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Approach to a Patient with Post Laparoscopic Cholecystectomy Bile Leak

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Abstract

With the widespread practice of laparoscopic cholecystectomy and the advancements in imaging and endoscopic therapy the management of bile leaks following cholecystectomy has evolved over the years. Majority of the bile leaks are detected post-operatively. A high index of suspicion should exist for a possible bile leak if a patient presents with abdominal pain, fever, and tenderness within a week following a complicated or converted laparoscopic cholecystectomy, or it may present as an overt external biliary fistula. Leaks which are detected intra-operatively and managed appropriately carry the best prognosis. Interventional radiologists along with expert endoscopists can successfully manage many of the minor bile leaks. Major bile duct injuries should be properly characterized by appropriate imaging studies. One should avoid undue haste while opting for surgical interventions which are invariably required for such major injuries. Such repairs should be undertaken by expert hepatobiliary surgeons as the first repair has the greatest chance of success and failed repairs raises the level of injury making subsequent repairs more difficult.

Keywords: Laparoscopic cholecystectomy; Bile duct injury; External biliary fistula; Bilioma; Biliary ascites; Biliary reconstruction

Introduction

Laparoscopic cholecystectomy (LC) has become the gold standard treatment for symptomatic gall stone disease. Post cholecystectomy bile leak occurs mostly because of extra-hepatic bile duct injuries. It is a rare but potentially disastrous complication associated with significant morbidity and mortality, increase in healthcare expenses, and also is the commonest reason for medical litigation in gastrointestinal surgery [1].

In-spite of its many advantages, population-based studies have consistently reported a higher incidence of cholecystectomy-associated bile duct injury (BDI) following laparoscopic approach (0.4% to 0.6%) over the conventional open cholecystectomy (0.1% to 0.2%) [2,3]. Moreover, laparoscopy-related BDI tend to be complex, more proximal and often associated with concomitant vascular injury [4]. An important point to note in this context is that, surgeons who are mostly trained in laparoscopic approach may lack experience in difficult open cholecystectomy and the incidence of BDI may increase in their hands during "converted" cholecystectomy.

This article, based on review of the literatures available on this subject, describes in a systematic fashion the strategies the operating surgeon should adopt and the management guidelines to follow when faced with this dreaded complication.

Etiology of Post Cholecystectomy Bile Leak

Bile leak may be classified into a minor leak with low output drainage (<300 ml of bile/24 hours) or leaks due to major bile duct injury with high output drainage (>300 ml/24 hours). Cholecystectomy is the commonest cause of bile leak; it may also be a complication of any bilio-enteric anastomosis, percutaneous interventions, abdominal trauma or liver resections.

The majority of minor bile leak results from Strasberg type A injuries with intact biliary-enteric continuity and includes leaks from cystic duct (CD) stump (55%-71%) or small (less than 3 mm) subsegmental duct in gall bladder (GB) bed (16%) and minor ducts like cholecystohepatic duct or supravesicular duct of Luschka (6%) [5]. an injury to the supravesicular duct occurs if the surgeon dissects into the liver bed while separating the gall bladder. This duct does not drain the liver parenchyma.

A leak from the cystic duct stump may occur from clip failure due to necrosis of the stump secondary to thermal injury/pressure necrosis or when clips are used in situations where ties are appropriate (acute cholecystitis) and in a significant majority from distal bile duct obstruction caused by a retained stone and resultant blow out of the cystic stump [6].

Strasberg type C and type D injuries usually presents with minor leak as well. The former results when an aberrant right hepatic duct (RHD) or right posterior sectoral duct (RPSD) is misidentified as the CD and divided because the anomalous insertion of CD into either of these ducts [7].

Type D injuries are lateral injuries to the extra hepatic ducts (EHD) caused by cautery, scissors or clips (Figure 1). High output biliary fistulas are the result of major transectional injury of EHD (Strasberg type E). Here the common bile duct (CBD) is misidentified as the CD and is clipped, divided and excised [8]. This not only results in a segmental loss of the EHD but often associated with injury or ligation of right hepatic artery as well. Such devastating injuries are peculiar to LC and have been described by Davidoff as "classic laparoscopic biliary injury" [9].

