Original Research Article

DOI: http://dx.doi.org/10.18203/2349-2902.isj20203084

Extra hepatic bile duct injury after laparoscopic cholecystectomy: a retrospective study

Ankit Gupta, Saurabh Agrawal*, Namrata Sharma, Nukum Parth

Department of General Surgery, Heritage Institute of Medical Sciences, Varanasi, Uttar Pradesh, India

Received: 24 June 2020 Accepted: 10 July 2020

*Correspondence: Dr. Saurabh Agrawal,

E-mail: saurabhms005@yahoo.co.in

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Laparoscopic cholecystectomy (LC), being one of the most common performed surgical procedure among the basic surgeries. Incidence of common bile duct (CBD) injury as high as 1.4-3% has been reported in some studies. The aim of this study was to estimate the incidence and predictors of CBD injury who underwent elective laparoscopic cholecystectomy.

Methods: A retrospective observational study conducted at Heritage Institute of Medical Sciences, Varanasi, Uttar Pradesh India. Data was collected for a period of 1 year between March 2019 till 2020.

Results: In majority of laparoscopic cholecystectomy we encountered moderate degree of difficulty. Extra hepatic bile duct injuries occurred in 1.4% of cases and were classified according to Strasberg classification. Type A injury was most common followed by type E2. Most major bile duct injuries were recognized intraoperatively. No mortality was noted in our study.

Conclusions: Bile duct injuries is a major complication of laparoscopic cholecystectomy with significant morbidity and mortality, reduced survival impaired quality of life and subsequent litigations. Majority of bile duct injuries, results mainly from the surgeon's inexperience, misinterpretation of anatomy and poor surgical techniques.

Keywords: Laparoscopic cholecystectomy, Bile duct injury, Critical view of safety, Operative grading system for cholecystitis severity

INTRODUCTION

Laparoscopic cholecystectomy (LC), one of the most commonly performed surgical procedures worldwide is accepted as the gold standard in the treatment of symptomatic gallstones. Morbidity and mortality rates have been traditionally used to measure the outcome in a surgery. The outcome of laparoscopic cholecystectomy in literature has been assessed by many different outcomes measures common bile duct (CBD) injuries, conversion rates, morbidity and mortality. The incidence of CBD injury appeared to be more during the initial early learning curve and was related to early experience with LC. Despite the broad experience of the

surgeons in LC incidence of CBD injury as high as 1.4% has been reported in some studies. Pre-operative assessment of factors is needed in order to avoid complications and guarantee an efficient course of surgery. Outcome of LC is particularly affected by the presence and severity of inflammation, advancing patient's age, male sex and greater body mass index. Previous upper abdominal surgery is associated with a higher rate of adhesions, an increased risk of operative complications, a greater conversion rate, a prolonged operating time and longer stay. Lade and the procedure resulted in optimized intraoperative processes, such as documentation of the 'critical view of safety' (CVS), first described by Strasberg and colleagues almost 20 years ago. 13.14 The

aim of this study was to estimate the incidence and predictors of CBD injury who underwent LC.

METHODS

A retrospective observational study was conducted at Heritage Institute of Medical Sciences, Varanasi, Uttar Pradesh India. Data was collected for a period of 1 year between March 2019 till 2020. Data was taken from administrative discharge database. Five hundred patients who underwent elective LC within 1 year of timeframe were included in the study. Diagnosis of gall stone disease was made clinically and confirmed radiologically. All the patients were taken for elective LC after taking informed written consent and were operated by surgeons who had more than 2 years' experience of laparoscopic surgery. Pneumoperitoneum was created by Veress needle or by Hassan's technique depending upon the surgeon preference. Intraoperative finding was noted and based on intraoperative findings, grading of degree of difficulty of surgery was assessed. Reference of the intraoperative scoring system was taken from the study of Sugrue et al (Table 1).15

Table 1: Operative grading system for cholecystitis severity.

