

Case Report

Iatrogenic Bile Duct Injury after Laparoscopic Cholecystectomy and Endoscopic Retrograde Cholangiopancreatography Stenting Failure: A Case Report and Considerations

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Article information

Received: October 15th, 2023; **Revised:** December 15th, 2023; **Accepted:** December 20th, 2023; **Published:** December 22nd, 2023

Cite this article

Lauro RM, Pastore E, D'Addea I, Paganelli M, Catena M, Aldrighetti L. Iatrogenic bile duct injury after laparoscopic cholecystectomy and endoscopic retrograde cholangiopancreatography stenting failure: A case report and considerations *Surg Res Open J.* 2023; 8(1): 7-12. doi: [10.17140/SROJ-8-130](https://doi.org/10.17140/SROJ-8-130)

ABSTRACT

Bile duct injuries (BDI) have an incidence that could reach 0.1- 0.3% during open and laparoscopic cholecystectomy, respectively. Nevertheless, they can cause severe complications that could substantially impact the patient's quality of life. At worst, all these conditions can evolve into septic shock and finally to the patient's death..

Keywords

Acute cholecystitis; Bile duct injury (BDI); Biliary tree reconstruction. Endoscopic retrograde cholangiopancreatography (ERCP); Laparoscopic cholecystectomy (LC).

INTRODUCTION

Bile duct injuries (BDI) have an incidence that could reach 0.1% to 0.3% during open and laparoscopic cholecystectomy, respectively.¹ Nevertheless, they can cause severe complications that could substantially impact the patient's quality of life. At worst, all these conditions can evolve into septic shock and finally to the patient's death.

At the beginning of the '50s, Antony Eden, "Lord Avon", Sir Winston Churchill's Prime Minister's successor, experienced "a biliary tract saga" that compromised the political events over that time and forced Sir Eden to undergo several operations overseas before healing completely.² We can confirm that the BDI can seriously impact the patient's quality of life (QoL). Even considering the past, the improvement of the surgical technique has not cancelled for good the possibility of bile duct injury, which remains around 0.3-0.5%.

In the event of BDI detected during laparoscopic cholecystectomy, surgeons must promptly analyse the injury and choose between an intra-operative repair or a "drain now and fix later" strategy.

Biliary anatomical variations are encountered in 18-39% of cases, with potentially hazardous anomalies predisposing to BDI in only 3-6%.³ Anomalous right hepatic ducts are considered the most dangerous type of variation. According to the Bismuth-Strasberg classification, the injuries occurring during LC include a partial or complete transection or wide resection. The injury is not always recognized by the surgeon immediately. A prompt recognition can be treated immediately if the surgeon is skilled in hepato-biliary (HPB) surgery. Often, minimal leakage highlights the day 1 or 2 after the operation, and in this case, an appropriate diagnostic workup for correct identification of the injury is mandatory. A minimal leakage detected during the post-operative time can be treated successfully with an endoscopic approach. Biliary leaks after laparoscopic or open cholecystectomy may be due to multiple causes, injury to the main bile duct, leakage of bile through the cystic stump or presence of accessory ducts communicating the liver with the gallbladder or cystic duct (Luschka's Ducts) that were not identified and ligated.⁴

In case of failure of non-operative management (NOM) with worsening symptoms, an endoscopic retrograde cholangiopan-

creatography (ERCP) may be indicated with sphincterotomy +/- stent placement. In need of surgery instead, the surgery team should always quickly refer the patient to a tertiary HPB centre.

We describe a bile duct injury case during laparoscopic cholecystectomy managed surgically by a tertiary HPB centre for the bile duct reconstruction after NOM and ERCP stenting failure.

CASE REPORT

A 54-year-old male patient who suffered from chronic cholecystitis and acute cholecystitis episodes with several admissions to the Emergency Department (ED) during the severe acute respiratory syndrome coronavirus 2 (SARS-Cov2) pandemic was treated conservatively with antibiotic therapy. Two years after the first episode, he was finally listed for surgery. The patient had no comorbidities and chronic pathologies to be highlighted. We planned an expedited surgery after an accurate preparation and a complete diagnostic work-up, which included blood tests, chest X-ray, electrocardiogram (EKG or ECG), SARS-Cov2 swab, and anesthetic evaluation. A laparoscopic retrograde cholecystectomy was carried out. The Hartman's pouch was attached to the CBD during the operation, making the procedure challenging and demanding. The Calot Triangle was complicated to identify. A minimal bile leak was detected during the blunt dissection of the Calot Triangle. After the cholecystectomy, the gallbladder fossa and the common bile duct (CBD) were explored to assess the origin of the bile leak site. There was a minimal bile leak below the biliary bifurcation. The damage was not seen clearly. We only detected that there were no apparent severe bile duct (BD) injury of the BD with uncertain bile leak origin (Figure 1).