Presentations

Only about one third of the injuries are recognized preoperatively [10]. The presentations of those detected in the post-operative period vary according to whether drains were used/functioned or not. Those with a functioning drain presents with a controlled high or low output (depending on the nature of injury) external biliary fistula (EBF).

The other group of patients without a functioning drain presents with uncontrolled leak from wound/drain site or serious complications

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like bilioma or biliary ascites secondary to intra-peritoneal bile collection either localized or generalized respectively, peritonitis and intra-abdominal abscesses. Thus if a patient fails to recover, appears ill or has any deviation from the projected clinical course after what appeared to be a routine LC, the surgeon must keep the possibility of biliary leak in mind and proceed accordingly. Skin complications never occur in pure biliary fistula (as opposed to duodenal fistula).

Fluid and electrolyte disturbances, deficiency of fat soluble vitamins, protein/calorie malnutrition and even coagulopathy are the secondary consequences of high output EBF persisting for >3 weeks. Bile mixed with some sweetened drink may be reefed do obviate such complications related to EBF [11].

Management

Early recognition is the most important part of the management of bile leak due to iatrogenic injuries. Recognition may be intra-operative or post-operative (early/late). Leaks which are detected intra-operatively and managed appropriately carry the best prognosis.

Intra-operative detection

The operating surgeon should suspect a possible bile duct injury if while operating he notices unexplained golden bile during dissection (bile from gall bladder is viscid and greenish while that from bile duct is golden yellow and watery), sudden hemorrhage which is difficult to control, or what he has divided or clipped as the "cystic duct" was unusually wide, and if distinct openings of divided ducts are visible while separating GB from liver bed. Finally, seeing the excised segment of the bile duct attached to the removed specimen of GB should confirm the suspicion.

If the injury is recognized the first step should be to convert to an open procedure at the earliest (thereby avoiding further dissection or clipping of the proximal duct) and wherever possible perform an intra-operative cholangiogram to confirm the injury and assess the site, type and extent of lost segment of EHD.

For surgeons working in the periphery without experience in complex biliary surgery or not having specialist support it would be prudent to transfer the patient to a tertiary care center with multidisciplinary facilities, after creating a controlled biliary fistula by cannulating the proximal biliary tree in a retrograde fashion as well as placing a sub-hepatic suction drain and closing the abdomen. Intravenous antibiotics should be started and a detailed operative note must be sent to the referral institute.

The first attempt of repair is the best time to fix the problem and should be done by an experienced biliary surgeon. Attempted repair by surgeons inexperienced in managing such injuries or by the primary surgeon himself has a low success rate and adversely affects the ultimate outcome [12].

Even if the operating surgeon is technically capable of performing the repair, a hepatobiliary consultation is always preferable. If exploration and cholangiography confirms a leaking supravesicular duct (Strasberg type A) simple ligation of the duct is all that is required. For injuries involving the RPSD (Strasberg type C), simple ligation will suffice if it is ≤ 3 mm in diameter (*draining a segment or less)*. However if the sectoral duct is ≥ 4 mm (*draining >1 segment but secluded from the main ducts)* a formal Roux-en-Y bilio-enteric drainage is required [12,13] (Figure 2).

Lateral injuries to major bile ducts (Strasberg type D) which are not caused by diathermy and involves <50% of the circumference are considered as "minor" injuries may be repaired with fine absorbable sutures over a T-tube, with the horizontal limb being brought out through a separate choledochotomy incision. On the other hand, such injuries are considered "major" when they are caused be diathermy, involves >50% of the circumference or when it involves very narrow ducts. Roux-en-Y hepatico-jejunostomy ensures tension free repair with good long term results for such "major" injuries [12,13].