	- C
Operative predictor	Score
Difficulty in access	
BMI >30	1
Adhesions from the previous surgery	1
limiting access	1
Gall bladder and omental adhesion	
No adhesion	
Adhesions, 50% of gall bladder	Max 3
Adhesions burying gall bladder	
Appearance of gall bladder	
Distension/contraction distended GB (or	1
contracted shrivelled GB)	1
Unable to grasp with atraumatic	1
laparoscopic forceps	1
Stone ≥1 cm impacted in Hartman's pouch	1
Severe sepsis/complications	
Bile or pus outside GB	1
Time to identify cystic artery and duct >90	1
minutes	1
Total max	10
Grading of difficulty	
Mild	2
Moderate	2-4
Severe	5-7
Extreme	8-10

^{*}Score 0 for no adhesion; score 1 for, 50 % adhesion; score 2 for adhesion in between 50% and completely buried gall bladder; and score 3 when gall bladder is completely buried in adhesion.

Grading of degree of difficulty of surgery was assessed on the basis of following aspects; difficulty in access, omental and gall bladder adhesions, appearance of GB, severe sepsis or complications, and time taken to dissect Calot's triangle. Predictors of CBD injury were assessed based on grading of degree of difficult LC and visualization of critical view of safety (CVS). The CVS has three requirements. First; the hepatocytic triangle is cleared of all fat and fibrous tissues. Second, the lower one-third of the gallbladder is dissected off the liver to expose that portion of the cystic plate. The cystic plate by definition is the white fibrous tissue where the gallbladder is attached to the liver. The third component of the CVS is that two and only two structures are seen to enter the gallbladder. All three criteria must be fulfilled in order to claim that the CVS has been achieved. BDI was classified according to Strasberg classification (Table 2). The follow up protocol for patients who had bile duct injuries included clinical assessment and liver function test (LFT) every 2 months.

Table 2: Strasberg classification.

Types	Classification
Type A	Bile leak from cystic duct stump or minor biliary radical in gallbladder fossa.
Type B	Occluded right posterior sectoral duct.
Type C	Bile leak from divided right posterior sectoral duct.
Type D	Bile leak from main bile duct without major tissue loss.
Type E1	Transected main bile duct with a stricture more than 2 cm from the hilus.
Type E2	Transected main bile duct with a stricture less than 2 cm from the hilus.
Type E3	Stricture of the hilus with right and left ducts in communication.
Type E4	Stricture of the hilus with separation of right and left ducts.
Type E 5	Stricture of the main bile duct and the right posterior sectoral duct.

Statistical analysis

Statistical testing was conducted with the statistical package for the social science system version SPSS 22.0. Continuous variables are presented as mean \pm SD, and categorical variables are presented as absolute numbers and percentage.

RESULTS

In our study mean age of presentation was 42.5 years. Out of 500 patients 333 (66.66%) were female and 167 (33.33%) were male. Most common presentation was chronic cholecystitis 61.2% followed by acute cholecystitis 22.6% (Table 3). Degree of difficulty was assessed and severity score calculated as shown in (Table

1-4) and accordingly we encountered mild to severe degree of difficulty in 96.60% (483 patients).

Table 3: Diagnosis.

Diagnosis	Frequency	Percent
Chronic cholecystitis	306	61.2
Acute cholecystitis	113	22.6
Gall stone induced pancreatitis	21	4.2
Empyema gall bladder	28	5.6
Mucocele gall bladder	25	5.0
Mirizzi's syndrome	7	1.4
Total	500	100.0

Table 4: Degree of difficulty.

Degree of difficulty	Frequency	Percent
Mild	124	24.8
Moderate	279	55.8
Severe	80	16.0
Extreme	17	3.4
Total	500	100.0

In majority of laparoscopic cholecystectomy, we encountered moderate degree of difficulty. Critical view of safety (CVS) was documented in more than 95% of cases (476 cases) (Table 5).

Type 5: Documentation of CVS.

CVS	Frequency	Percent
Yes	476	95.2
No	24	4.8
Total	500	100.0

Table 6: Laparoscopic cholecystectomy converted to open cholecystectomy.

Diagnosis	Number of cases (n=21)
Chronic cholecystitis	03
Acute cholecystitis	10
Gall stone induced pancreatitis	04
Empyema gall bladder	02
Mucocele gall bladder	01
Mirizzi's Syndrome	01
Total	21

Extra hepatic bile duct injury occurred in seven patients (1.4% cases) and these injuries were classified according to Strasberg classification (Table 7).

