



Prevention of Bile Duct Injury in an Aberrant Right Hepatic Duct during Laparoscopic Cholecystectomy: A Case Report and Literature Review

Zhi-Wei Su¹, Guo-Xiu Liao²

¹Department of General Surgery, Hualien Armed Forces General Hospital, Hualien 97144, ²Department of General Surgery, Tri-service General Hospital, National Defense Medical Center, Taipei 11490, Taiwan

Cystic duct (CD) variation is challenging for surgeons performing biliary surgery. The misunderstanding of CD variants can lead to iatrogenic bile duct injuries (BDIs). We describe a 65-year-old man who presented with a 10-day history of abdominal pain and intermittent fever. He was admitted with the diagnosis of acute cholecystitis and underwent laparoscopic cholecystectomy during hospitalization. Intraoperatively, we found that the CD drained into the right hepatic duct rather than directly through the common bile duct, which is a very rare anatomic variation. This unusual case emphasizes the importance of recognizing this CD variation to avoid iatrogenic BDIs. This is particularly valuable for less experienced surgeons.

Key words: Cystic duct variation, fundus first approach, critical view of safety, intraoperative cholangiography

INTRODUCTION

Extrahepatic bile duct injury (BDI) is a serious complication of laparoscopic cholecystectomy (LC), with an incidence ranging from 0.4% to 0.7%.¹ A severely inflamed, fibrotic gallbladder can make identification of Calot's triangle difficult and increase the risk of extrahepatic BDI. In addition, anatomical variations of the cystic duct (CD), a rare but possible setting, can lead to BDI due to misjudgment by a surgeon.^{2,3} Therefore, surgeons must have detailed knowledge of all possible anatomical variations of the CD and the cysticohepatic junction (CHJ) to prevent inadvertent ductal injury or transection. In the present case, an aberrant anatomy of the CD, characterized by the CD draining into the right hepatic duct (RHD), was found during LC.

CASE REPORT

A 65-year-old man experienced right upper quadrant abdominal pain and intermittent fever for 10 days. He had been to a local hospital in Keelung, Taiwan, and received in-hospital antibiotic therapy for 4 days under the diagnosis of acute cholecystitis. However, he was transferred to our department because of persistent symptoms. The patient also

had slight nausea and anorexia. Vital signs were within the normal range, but he had slight tachycardia and a low-grade fever. The physical examination was positive for Murphy's sign. The complete blood count showed a white blood cell count of 14,300/ μ L (reference range, 4800–10,800/ μ L) with 85.6% neutrophils. The C-reactive protein concentration was 13.28 mg/dL and total bilirubin concentration was 1.2 mg/dL. A liver ultrasonogram showed a distended, swelled gallbladder containing sludge and stones. The common bile duct (CBD) and intrahepatic duct were not dilated. Acute cholecystitis was diagnosed. Owing to the medical intractability, the patient underwent LC after providing informed consent. Intraoperatively, we placed a grasper on the fundus of the gallbladder and elevated the liver to expose Calot's triangle. However, the gallbladder was severely inflamed and fibrotic, making it difficult to complete the dissection of the Calot's triangle safely. Then, we changed the procedure to a retrograde approach to dissect the Calot's triangle from the liver bed. Sharp dissection with hook electrocautery was used to separate the gallbladder from liver bed, and blunt dissection with dissector was used to skeletonize the cystic artery and bile duct within Calot's triangle. After careful dissection, we

Received: September 25, 2017; Revised: October 31, 2017;
Accepted: January 10, 2018

Corresponding Author: Dr. Zhi-Wei Su, No.163, Jiali Rood, Xincheng Township, Hualien County 971, Taiwan. Tel: +886-9369710630, Fax: +886-3-8260601. E-mail: goolulan@gmail.com

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Su ZW, Liao GX. Prevention of bile duct injury in an aberrant right hepatic duct during laparoscopic cholecystectomy: A case report and literature review. J Med Sci 2018;38:42-5.

found that the CD was joined to an aberrant RHD at the CHJ, rather than to the CBD in normal anatomy [Figure 1]. This means that efflux of the gallbladder passed through the RHD to the CBD. The cystic artery was first ligated, and then, the CD was ligated proximal to its confluence with the RHD. One 10-mm Jackson–Pratt drain was placed in Morrison’s pouch at the end of the procedure. The histopathological examination confirmed acute cholecystitis.

The patient’s postoperative recovery was uneventful without jaundice. He was discharged on the 4th day postoperatively.

DISCUSSION

LC is the treatment of choice for many different gallbladder disorders, especially symptomatic gallstone disease. Although LC is a safe, routine procedure nowadays, it may lead to major morbidities. BDI is one of the most dreaded complications of LC. The primary cause of BDIs is failure of visual recognition of anatomy in 71%–97% of cases.⁴ Many factors hinder visual assessment, including acute and chronic cholecystitis, prior upper abdominal surgery, and anatomic variation.⁵ In this

case, we encountered two main problems. One was the fibrotic Calot’s triangle secondary to acute inflammation, and the other was an anatomic variant of the CD.