In transectional injuries (Strasberg type E), the non-dilated, retracted and sometimes multiple ductal injuries make the repair difficult. All clips including those on the cystic artery are removed. The cystic artery and distal end of the bile duct are ligated. The transected common hepatic duct is cut back to a healthy portion, approximately

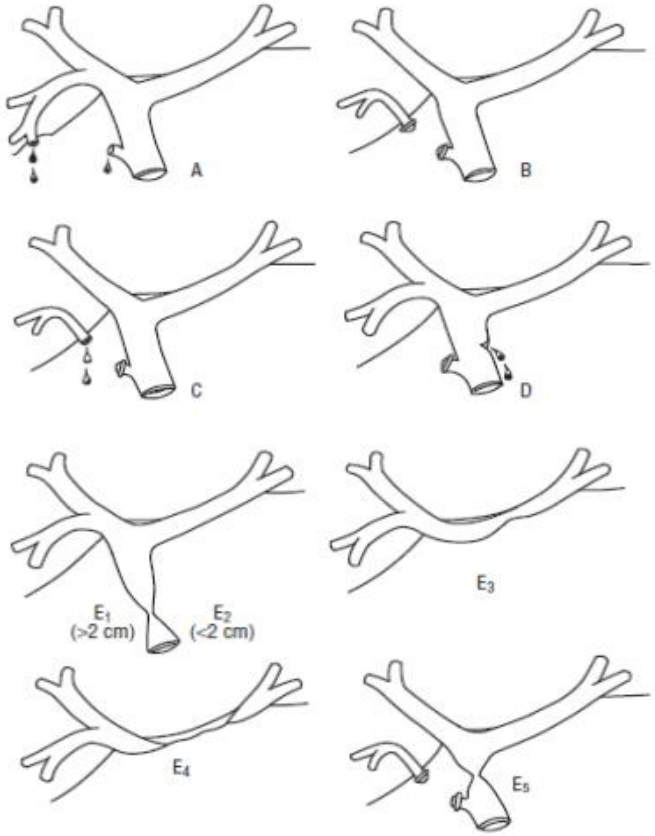

Figure 1: Strasberg classifications of biliary injury from laparoscopic cholecystectomy [16].

Figure 2: Strasberg type C injury: intraoperative cholangiogram done through transected RPSD showing secluded segment having no connection with the main biliary tree.

1cm from the confluence and divided. The procedure is completed by an end to side hepatico-jejunostomy with a 60 cm tension free Roux limb of jejunum with a trans-hepatic stent placed across the anastomosis for protective biliary decompression. This procedure is effective in 90% of the cases with low rate of late stricture but carries the risk of nutritional and metabolic disturbances because of duodenal exclusion and loss of intestinal absorptive surface area [13].

If the injured segment of the bile duct is <1 cm, injury is not close to the hilum, and proper mobilizations enables the transected ends can be approximated without tension, one may attempt a primary end-to-end repair over a T-tube. This approach has been criticized by some authors because of the very high rate of anastomotic stricture [13,14].

However now a days, expert endoscopists can treat such strictures with excellent results by balloon dilatation and stenting [15] (Figure 3).

Post-operative detection

Unfortunately, most of the bile duct injuries are not recognized preoperatively [10]. Optimal management of BDI detected postoperatively requires a good coordination between the radiologist, endoscopists and an experienced hepatobiliary surgeon [16]. As mentioned earlier such detection may be early or late.

There is a scope of re-laparoscopy, within 24 hours of surgery, in situations where a low output fistula (<300 ml/day) is confirmed (by reviewing the operative video), to be because of a slipped CD clip. Through lavage, clipping or tying the CD stump with an endoloop may be a simple solution. Such approach is not useful after 24 hours as inflammatory adhesions and edema will make the job difficult [17].

If low output *controlled* biliary fistula is detected after 24 hours, a wait and watch policy should be followed as many of the minor leaks will close within 5 to 7 days. If the leak fails to resolve or if the drainage amount is >300 ml/day (high output), an ERCP should be performed both to delineate the biliary tree and some therapeutic interventions if indicated. The possibilities in such scenarios may be either of the following.

Leaking duct of luschka: Endoscopic sphincterotomy to decrease endobiliary pressure and maintenance of percutaneous drain till bile leak stops is successful in most of the cases [18] (Figure 4).

Leak from a CD stump sometimes with choledocholithiasis: This requires endoscopic sphincterotomy, extraction of CBD stone if any followed by stenting; percutaneous drain is to be kept till drainage continues [19,20]. The plastic stent inserted into the CBD needs removal after 6 weeks. Recent studies on 528 patients with post LC bile leak have concluded that leaks from duct of Luschka or CD can be almost exclusively managed by endoscopist [15] (Figure 5).