Planned laparoscopic cholecystectomies were converted to open cholecystectomy in 21cases 4.2% either due to intraoperative difficulties when degree of difficulty found was severe to extreme, extra hepatic bile duct injuries and non-documentation of CVS. Total of 21 cases 4.2% were converted to open surgery and most of them were acute cholecystitis (10 cases), followed by gall stone induced pancreatitis (4 cases all were index cholecystectomies) (Table 6).

Table 7: Distribution of patients as per Strasberg classification.

Type of injury	Distribution of cases (n=7)
A	04
В	00
С	00
D	01
E 1	00
E2	02
E3	00
E4	00
E5	00

Out of seven injuries, most of the injuries occurred when degree of difficulty was severe to extreme (5 out of 7 cases). Other two injuries occurred when degree of difficulty was mild and moderate respectively and occurred due to misinterpretation of anatomy and slippage of clips while ligating cystic duct. Out of these seven, three injuries (one case type D and two cases type E) were recognized intra operatively and were managed accordingly. Type A injury (4 out of 7 cases) were on endoscopic retrograde cholangiodiagnosed pancreatography (ERCP) post operatively. ERCP was followed by endoscopic papillotomy (EPT) and insertions of 10 or 12 French plastic stent into common bile duct. Sub hepatic bilioma was drained by ultrasound guided percutaneously placed pig-tail catheter whereas in diffuse biliary peritonitis re-laparoscopy or laparotomy was done with peritoneal lavage and placement of drain. Bile leak subsided in a mean period of 10 days (4 days to 4 weeks) and drain/pig-tail was removed after 10-14 days. One patient developed mild post-ERCP pancreatitis which was managed conservatively. One patient had partial transection of common bile duct (type D) that was repaired over T-tube. T-tube was removed after 21 days after T-tube cholangiogram. Two patients had complete transection of the common bile duct (type E2) and were intra operatively and recognized underwent hepaticojejunostomy with trans jejunal stents. Postoperative recovery was uneventful in all these three patients. Stents were removed after 3 months after proper assessment. In our study no mortality was noticed.

DISCUSSION

Carl Langenbuch performed the first open cholecystectomy in 1882. ¹⁶ Open cholecystectomy (OC) remained the gold standard for treatment of gall stone until the late 1980s when LC was introduced by Erich

Muhe and now has become gold standard for cholelithiasis.¹⁷ During the initial learning curve for this new technique there was rise in the reports of bile duct in juries, resulting mainly from the surgeon's inexperience and misinterpretation of anatomy.¹⁸ There is some evidence, which shows that the incidence of CBD injury decreases with increasing experience of the surgeon.¹⁹ This in fact is suggested by the results of two prospective audit surveys from the West of Scotland and Switzerland. 20-23 In the Scottish audit the incidence fell from 0.8% to 0.4% with increasing experience and in the Swiss audit from 0.6% to 0.3%. All the available evidence indicates that misinterpretation of the anatomy is the dominant factor and it accounts for 70% of biliary duct injuries sustained during LC.^{20,21} In our study female predominance is seen which co relates with the literature.²⁴ Repair of a bile duct injury increases the cost as well as hospital stay and carries the risk of complications and even death.²⁵ Early recognition (during operation or in the early post-operative period) improves the outcome and reduces the costs.²⁶ In our study, 3 cases of major CBD injury were recognized intra-operatively.²⁴ Recently there is increasing trend to perform laparoscopic cholecystectomy at index admission of acute cholecystitis. Intraoperative scoring system will provide indications for conversion to open surgery and allow for assessment of outcome.²⁷ Various scoring system are used to access the severity of difficult LC so as to reduce the morbidity and mortality associated with LC. In our study we used scoring system designed by Sugrue et al.¹⁵ for assessment of degree in difficult in LC and we used this scoring system to predict conversion to OC and CBD injuries.