Calot’s triangle (or the cystohepatic triangle) is an anatomic space bounded superiorly by the inferior surface of the liver, laterally by the CD, and medially by the common hepatic duct. Identification of this anatomic space may be difficult in cases of acute or chronic inflammation, which is often secondary to cholecystitis. In such circumstances where Calot’s triangle is unclear, performing LC using the retrograde approach (fundus first approach)⁶ is an alternative way to avoid BDI. Instead of the anterograde approach, which starts the dissection from the Calot’s triangle toward the liver bed, the retrograde technique begins the dissection from the gallbladder fundus toward the Calot’s triangle. It facilitates complete dissection of the “critical view of safety.”⁷ This means full dissection of Calot’s triangle, cystic plate exposure, and the entrance of only two structures (the cystic artery and CD) into the gallbladder before ligation of any ductal structures. In our case, we used the retrograde approach to identify Calot’s triangle. Complete clearance

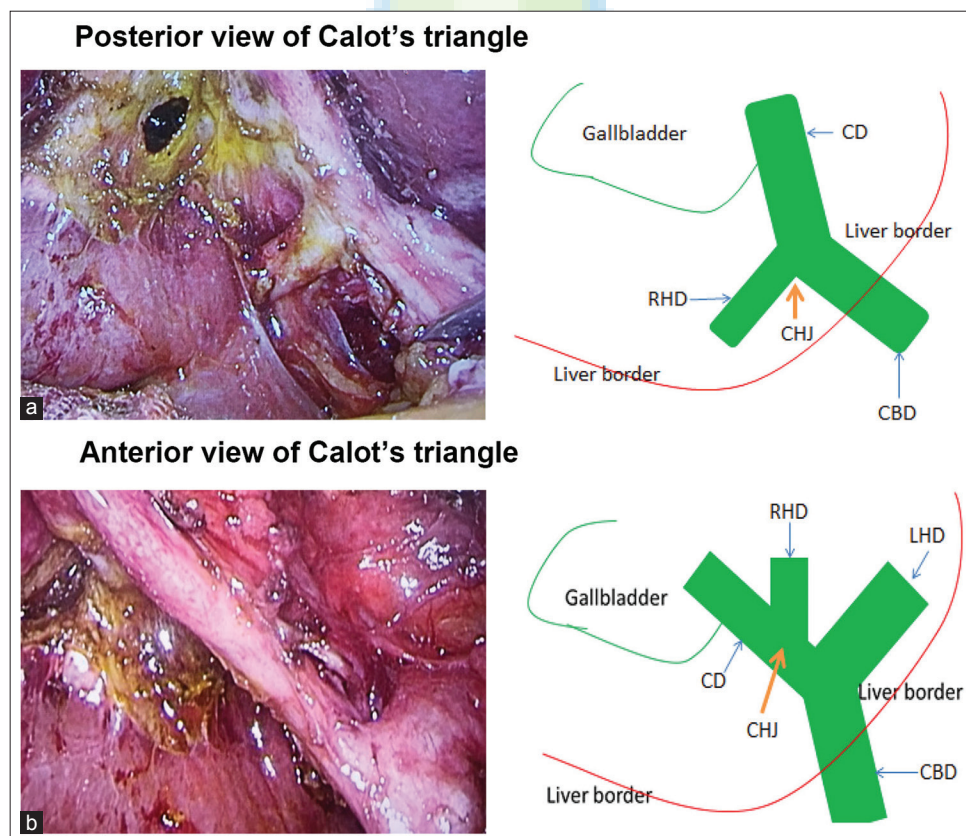


Figure 1: Intraoperative picture and anatomic drawings of the cysticohepatic junction: (a) posterior view and (b) anterior view of Calot’s triangle. Instead of being connected to the common bile duct directly, the cystic duct is connected to the right hepatic duct first, and then it converges with the common bile duct, the left hepatic duct

Prevent BDI in an aberrant right hepatic duct during LC

of the liver bed helps surgeons confirm the relevant ductal structure connected to the gallbladder.

Another challenge we encountered was the CD variation. Some rare but possible CD variations were described in the literature⁸ including (1) parallel cystic and common hepatic ducts; (2) low confluence of the CD; (3) adherence of the CD to the common hepatic duct; (4) high confluence of the cystic and common hepatic ducts; (5) absent or short CD; (6) double CDs; (7) CD drainage into the RHD; (8) CD crossing posterior to the common hepatic duct and joining it anteriorly; and (9) CD crossing anterior to the common hepatic duct and joining it posteriorly.

In this case, the anatomical variation was a CD draining into the RHD, a rare setting in the literature.⁹ Kullman *et al.*¹⁰ reported a 2.9% incidence of this anomaly in 513 patients who underwent routine intraoperative cholangiography (IOC). In another study, Sarawagi *et al.*¹¹ detected this anomaly in 0.5% of 198 patients who received magnetic resonance cholangiopancreatography before any surgical, percutaneous, or endoscopic interventional procedures. Patients with this anatomical variation are vulnerable to BDI since the RHD may be mistaken for a CD and be ligated inadvertently. As we described earlier, the “critical view of safety” was achieved by meticulous dissection. This enabled us to confirm the anatomic variant with confidence and avoid BDI. No signs of BDI were found during and after the surgery.

