could get more patients in the Hospital and finally had 300 patients in this study.

Inclusion criteria

Inclusion criteria were; Patients above 18 years admitted for: Acute calculous cholecystitis, Chronic calculous cholecystitis, Recent acute cholecystitis treated conservatively and Common bile duct stones treated with endoscopic retrograde cholangio pancreatography.

Exclusion criteria

Exclusion criteria were; Patients with known carcinoma of Gallbladder, Patients who underwent laparoscopic cholecystectomy with other laparoscopic intervention in same setting and Patients who will undergo laparoscopic cholecystectomy with Common Bile Duct (CBD) exploration.

Data collection

A detailed history including the general details of the patient (age, gender etc.) clinical history, per abdomen examination, biochemical parameters, ultrasonological findings, intra operative findings were collected. All data were noted in the study proforma (given in the appendix) and tabulated in Microsoft Excel.

Procedure

Patients presenting with symptomatic cholelithiasis at The Calcutta medical research institute Kolkata and falling into the inclusion criteria were chosen for the study. The study subjects were first given an informed consent form. After explaining the procedure to the subjects in detail written consent were obtained from those who agree to participate in the study. For every individual consented to participate in the study, a study proforma were filled. All patients participated in the study were undergo thorough clinical examination, laboratory investigations and Ultrasonographic examination. Intraoperative finding were noted for each patient undergoing study

Laparoscopic cholecystectomy

Steps: Pneumoperitoneum created by Veress needle entry either at umbilicus or at Palmer's point. The trocar placement (10 mm at umbilicus, 10 mm epigastric, 5 mm ports are placed in the right lateral subcostal position and right subcostal mid-clavicular line). The fundus has been grasped and retracted cephalad to expose the proximal gallbladder and the hepatoduodenal ligament. Another grasper retracts the gallbladder infundibulum poster laterally to better expose the triangle of Calot's. The triangle of Calot has been opened and the neck of the gallbladder and part of the cystic duct dissected free. The critical view of safety has been achieved. Cystic artery is clipped and divided followed by Cystic duct is clipped and divided. Gall bladder dissected off liver bed**.** Specimen removal and followed by ports removal.

Open cholecystectomy

Although this operation can be performed safely through a midline, paramedian, or right subcostal incision, we preferred the right subcostal (Kocher) incision.

Statistical analysis

Categorical variables (gender, pain abdomen) expressed as Number of patients and percentage of patients and compared across the groups using Pearson's Chi Square test for Independence of Attributes. Continuous variables (age, biochemical parameters etc.) were expressed as Mean±Standard Deviation and compared across groups using unpaired t test/One Way ANOVA if the data follows normal distribution and Mann-Whitney U test/Kruskal Wallis Test if the data does not follow normal distribution. Univariate linear/logistic regression analysis was used to find the significant risk factors depending upon whether the response variable is continuous or categorical. Those found significant on univariate analysis will be analyzed using multivariate linear/logistic regression model depending upon whether the response variable is continuous or categorical. The statistical software SPSS version 20 will be used for the analysis. An alpha level of 5% has been taken, i.e. if any p value is less than 0.05 it will be considered as significant.

RESULTS

Total no. of cases included in the study were 300. Total no. of attempted laparoscopic cholecystectomy was 300. no. of successful laparoscopic cholecystectomy was 273. No. of conversions to open cholecystectomy were 27.

Table 1: Distribution based on conversions to open cholecystectomy.

Conversion to open cholecystectomy	N	%
Yes	27	9
No	273	91
Total	300	100

Age with conversion

In 27 patients conversion to open cholecystectomy were done in which 10 were in 51-60 yrs age group ,7 were in 41-50 yrs age group, 5 were in 61-70 yrs age group, 3 were in 71-80 yrs age group, 2 were in 31-40 yrs age group. The mean age for successful laparoscopic cholecystectomy were 45.01 with a standard deviation of ±12.26. The mean age for converted open cholecystectomy were 55.74 with a standard deviation of ±10.39. In this study age was found to be statistically significant for conversion to open operation (p value of 0.010).

History of pain with conversion

Patients presented with pain (include first time pain or recurrent pain) out of 230 patients conversion to open operation were seen in 27 patient. Patients with other symptom (except pain) out of 70 patient no conversion seen. It was found to be statistically significant for conversion to open operation (p value of 0.003).