Leaking RPSD: Here the ERCP does not demonstrate leak and may be apparently "normal", only careful scrutiny will reveal that ducts from a particular volume of the liver are not filling or direct cholangiogram of the involved segmental duct will demonstrate the secluded segment having no connection with the main biliary tree. As the leaking duct is not in continuity with CBD distal stenting will be ineffective. In such cases maintenance of percutaneous drain as a controlled EBF, control of sepsis and observation for a few weeks may lead to spontaneous closure by fibrosis in situations where the duct has sub segmental drainage (injury gets converted from Strasberg type C to Strasberg type B). In situations where the duct drains two or more segments the leak is expected to persist. These would require a Roux-en-Y bilio-enteric anastomosis after a waiting period of at least 6 weeks [16,21].

Another possibility is leak from lateral or partial injury to the bile duct where continuity of the biliary system is maintained (this includes

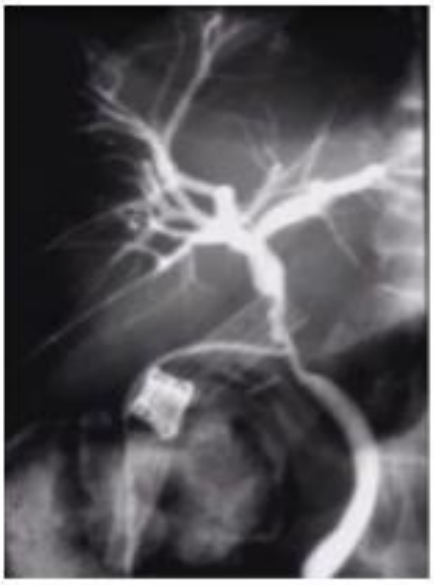

Figure 3: T-tube cholangiogram showing stricture at the site of end-to-end repair of a transected CBD.

Figure 4: ERCP showing leak from duct of Luschka.

Figure 5: ERCP showing leak from cystic duct stump.

lateral injury of the RHD or Stewart-Way class IV injuries also) [22]. These injuries are usually cautery or scissors induced. These injuries are classified under Strasberg type D, but when the injury involves >50% of the duct circumference they should be treated as Strasberg type E injuries [23]. When the injury is non-thermal, involves <50% of the duct circumference and the duct is not too narrow, endoscopic sphincterotomy, stenting across the injury, percutaneous drainage and control of sepsis results in closure in majority of the cases without any sequel [24]. When above measures fail an operative repair over a T-tube may be done. However, if these injuries involve >50% of the duct circumference or have been caused by diathermy or when the bile duct is very narrow, reconstruction by hepaticojejunostomy should be the preferred option [23].

A high output leak from complex bile duct injuries with transected common hepatic duct or CBD with loss of bilio-enteric continuity and associated vascular injuries are becoming more common as surgeons with increased confidence are performing laparoscopic cholecystectomy indiscriminately even in peripheral setups [25]. ERCP in such cases shows an abrupt termination of the dye at the region of the clips without proximal delineation ("Cholangiogram of doom") (Figure 6). Percutaneous transhepatic cholangiogram (PTC) would help to demonstrate the proximal biliary tree and help delineate the full extent and type of the injury. Subsequently such patients should be evaluated by a CECT abdomen to exclude intra-peritoneal collection (if there is drainable collection it should be drained by intervention radiology); the arterial phase picture would help in excluding associated vascular injury (20% of major BDI have associated hepatic artery injury) [4,26]. External drainage of the biliary system by placements of multiple percutaneous trans-hepatic stents would help in drying up leak from the injury site. The operatively placed abdominal drains should be maintained till it drains. These stents not only controls the leak and allows early removal of the abdominal drains, they also help in the intra-operative identification of the transected proximal end of the BD during subsequent repair. Prophylactic broad-spectrum antibiotics will help in controlling sepsis and periportal inflammation which may be induced by the various interventions. Definitive repair (tension free duct to mucosa Roux-en-Y hepatico-jejunostomy) should be done at an appropriate time (usually at three months) after resolution of the inflammatory process and giving due allowance for the ischemic ducts to die back to a point where they are adequately vascularized [27]. It is prudent to keep in mind that these repairs should be done by experts, as the first repair has the greatest chance of success and failed repairs raises the level of injury making subsequent repairs more difficult [12]. The basic principles of the repair are to use of a proximal healthy non-ischemic bile duct and creation of a tension free direct mucosa to mucosa anastomosis with an 60 cm long Roux-en-Y jejunal limb (Figure 6).