Based on the available literature, IOC is the procedure of choice when the biliary anatomy is uncertain or BDI is suspected. It may help surgeons to confirm the biliary anatomy before dividing any ductal structures, and thus prevent BDI, or to confirm BDI intraoperatively.^{12,13} However, routine use of IOC is still under debate.^{14,15} Many techniques have been developed for biliary tract evaluation, such as laparoscopic ultrasonography, dye cholangiography, and near-infrared fluorescence cholangiography.¹⁶ Many comparative studies are still ongoing to determine whether these techniques are superior in regard to safety, accessibility, ease of interpretation, and radiation exposure.

Anatomic variations of the CD are uncommon, and a CD that drains into the RHD, as reported herein, is even rarer. Surgeons should always keep these variants in mind and try to identify them during dissection of Calot's triangle. Inadvertent ductal injuries cause significant morbidities that require re-exploration in these patients. In addition, Calot's triangle may be difficult to delineate in inflamed conditions such as cholecystitis. In these kinds of difficult cases, care must be taken to achieve the “critical view of safety,” and a retrograde approach may facilitate the procedure. Intraoperative biliary imaging modalities, such as IOC, laparoscopic ultrasonography, dye cholangiography, or near-infrared fluorescence cholangiography, may serve as a

good adjunct to recognize an aberrant bile duct or even possible BDI when uncertain.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Lau WY, Lai EC, Lau SH. Management of bile duct injury after laparoscopic cholecystectomy: A review. *ANZ J Surg* 2010;80:75-81.
2. Onder H, Ozdemir MS, Tekbaş G, Ekici F, Gümüş H, Bilici A, *et al.* 3-T MRI of the biliary tract variations. *Surg Radiol Anat* 2013;35:161-7.
3. Khayat MF, Al-Amoodi MS, Aldaqal SM, Sibiany A. Abnormal anatomical variations of extra-hepatic biliary tract, and their relation to biliary tract injuries and stones formation. *Gastroenterology Res* 2014;7:12-6.
4. Way LW, Stewart L, Gantert W, Liu K, Lee CM, Whang K, *et al.* Causes and prevention of laparoscopic bile duct injuries: Analysis of 252 cases from a human factors and cognitive psychology perspective. *Ann Surg* 2003;237:460-9.
5. Nuzzo G, Giuliani F, Giovannini I, Ardito F, D'Acapito F, Vellone M, *et al.* Bile duct injury during laparoscopic cholecystectomy: Results of an Italian national survey on 56 591 cholecystectomies. *Arch Surg* 2005;140:986-92.
6. Kato K, Kasai S, Matsuda M, Onodera K, Kato J, Imai M, *et al.* A new technique for laparoscopic cholecystectomy – Retrograde laparoscopic cholecystectomy: An analysis of 81 cases. *Endoscopy* 1996;28:356-9.
7. 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.
8. Turner MA, Fulcher AS. The cystic duct: Normal anatomy and disease processes. *Radiographics* 2001;21:3-22.

9. Carbajo MA, Martín del Omo JC, Blanco JI, Cuesta C, Martín F, Toledano M, *et al.* Congenital malformations of the gallbladder and cystic duct diagnosed by laparoscopy: High surgical risk. *JSLs* 1999;3:319-21.
10. Kullman E, Borch K, Lindström E, Svanvik J, Anderberg B. Value of routine intraoperative cholangiography in detecting aberrant bile ducts and bile duct injuries during laparoscopic cholecystectomy. *Br J Surg* 1996;83:171-5.
11. Sarawagi R, Sundar S, Gupta SK, Raghuwanshi S. Anatomical variations of cystic ducts in magnetic resonance cholangiopancreatography and clinical implications. *Radiol Res Pract* 2016;2016:3021484.
12. Khaira HS, Ridings PC, Gompertz RH. Routine laparoscopic cholangiography: A means of avoiding unnecessary endoscopic retrograde cholangiopancreatography. *J Laparoendosc Adv Surg Tech A* 2009;9:17-22.
13. Flum DR, Flowers C, Veenstra DL. A cost-effectiveness analysis of intraoperative cholangiography in the prevention of bile duct injury during laparoscopic cholecystectomy. *J Am Coll Surg* 2003;196:385-93.
14. Piacentini F, Perri S, Pietrangeli F, Nardi M Jr., Dalla Torre A, Nicita A, *et al.* Intraoperative cholangiography during laparoscopic cholecystectomy: Selective or routine? *G Chir* 2003;24:123-8.
15. Massarweh NN, Flum DR. Role of intraoperative cholangiography in avoiding bile duct injury. *J Am Coll Surg* 2007;204:656-64.
16. Buddingh KT, Nieuwenhuijs VB, van Buuren L, Hulscher JB, de Jong JS, van Dam GM, *et al.* Intraoperative assessment of biliary anatomy for prevention of bile duct injury: A review of current and future patient safety interventions. *Surg Endosc* 2011;25:2449-61.