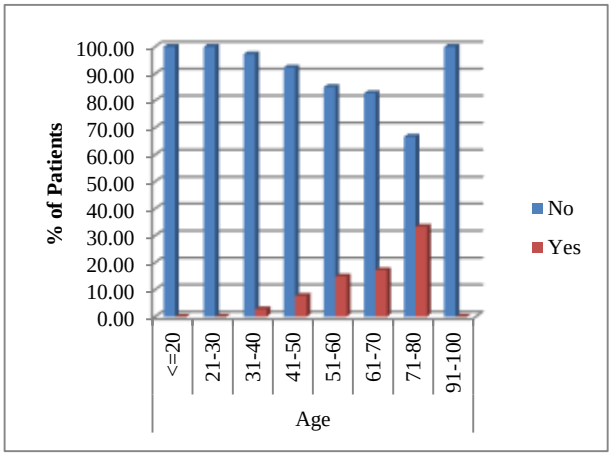

Figure 1: Age based distribution.

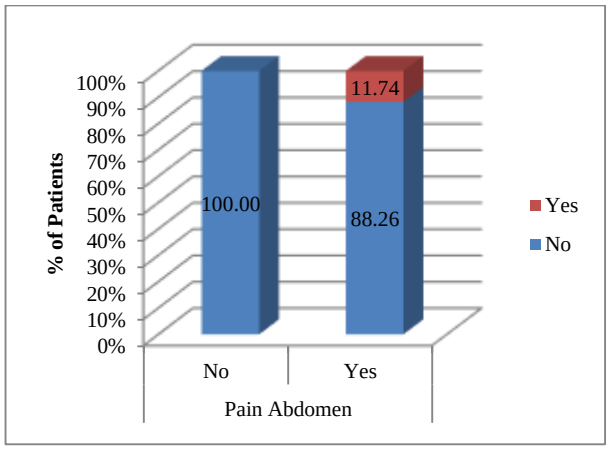

Figure 2: Abdominal pain-based distribution.

Previous history of acute cholecystitis with conversion

Out of the 101 with previous attack of cholecystitis, conversion to open surgery seen in 24 patients. Out of 199 patients without previous attack of cholecystitis conversion to open surgery seen in only 3 patients. Thus, there was a strong statistical co-relation present (p value of 0.001).

History of jaundice with conversion

Out of 287 patients with history of no jaundice pre-operatively, conversion seen in 23 patients, out of 13 patients with history of jaundice pre-operatively conversion seen in 4 patients. It was found statistically

significant for conversion to open surgery (p value of 0.005).

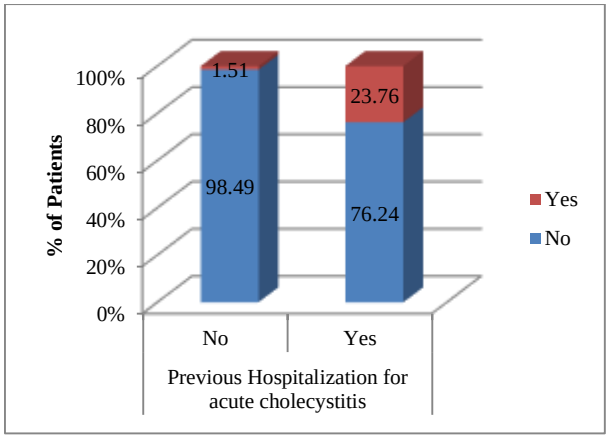

Figure 3: Previous hospitalization of acute cholecystitis.

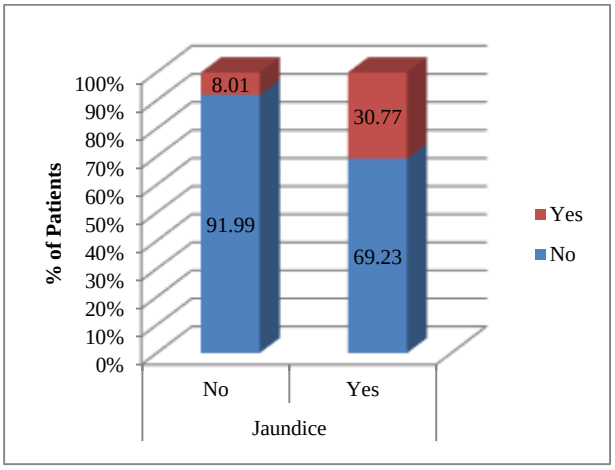

Figure 4: Distribution based on history of jaundice.