In our study most common presentation was chronic cholecystitis 56% followed by acute cholecystitis 28% which is similar to study done by Sahu and colleagues. In our study, we encountered majority of the CBD injury when the score was 6 or more. We also encountered mild to severe degree of difficulty in 96.60% (483 patients) and when the score was 7 or more conversion to OC was done which is similar to study done by Kumar et al. In an effort to reduce the rate of biliary injury, the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) launched the safe cholecystectomy task force with the goal of enhancing a universal culture of safety around this operation. Set program was formed to minimize these injuries (Table 8).

A retrospective analysis to evaluate the feasibility and efficacy of this protocol was recently reported by Barot et al where after implementation of the 6-step program, CVS achievement was increased from 57.1% to 95.1% and recognition of aberrant anatomy increased from 1.4% to 8.7%.³⁰ The rate of intra-operative complications also decreased significantly from 5.7% to 0%.³⁰ In our study CVS was documented in more than 95% (476 cases), and in remaining 24 cases in whom CVS was not achieved 21 cases 87.5% were converted to open surgery due to anatomical difficulties intra-operatively (with severity

score 7 or more), while in remaining 3 patients 12.5% operations were converted to open surgery due to bile duct injuries. It is clear from the literature that bile duct injuries occur even in the hands of experienced and competent surgeons but, obviously, inexperience increases the risks. Even a "simple" gallbladder (resection) may result in a catastrophe, due to misunderstanding of CVS as described by Strasberg. Incidence of CBD injury in whom CVS was not achieved was 71.2% (5 cases). Nijssen and colleagues found an overall BDI rate of 1.7%. Of these 0.6% was major BDIs.³¹ In their analysis, they found that the operative notes indicated that the CVS was achieved in 80%, but on video review the authors found that the CVS was actually achieved in only 10.8% of cases.

Table 8: SAGES 6 steps program for prevention of bile duct injury during laparoscopic cholecystectomy.

Steps	Strategies
Step 1	Use the critical view of safety (CVS) method of identification of the cystic duct and cystic artery during laparoscopic cholecystectomy.
Step 2	Understand the potential for aberrant anatomy in all cases.
Step 3	Make liberal use of cholangiography or other methods to image the biliary tree intraoperatively.
Step 4	Consider an intraoperative time-out during laparoscopic cholecystectomy prior to clipping, cutting or transecting any ductal structures.
Step 5	Recognize when the dissection is approaching a zone of significant risk and halt the dissection before entering the zone. Finish the operation by a safe method other than cholecystectomy if conditions around the gallbladder are dangerous.
Step 6	Get help from another surgeon when the dissection or conditions are difficult.

Most importantly, the CVS was not reached in any of the patients with biliary injuries which are similar with our study that achieving CVS is important step before ligating cystic duct to avoid BDI. In the setting of a difficult gallbladder in which the CVS cannot be obtained, this should alert the surgeon to the potential danger in persistence with the dissection. Several strategies are available. One is to do a cholangiogram or other means of intraoperative biliary imaging to prevent BDIs. Recently, the Gallriks study group reported incidence of BDIs was 1.5%. They used intra operative cholangiography (IOC) for earlier detection of injury and reduce the risk of death by 69%.32 Sheffield and colleagues in their study found that there was no significant association between use of IOC and duct injury.³³ Study conducted by Gharaibeh et al in 2001, incidence of bile duct injury reported was 0.30% as compared to our study where bile duct injury were seen in 1.4%. ³⁴According to the literature, the leak may be minor, arising from a small, accessory bile duct and clinically insignificant; such cases should be treated with percutaneous drainage.³⁵ In our study minor biliary leaks (type A) were common (four of seven); and were due to loosely applied clips to the cystic duct and these cases were managed by ERCP and stenting. Injuries to the accessory bile duct are the most common cause of postoperative bile leak.³⁶ ERCP can be both diagnostic and therapeutic. ERCP and stenting has proved to hasten the recovery. In those bile duct injury where a portion of the bile duct is lost and simple repair, as may be done in transection and laceration, is not possible major surgeries are performed.³⁷ This is the reason why in our study (2 cases) with major extrahepatic biliary duct injures (type E2) underwent hepatojejunostomy, while in other case where CBD was partially transected (type D), repair was done with T tube placement.