Figure 1. Bile Leak from the Bile Duct



We placed a 4×10 mm Jackson-Pratt drain on the gallbladder bed. A minimal bile discharge was detected in the drain bag on the first post-operative day. Given a subtle increase in bile output through the drain over the following days a cholangio-magnetic resonance imaging (MRI) was performed. It showed an increase of signal hyperintensity in T1 fase weighted sequences, with minimal partial dimension increasing after post-re-evaluation suspected of biliary leakage from the BD (Figures 2 and 3), we consid-

ered NOM. The patient was stable, with no sign of sepsis and no temperature. Procalcitonin was 0.5 ng/mL and C-reactive protein (CRP) was 5 mg/L.

Figure 2. Cholangio-MRI with Bile Leak after the Laparoscopic Cholecystectomy (Coronal)

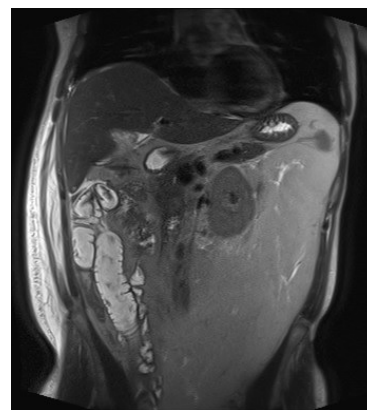
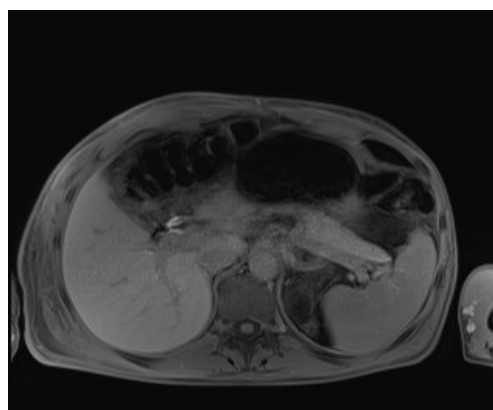


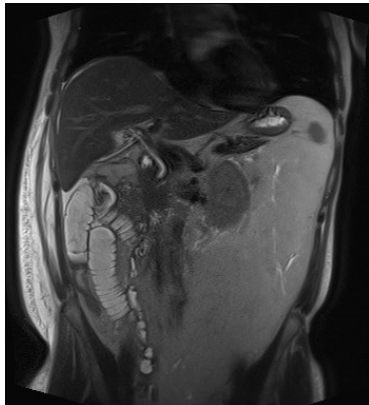
Figure 3. Cholangio-MRI with Bile Leak after Lap. Cholecystectomy (Axial)



According to Strasberg's classification, the bile leak showed at the colangio-MRI, was supposed to be type D, since it was a minimal partial section of the bile duct without complete loss of continuity with the rest of the biliary tract. As the bile output from the drain was still consistent, the patient underwent two attempts of ERCP, with unsuccessful BD cannulation at our trust. Two days later, a biliary stent was placed through an ERCP in another institution in Milan with high-volume ERCP procedures. After the procedure, the patient's general conditions worsened because of a progressive increase in bile output from the drain associated with fever. Procalcitonin was 8.5 ng/mL and CRP was 27 mg/L. An abdomen computed tomography (CT) scan showed a stent dislocation through the right bile duct injury. A new ERCP was carried out at the exact centre to remove the dislocated stent. A new stent was positioned over the same procedure. Despite the further stenting, the bile output from the drain remained very high, and the patient's condition started deteriorating even further. He was moved to a high-volume HPB unit in Milan. After a percutaneous-transhepatic-catheter (PTC) attempt, a diagnostic laparoscopy was carried out. The diagnosis was done