Previous abdominal surgery with conversion

Presence of previous abdominal operation was found in 65 out of the 300 patients. 12 out of these 65 patients were converted to open operation, 15 patients out of 235 converted to open surgery. This was found to be statistically significant (p value of 0.003). Out of 300 patient ,65 patient had a history of previous surgery (divided into infraumbilical and supraumbilical) 59 patients with infraumbilical had 8 conversions to open surgery, 4 out of 6 supraumbilical were converted to open surgery. P value of 0.003 which was found statically significant.

BMI with conversion

In comparison of patients whose BMI>25, out of 101 patients conversion to open was seen in 10 patients. In other group, whose BMI<25 out of 199 patients, conversion to open was seen in 17. This difference was statistically not significant (p value of 0.698).

Co-morbid condition with conversion

The presence of comorbid diseases (e.g. Diabetes, hypertension, hyperthyroidism, chronic obstructive pulmonary disease, rheumatic diseases, ischemic heart diseases, etc.) for which patient is on regular medication was collected. In comparison of patient with co-morbid condition, out of 195 patients without any co-morbid condition conversion to open seen in 8 patients, out of 105 patients with co-morbid condition conversion seen in 19 patients. This difference was strongly statistically significant (p value of 0.001).

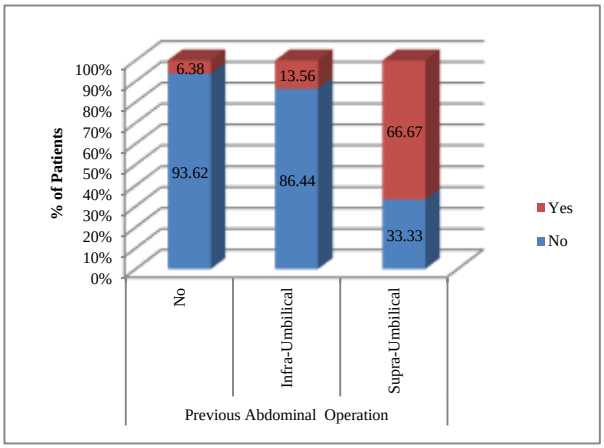

Figure 5: Distribution based on history of previous abdominal surgery.

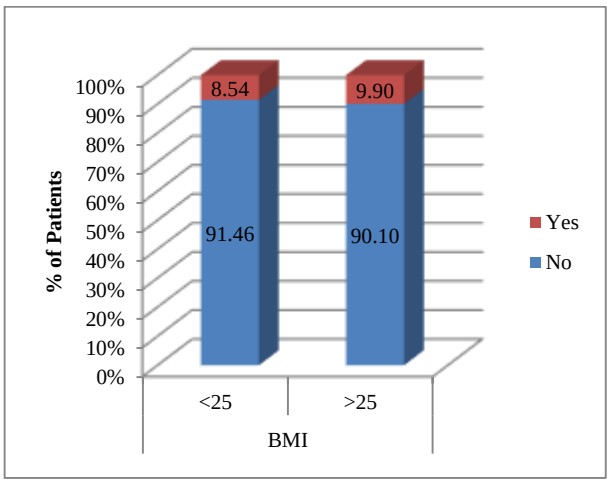

Figure 6: Distribution based on BMI.

GB wall thickness with conversion

Out of 109 patients with a gall bladder wall thickness of >3 mm, conversion to open surgery was in 25 patient
Out of the remaining 191 patients with gall bladder wall thickness <3 mm, conversion to open was seen in 2 patients. This difference was statistically significant (p value of 0.001). In patients converted to open cholecystectomy (9%); Chronic infection with gall bladder adhesions was found to be the most common

cause of conversion -33.3%. Acute infection with gall bladder adhesion was found to be the second most common cause of conversion 18.5%. Injury to bile duct and uncontrolled bleeding (cystic artery, hepatic artery, liver bed bleed) the third and fourth common cause; 14.8%, 14.8% respectively followed by thermal injury to gut 11.1% and last Mirrizi disease 7.4% least common cause of conversion.