CONCLUSION

Laparoscopic cholecystectomy has become treatment of choice for symptomatic cholelithiasis, and is associated with increased risk of bile duct injury with significant morbidity and mortality, reduced survival impaired quality of life and subsequent litigations. Documentation of critical view of safety is important step in laparoscopic cholecystectomy to reduce the risk of bile duct injury. Intra operative scoring system helps us to predict the severity and grading the difficulty in performing laparoscopic cholecystectomy. Both morbidity and mortality can be reduced if these injuries are diagnosed early and prompt treatment is given.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. Parul R. Agrawal for her valuable inputs and also sincere thanks to medical department for their cooperation.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

REFERENCES

- Sahu SK, Agrawal A, Sachan PK. Intra-operative Difficulties in Laparoscopic Cholecystectomy. Jurnalul de Chirurgie. 2013;2:149-55.
- 2. Choudhry NK, Wright JG, Singer PA. Outcome rates for individual surgeons: concerns about accuracy, completeness, and consequences of disclosure. Surgery. 1994;115:406-8.
- 3. Russell EM, Bruce J, Krukowski ZH. Systematic review of the quality of surgical mortality monitoring. Br J of Surg. 2003;90:527-32.

- 4. Martin RCG, Brennan MF, Jaques DP. Quality of complication reporting in the surgical literature. Ann Surg. 2002;235:803-13.
- 5. Birkmeyer JD, Dimick JB, Birkmeyer NJ. Measuring the quality of surgical care: structure, process, or outcomes. J Am Coll Surg. 2004;198:626-32.
- 6. Mant J. Process versus outcome indicators in the assessment of quality of health care. Int J Qual Health Care. 2001;13:475-80.
- 7. The Southern Surgeons Club. A prospective analysis of 1518 laparoscopic cholecystectomies. N Engl J Med. 1991;324:1073-8.
- 8. Windsor JA, Pong J. Laparoscopic biliary injury: more than a learning curve problem. Aust N Z J Surg. 1998;68:186-9.
- 9. Calvete J, Sabater L, Camps B. Bile duct injury during laparoscopic cholecystectomy: myth or reality of the learning curve. Surg Endosc. 2000;14:608-11.
- 10. Sodergren M, Espina OF, Clark J, Teare J, Yang G. Evaluation of orientation strategies in laparoscopic cholecystectomy. Annals Surg. 2010;252:1027-36.
- 11. Kanakala V, Borowski DW, Pellen MG, Dronamraju SS, Woodcock SA. Risk factors in laparoscopic cholecystectomy: a multivariate analysis. Int J Surg. 2011;9:318-23.
- 12. Bouasker I, Ouaer EMA, Smaali I, Khalfallah M, Achour BJ. Laparascopic cholecystectomy on a previously operated abdomen. Tunis Med. 2010;88:88-91.
- 13. Sanford DE, Strasberg SM. A simple effective method for generation of a permanent record of the Critical View of Safety during laparoscopic cholecystectomy by intraoperative 'doublet' photography. J Am Coll Surg. 2014;218:170-8.
- 14. Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg. 1995;180:101-25.
- Sugrue M, Sahebally SM, Ansaloni L, Zielinski MD. Grading operative findings at laparoscopic cholecystectomy: a new scoring system. World J Emergency Surg WJES. 2015;10:14.
- 16. Langenbuch CJA. Ein Fall von Extirpation Gallenblase wegen chronischer Cholelithiasis: Heilung. Berl Klin Wochenschr. 1882;19:725-7.
- 17. Mouret P. From the first laparoscopic cholecystectomy to the frontiers of laparoscopic surgery: the prospective future. Dig Surg. 1991;8:124.
- 18. Huang ZQ, Huang XQ. Changing patterns of traumatic bile duct injuries: A review of forty years' experience. World J Gastroenterol. 2002;8:5-12.
- 19. Moore MJ, Bennett CL. The learning curve for laparoscopic cholecystectomy: The Southern Surgeons Club. Am Surg. 1995;170:55-9.
- 20. Fullarton GM, Bell G. Prospective audit of the introduction of laparoscopic cholecystectomy in the west of Scotland; West of Scotland Laparoscopic