On the other hand, bile leak may present covertly 3 to 4 days after surgery, with anorexia, abdominal pain, bloating, mild jaundice with or without features of sepsis due to intra-peritoneal collection of bile either localized (bilioma) or generalized (biliary ascites). Surgeons should be vigilant and promptly investigate patients presenting with these postoperative symptoms. A CECT abdomen will be the best investigation in these circumstances to reveal bilioma or bile ascites. The approach to such patients should be to control sepsis by prompt drainage of the collection either by intervention radiology or formal laparotomy and serial imaging to rule out recollection. After the patient improves and a tract forms around the drain (usually after 2 to 3 weeks) a fistulogram may be done as a simple and cost-effective investigation to delineate the biliary tree [21]. Subsequent treatment at appropriate time is dictated according to the type of injury as described earlier.

Figure 6: ERCP showing complete cutoff of CBD ("Cholangiogram of doom").

Figure 7: MRCP showing Strasberg E2 type injury along with a thick walled subhepatic bilioma.

Delayed vs. early repair

Most important factors for successful biliary reconstruction include complete eradication of intra-abdominal infection, the proper characterization of the injury with cholangiography, proper surgical technique, and repair by an expert [9,14,26,28] (Figure 7).

Though the optimal time of operative repair remains controversial the standard teaching is to allow more than 6 weeks for intra-abdominal inflammation to subside before the repair is undertaken [28].

Some authors are in favor of an early repair (within 72 hours), provide there is no local infection, the injury has been properly characterized and the repair is done by an expert. They believe that this does not compromise the ultimate outcome and in fact decreases hospital stay, pain, and inconvenience [29-31].

However, injuries repaired in the intermediate period (between 72 hours and 6 weeks) are associated with a high rate of biliary strictures compared with immediate or late repairs [29].

Conclusion

As surgeons become more and more confident with LC there may be a tendency on their part to deviate from the principles of safe cholecystectomy. This may end up with the dreaded complication of bile duct injury and its associated morbidity, increased healthcare

costs, hospital stay. An early detection, appropriate intervention, and referral to higher centers for a coordinated approach by radiologist, endoscopists and hepatobiliary surgeons especially to the complex bile duct injuries will go a long way in assuaging the frustrating legal issues that may be associated with this avoidable complication.

Conflict of interest

Authors have no conflict of interest to disclose.