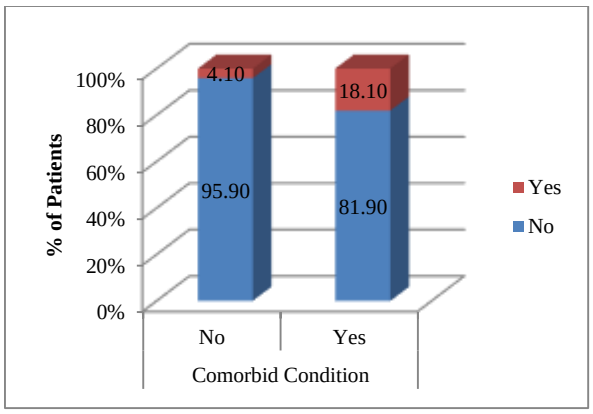

Figure 7: Distribution based on co-morbid condition.

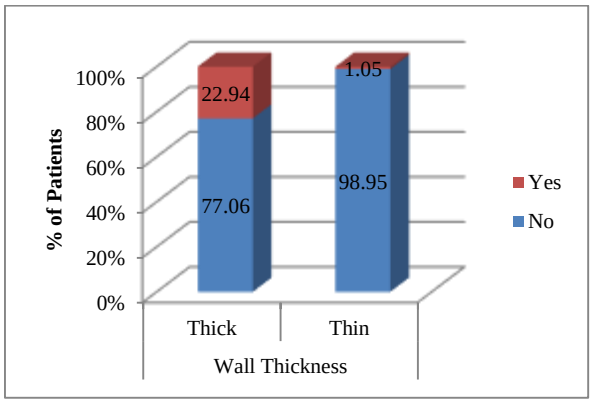

Figure 8: Distribution based on GB wall thickness.

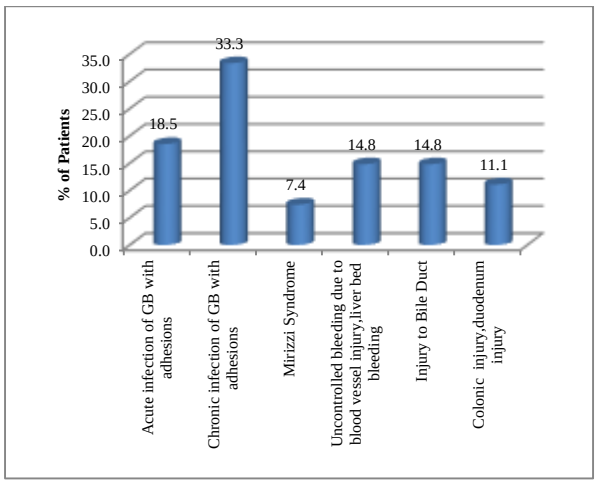

Figure 9: Intra-operative cause of conversion to open cholecystectomy.

DISCUSSION

In our study 9% patient were converted to open cholecystectomy while 91% of the patient underwent successfully laparoscopic cholecystectomy. Different pre operative parameter were taken during study like age of patient (p value of 0.001), history of pain abdomen (p value of 0.003),previous of history acute cholecystitis (p value of 0.001), history of jaundice (p value of 0.005), previous abdominal surgery history (p value of 0.003), co-morbid condition (p value of 0.003), increased total leucocyte count (p value of 0.001), increased total bilirubin (p value of 0.001), increased alkaline phosphatase (p value of 0.001), increased alanine transaminase (p value of 0.001), increased aspartate transaminase (p value of 0.019) were found significant in my study while other parameters like gender of patient (p value of 0.07), body mass index (p value of 0.698), palpable gall bladder (p value of 0.547), direct bilirubin (p value of 0.220), and gamma GGT (p value of 0.667) were found statistically not significant in my study Male sex has been identified as a risk factor for conversion in several series (due to dense fibrosis and inflammation).[8,9] According to Liu et al no increased risk of conversion in relation to gender of patient.[10] But this study did not find gender to be statistically significant for conversion to open operation (p value of 0.070).

Table 2: Conversion rate.