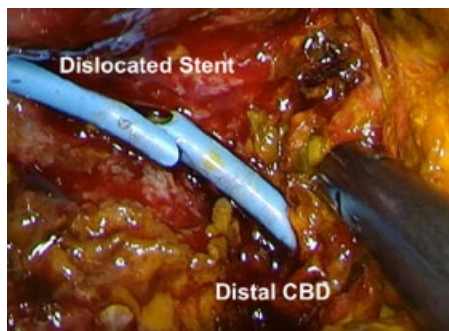
intra-operatively during the laparoscopy. Right and Left ducts were completely severed, so according to the Strasberg Classification, it was a type E6 injury.⁵ It was quite clear the further attempt to place a new stent in the biliary tract severed completely the biliary tree causing further damage that was finally demonstrated at the laparoscopy (Figure 4).

Figure 4. Cholangio-MRI with Drain, Bile Leak, Bile Collection after Laparoscopic Cholecystectomy



The stent was removed, and two “bracci’s biliary catheters” were inserted in the right and left hepatic duct and the distal BD (Figure 5). Multiple drains were positioned.

Figure 5. Dislocated ERCP Stent and Outside of the Biliary Tree. Laparoscopic View



Eighteen-days later, in open surgery, the BD was reconstructed with 4B liver segment resection to visualise better the right and left bile ducts and permit a safe end-to-side anastomosis of the biliary sheath, allowing a Roux-en-Y anastomosis, performed forty cm from Treitz’s angle and Witzel-Karewski jejunostomy. The post-operative time was uneventful, and the patient was discharged on day 14.

DISCUSSION

According to the literature data, the incidence of BDI by laparoscopic approach is very low. Since the introduction of the laparoscopic approach in 1989, the incidence of BDI increased from 0.04% in 1989 to 0.24% in 1991, corresponding to the introduc-

tion of laparoscopic cholecystectomy (LC), but then decreased to 0.11% in 1993.⁵ Nowadays, BDI occurs in 0.2-0.9%.⁵

The failure to recognise the triangle of Calot anatomy is the common cause of DBI.

The risk factors during LC include surgeon’s learning curve, acute or sclero-atrophic cholecystitis, misidentified anatomy (misidentification of the cystic duct and the common hepatic duct), misinterpreted or incomplete cholangiography, anatomical variations that can lead to lateral clipping of the common hepatic duct, traumatic avulsion of the cystic duct junction, diathermic injury of the common hepatic duct and injury of the anomalous right hepatic duct. Excessive bleeding is another challenging situation that can mislead surgeons into injuring the biliary tract.

Further inherent risk factors of the laparoscopic approach are the limitation of two-dimensional vision, absence of manual palpation of the porta and hepatic veins, use of tangential and lower approaches to the common biliary duct, and reduced visual field during significant bleeding. The surgeon’s laparoscopic “learning curve” is crucial in bile duct injury. Also, local anatomical risk factors are essential, such as chronic cholecystitis with strict adhesion between the Hartmann pouch and the BD⁶; (probably this caused the BDI in our case. The Calot triangle was not fully opened, and the critical view of safety was not reached completely).⁶ Severe chronic scarring of the gallbladder and excessive fat in the hepatic hilum are other local risk factors that seem to be present in 15-35% of BDI.⁷⁻⁹

Identifying acute cholecystitis clinically and carrying out the LC quickly without overcoming symptoms three days from the start of symptoms is of paramount importance. The National Institute for Health and Care Excellence’s (NICE) Guidelines point out that patients with acute cholecystitis must be subjected to early laparoscopic cholecystectomy, which should be carried out within one week of diagnosis. Recent literature shows that the conversion rate in prompt laparoscopic cholecystectomy in the acute phase is lower than in delayed surgery.

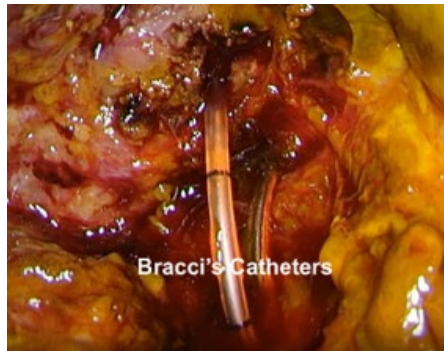
In case of injury, if the surgeon is not skilled in HPB surgery, refer the patient to a tertiary centre with a high volume of HPB surgery.