References

1. Gossage JA, Forshaw MJ (2010) Prevalence and outcome of litigation claims in England after laparoscopic cholecystectomy. Int J Clin Prac 64: 1832-1835.
2. Viste A, Horn A, ØvrebØ K, Christensen B, Angelsen JH, et al. (2015) Bile duct injuries following laparoscopic cholecystectomy. Scand J Surg 104: 233-237.
3. Mishra PK, Saluja SS, Nayeem M, Sharma BC, Patil N (2015) Bile duct injury-from injury to repair: an analysis of management and outcome. Indian J Surg 77: 536-542.
4. Strasberg SM, Helton WS (2011) An analytical review of vasculobiliary injury in laparoscopic and open cholecystectomy. J Hepatobiliary Pancreat Surg 13: 1-14.
5. Familiari L, Scaffidi M, Familiari P, Consolo P, Ficano L, et al. (2003) An endoscopic approach to the management of surgical bile duct injuries: nine years' experience. Dig Liver Dis 35: 493-497.
6. Shaikh IA, Thomas H, Joga K, Ibrahim A, Thomas D (2009) Post-cholecystectomy cystic duct stump leak: A preventable morbidity. J Dig Dis 10: 207-212.
7. Mercado MA, Dominguez I (2011) Classification and management of bile duct injuries. World J Gastrointest Surg 3: 43-48.
8. Chun K (2014) Recent classifications of common bile duct injury. Korean J Hepatobiliary Pancreat Surg 18: 69-72.
9. Davidoff A, Pappas T, Murray E, Hilleren DJ, Johnson RD, et al. (1992) Mechanism of major biliary injury during laparoscopic cholecystectomy. Ann Surg 215: 196-202.
10. Pottakkat B, Vijayahari R, Prakash A (2010) Incidence, pattern and management of bile duct injuries during cholecystectomy: experience from a single centre. Dig Surg 25: 375-379.
11. Ostroff JW (2010) Management of biliary complications in liver transplant patient. Gastrenterol Hepatol 6: 264-272.
12. Kapoor V K (2007) Bile duct injury repair: When? What? Who? J Hepatobiliary Pancreat Surg 14: 476-79.
13. Jablonska B, Lampe P (2009) Iatrogenic bile duct injuries: Etiology, diagnosis and management. World J Gastroenterol 2009; 15: 4097-4104.
14. Walsh RM, Henderson JM, Vogt DP, Brown N (2007) Long-term outcome of biliary reconstruction for bile duct injuries from laparoscopic cholecystectomies. Surgery 142: 450-456.
15. Pitt HA, Sherman S, Johnson MS, Hollenbeck AN, Lee J (2013) Improved outcome of bile duct injuries in the 21st century. Ann Surg 258: 490.
16. Strasberg SM, Hertl M, Soper NJ (1995) An analysis of the problems of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg 180: 101-125.
17. Gupta V, Jayaraman S (2017) Role of laparoscopy in the management of bile duct injuries. Can J Surg 60: 300-304.
18. Hii MW, Gyorki DE, Sakata K, Richard JC, Simon WB (2011) Endoscopic management of post-cholecystectomy biliary fistula. HPB (Oxford) 13: 699-705.
19. Weber A, Feussner H, Winkelmann F, Siewert JR, Schmid RM, et al. (2009) Long-term outcome of endoscopic therapy in patients with bile duct injury after cholecystectomy. J Gastrenterol Hepatol 24: 762-769.
20. Singh V, Singh G, Verma GR, Gupta R (2010) Endoscopic management of postcholecystectomy biliary leakage. Hepatobiliary Pancreat Dis Int 9: 409-413.
21. Kapoor S, Nundy S (2012) Bile duct leaks from the intrahepatic biliary tree: A review of its etiology, incidence and management. HPB Surgery 2012: 1-9.
22. Way LW, Stewart L, Gantert W, Liu K, Lee CM, et al. (2003) Causes and prevention of laparoscopic bile duct injuries: analysis of 252 cases from a human factors and cognitive psychology perspective. Ann Surg 4: 460.
23. McPartland KJ, Pomposelli JJ (2008) Iatrogenic biliary injuries: Classification, identification and management. Surg Clin North Am 88: 1329-1343.
24. Singh V, Narasimhan KL, Verma GR, Singh G (2007) Endoscopic management of traumatic hepatobiliary injuries. J Gastroenterol Hepatol 22: 1205-1209.
25. Hogan NM, Dorcaratto D, Hogan AM, Nasirawan F, McEntee P, et al. (2016) Iatrogenic common bile duct injuries: Increasing complexities in the laparoscopic era: A prospective cohort study. Int J Surg 33: 151-156.
26. Lau WY, Lai EC, Lau SH (2010) Management of bile duct injuries after laparoscopic cholecystectomy: A review. ANZ J Surg 80: 75-81.
27. Kukar M, Wilkinson N (2015) Surgical management of bile duct stricture. Indian J Surg 77: 125-132.
28. De Reuver PR, Grossmann I, Busch OR, Obertop H, Thomas MG, et al. (2007) Referral pattern and timing of repair are risk factors for complications after reconstructive surgery for bile duct injury. Ann Surg 245: 763-770.
29. Sahajpal AK, Chow SC, Dixon E, Greig PD, Gallinger S, et al. (2010) Bile duct injuries associated with laparoscopic cholecystectomy: Timing of repair and long term outcome. Arch Surg 145: 757-763.
30. Thomson BN, Parks RW, Madhavan KK, Wigmore SJ, Garden OJ (2006) Early specialist repair of biliary injury. Br J Surg 93: 216-20.
31. Stewart L, Way LW (2009) Laparoscopic bile duct injuries: timing of surgical repair does not influence success rate. A multivariate analysis of factors influencing surgical outcomes. HPB 11: 516-522.