Study results	Conversion rate (%)
Peters et at[9]	14
Kumar et al[22]	7.81
Alponat et al[18]	7.4
Anand et al[23]	11.93
Shamim et al[24]	6.5
Our study	9

In this study, mean age in a patients for uneventful laparoscopy cholecystectomy was found to be 45.01 years and patients who required conversion were found to have a mean age of 55.74 years and it was significant statistically (p value of 0.010) Liu et al, Simopolous et al and Kanaan et al reported that patients treated successfully by LC were generally younger than 50-60 years of age; in comparison, patients who required conversion had a mean age of more than 50 years, Atmaram et al found the average age of the patient in converted patients to be more than 60 years.[10-13] Pain abdomen (acute cholecystitis, recurrent acute cholecystitis) found significant in my study (p value of 0.03) which has been also reported in studies by Volkan et al, Wiebke et al.[14,15] Previous abdominal surgery found significant in my study (p value of 0.001) which has been also reported in study by Liu et al, Genc et al, Wiebke et al.[10,14,15] Pre-operative jaundice found stastically significant (p value of 0.005) which has been also reported in study by Hussein et al and also by van der Steeg et al.[16,17] The presence of co morbid diseases (e.g.

diabetes, hypertension, hyperthyroidism, chronic obstructive pulmonary disease, rheumatic diseases, ischaemic heart diseases, etc) for which patient is on regular medication was collected and found to have statically significant (p value of 0.001) which has been also reported in study by Simopolous et al, Bhar et al, had found diabetes and hypertension as to be significantly correlated with an increased conversion rate to open operation.[7,11] Increased total leucocyte count found significant in my study for conversion to open surgery which has been also reported in study conducted by Alponat et al.[18] Increased in total bilirubin, alkaline phosphatise, alanine transaminase, aspartate transaminase found significant (p value of <0.05) for conversion to open surgery which has been reported in study by Ambe et al and Rosen et al.[9,19] Increased wall thickness of gall bladder (p value of 0.01), pericholecystic fluid collection (p value of 0.04), stone impaction at gall bladder neck (p value of 0.001) found significant in my study for conversion to open surgery which has been also reported by Lal et al, Singh et al, Kumar et al.[20-22]

The conversion rate in our study was slightly higher as compared to other latest international studies as Laparoscopic cholecystectomy was attempted in all patients which is a well-documented reason for conversion rate to be higher [19] Further study required to be done to validate multiple pre-operative parameters prospectively in different study populations.

Limitations and strengths

Strength of current study was; in my study more pre-operative parameters (>20) were taken at a time. Limitations of current study were; In most of the study done previously large (>1000) sample size were taken, in our study sample size were 300 which is very less. Ultrasonography is an operator dependent procedure so variation may occur while assessing gall bladder thickness (25/27), pericholecystic fluid collection (14/27) which is the most pre operative parameters were seen in case of conversion which may be missed and Surgery were performed by multiple surgeons so the rate of conversion may differ from surgeon to surgeon depending on experience of the surgeon.

CONCLUSION

In our study 9% patient were converted to open cholecystectomy. The implications from our study are that the patients will be better prepared regarding the risk of conversion rate. The surgeon can stratify the risk for each individual patient; thus, the surgeon is better prepared in reducing intraoperative complications and allow an earlier conversion to open. We conclude that Laparoscopic cholecystectomy is the gold standard treatment for gall stone disease. Chronic infection and acute infection of the gall bladder both increase the risk of conversion to open operation. Injury to the Bile duct and artery inevitably leads to conversion. Identification and safeguarding the bile ducts and artery is of utmost importance.