- Cholecystectomy Audit Group. Gut. 1994;35:1121-6.
- Richardson MC, Bell G, Fullarton GM. The West of Scotland Laparoscopic Cholecystectomy Audit Group; Incidence and nature of bile duct injuries following laparoscopic cholecystectomy: an audit of 5913 cases. Br Surg. 1996;83:1356-60.
- 22. Schlumpf R, Klot HP, Wehrli H, Herog U. A nation's experience in laparoscopic cholecystectomy; prospective multicenter analysis of 3722 cases. Surg Endosc. 1994;8:35-41.
- 23. Z'graggen K, Wehrli H, Metzger A. Swiss Association of Laparoscopic and Thoracoscopic Surgery; complications of laparoscopic surgery in Switzerland: a prospective 3 years study of 10, 174 patients. Surg Endosc. 1998;12:1303-10.
- 24. Waheeb R. Bile Duct Injuries Following Laparoscopic Cholecystectomy: A Clinical Study. Al-Kubati Saudi J Gastroenterol. 2010;16(2):100-4.
- 25. Russell JC, Walsh SJ, Mattie AS, Lynch JT. Bile duct injuries, 1989-1993. A state wide experience; Connecticut Laparoscopic Cholecystectomy Registry. Arch Surg. 1996;131:382-8.
- Asbun HJ, Rossi RL, Lowell JA, Munson JL. Bile duct injury during laparoscopic cholecystectomy: Mechanism of injury, prevention, and management. World J Surg. 1993;17:547-52.
- 27. Pisano M, Ceresoli M, Campanati L, Coccolini F, Falcone C, Capponi MG, et al. Should We must push for primary surgery attempt in case of acute cholecystitis? A retrospective analysis and a proposal of an evidence based clinical pathway. Emergency Med. 2014;4:201.
- 28. Kumar N. Assessment of Degree of Difficulty in Laparoscopic Cholecystectomy using Intraoperative Scoring System. J Clin Diagnostic Res. 2017;11.
- 29. Pucher PH, Brunt LM, Fanelli RD. SAGES expert Delphi consensus: critical factors for safe surgical practice in laparoscopic cholecystectomy. Surg Endosc. 2015;29:3074-85.

- 30. Barot TC, Canales A, Irving J. SAGES 6 steps Protocol for minimizing bile duct Injuries: a single center experience. SAGES 2016. Available at: https://www.sages.org/meetings/annual-meeting/abstracts-archive/sages-6-step-protocol-forminimizing-bile-duct-injuriesa-single-center-experience.
- 31. Nijssen MA, Schreinemakers JM, Meyer Z. Complications after laparoscopic cholecystectomy: A video evaluation study of whether the critical view of safety was reached. World J Surg. 2015;39:1798-803.
- Tornqvist B, Stromberg C, Persson G. Effect of intended intra-operative cholangiography and early detection of bile duct injury on survival after cholecystectomy: population-based cohort study. BMJ. 2012;345:6457.
- 33. Sheffield KM, Riall TS, Han Y. Intra-operative cholangiography during cholecystectomy. JAMA. 2013;310:812-20.
- 34. Gharaibeh KI, Ammari F, Heiss AH, Jaberi ATM, Qasaimeh GR, Hani BK, et al. Laparoscopic cholecystectomy for gallstones. Ann Saudi Med. 2001;21:312-6.
- 35. Morgenstern L, Berci G, Pasternak EH. Bile leak after biliary tract surgery: a laparoscopic perspective. Surg Endosc. 1993;7:432-8.
- 36. Balija M, Huis M, Szerda F, Bubnjar J, Stulhofer M. Laparoscopic cholecystectomy accessory bile ducts. Acta Med Croatica. 2003;57:105-9.
- 37. Lien HH, Huang CS, Shi MY, Chen DF, Wang NY, Tai FC, et al. Management of bile leakage after laparoscopic cholecystectomy based on etiological classification. Surg Today. 2004;34:326-30.

Cite this article as: Gupta A, Agrawal S, Sharma N, Parth N. Extra hepatic bile duct injury after laparoscopic cholecystectomy: a retrospective study. Int Surg J 2020;7:2517-22.