Recommendations

Further study needed to validate multiple pre-operative parameters in different study population. Studies with a larger sample size are recommended to come to strong conclusions.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Bailey A, Love S. The gall bladder and bile duct. In: Williams NS, Bulstrode CJK, eds. Short practice of surgery. 26th ed. USA: Taylor and Francis group; 2013:1097-117.
2. Supe A. Gallstones and Laparoscopic Cholecystectomy. JAMA. 1993;269(8):1018-24.
3. Pitchumoni CS. Increasing prevalence of Gallstones: Diagnostic and therapeutic Options. Med Update. 2010;5:486-90.
4. Kumar S, Tiwary S, Agrawal N, Prasanna G, Khanna R, Khanna A. Predictive factors for difficult surgery in laparoscopic cholecystectomy for chronic cholecystitis. Int J Surg. 2007;16(2):12-8.
5. Nachnani J, Supe A. Pre-operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters. Indian J Gastroenterol. 2005;24(1):16-8.
6. Fischer JE. Laparoscopic cholecystectomy, intraoperative cholangiography and common bile duct exploration. In: Mastery of surgery. 6th ed. India: Wolters Kluwer Pvt. Ltd; 2012:1265-76.
7. Bhar P, Ray RP, Halder SK, Bhattacharjee PK. Pre-operative prediction of difficult laparoscopic cholecystectomy. Indian Med Gazette. 2013;147(4):128-33.
8. Kamran K, Afridi Z, Muqim R, Khalil J. Does sex affect the outcome of laparoscopic cholecystectomy?. A retrospective analysis of single center experience. Asian J Endosc Surg. 2013;6:21-5.
9. Ambe PC, Lothar K. Is the male gender an independent risk factor for complication in patients undergoing laparoscopic cholecystectomy for acute cholecystitis. Int Surg. 2015;100(5):854-9.
10. Liu CL, Fan S, Lai EC, Lo CM, Chu KM. Factors affecting conversion of laparoscopic cholecystectomy to open surgery. Arch Surg. 2011;131(1):98-101.
11. Simopoulos C, Botaitis S, Polychronidis A, Tripsianis G, Karayiannakis AJ. Risk factors for conversion of laparoscopic cholecystectomy to open cholecystectomy. Surg Endosc. 2005;19:905-9.
12. Kanaan SA, Murayama KM, Merriam LT, Dawes LG, Prystowsky JB, Rege RV, et al. Risk factors for

conversion of laparoscopic to open cholecystectomy. J Surg Res. 2002;106:20-4.
13. Atmaram DC, Lakshman KM. Predictive factors for conversion of laparoscopic cholecystectomy. Indian J Surg. 2011;73(6):423-6.
14. Volkan G, Marlen S. What necessitates the conversion to open cholecystectomy?. Clinics. 2011;66(3):417-20.
15. Wiebke EA, Pruitt AL, Howard TJ. Conversion of laparoscopic to open cholecystectomy: An analysis of risk factors. Surg Endosc. 1996;10(7):742-5.
16. Hussein A, Hussein BJ, Nawar YF. Conversion rate of laparoscopic cholecystectomy to open surgery at Al Karamah Teaching Hospital, Iraq. Surg Sci. 2015;6:221-6.
17. Steeg HJJ, Alexander S, Houterman S. Risk factors for conversion during laparoscopic cholecystectomy experiences from a general teaching hospital. Scand J Surg. 2015;100:169-73.
18. Alponat A, Kum CK, Koh BC. Predictive factors for conversion of laparoscopic cholecystectomy. World J Surg. 1997;21(6):629-33.
19. Wilson P, Leese T, Morgan WP, Kelly JF, Brigg JK. Elective laparoscopic cholecystectomy for all comers. Lancet. 1991;338;795-7.
20. Lal P, Agarwal PN, Malik VK, Chakravarti AL. A difficult laparoscopic cholecystectomy that requires conversion to open procedure can be predicted by preoperative ultrasonography. JSLS. 2002;6:59-63.
21. Singh K, Ohri A. Difficult laparoscopic cholecystectomy: a large series from north India. Ind J Surg. 2006;68:205-8.
22. Kumar S, Tiwary S, Agrawal N. Predictive factors for difficult surgery in laparoscopic cholecystectomy for chronic cholecystitis. Int J Surg. 2008;16(2):12-9.
23. Anand A, Pathania BS, Singh G. Surgery in laparoscopic cholecystectomy for chronic cholecystitis. JSLS. 2007;9)4):23-9.
24. Muhammad S, Amjad SM, Ashfaq AB, Mir MD. Reasons of conversion of laparoscopic to open cholecystectomy in a tertiary care institution. J Pak Med Assoc. 2009;59(7):38-43.

Cite this article as: Singh AK, Nayak PS, Dewangan KP. A prospective observational study of predictive factors for conversion of laparoscopic to open cholecystectomy. Int Surg J 2024;11:398-404.