For delayed bile leakage, ERCP with stenting of the BD is the procedure of choice.¹⁰ The failure rate is around 5-6% in the literature. Surgery is essential when the ERCP cannot place a stent and control the bile leakage.¹¹⁻¹³

In our experience, several attempts to place a stent into the BD failed. One of the last drain attempts probably caused a further lesion of the bile duct bifurcation, creating a false route outside the right bile duct. A correct diagnosis was only achieved after a laparoscopy performed in a tertiary centre with high-volume HPB surgery. The BD was completely severed, and the positioning of two Bracci catheters restored the anatomy between the right and left bile duct with the distal BD (Figure 6). A second operation

was performed after 18-days and after the resolution of initial sepsis. The BD was reconstructed with a 4B liver segment resection and an end-to-side anastomosis of the biliary sheath, allowing a Roux-en-Y anastomosis, performed forty cm from Treitz's angle and a jejunostomy tailoring (Witzel-Karewski technique). In this case, surgery performed in a tertiary centre was the only solution to a critical situation threatening the patient's life.

Figure 6. Bracci's Catheter Positioning before Bile Ducts Reconstruction



Critical View of Safety

The critical view of safety (CVS) can be achieved in most cases during laparoscopic cholecystectomy. Various guidelines highly recommend it. However, poor understanding and low adoption rates among practising surgeons have been global problems. Educational intervention and increasing awareness about the critical view of safety can increase its penetration in routine surgical practice.

Intra-operative Cholangiography

The role in preventing BDI remains controversial. The most significant value of intra-operative cholangiography (IOC) is detecting the biliary anatomy and showing the severity of BDI. Despite this, it is recommended in case of unclear biliary tract anatomy.¹⁴

Indocyanine Green Fluorescence

A new fluorescence technique (fluorescence cholangiography) highlights the possibility of making LC and biliary tract dissection much safer. It uses a laparoscope with near-infrared (NIR) capability.¹⁵

The intravenous injection of ICG a few hours before permits an accurate biliary tract study over the mini-invasive procedure, reducing the risk of possible biliary tract injury. Fluorescence of biliary structures may lower surgical complications due to accidental damage to the common bile duct. The ICG can also be injected directly into the gallbladder to define the cystic duct and bile duct anatomy. The technique may soon become a standard, considering its different diagnostic and oncological capabilities.

As ICG, once injected, concentrates in bile, it is possible to outline the biliary tree anatomy, especially in Calot's triangle, by visualisation under NIR light during laparoscopic cholecystec-

tomy in both elective and acute settings. The ICG dye is injected intravenously at least 15-20 min before surgery to allow ICG to concentrate in the bile. (dose: 0.4 mg/mL/kg).

Furthermore, if the vascular anatomy of the cystic artery requires clarification, a small bolus 2-3 mL of 0.4 mg/mL/kg can be injected. Fluorescence appeared at the level of Calot's triangle, defining the cystic artery generally after the 60s.¹⁶ The ICG is an interesting procedure that helps the surgeon better identify the BD, avoiding possible damages and injuries. Unfortunately, the procedure is not widespread in all surgery departments, especially rural hospitals. Furthermore, the ICG procedure is not costless. The dye cost is minimal, but the camera and the laparoscope to see it is costly and is not within the reach of all the trusts.

Further Consideration

It is understood that the SARS-Cov2 pandemic has delayed the possibility of operating on these patients within three to seven days, especially over the first wave of the pandemic in 2020. This delay has increased the likelihood of BDI, especially in sclero-atrophic cholecystitis with ghost Calot or anatomic variations. So many patients have been treated conservatively with antibiotics or drained for a long time before receiving surgery. New guidelines were immediately released by the World Society of Emergency Surgery (WSES) and other important organisations after the first wave of the pandemic in June 2020.

They maintain that laparoscopic cholecystectomy remains the treatment of choice for acute cholecystitis, even in the coronavirus disease-2019 (COVID-19) era. *"Moreover, since laparoscopic cholecystectomy is not more likely to spread the COVID-19 infection than open cholecystectomy (OC), it must be organised in such a way as to be carried out safely, even in the present situation, to guarantee the patient with the best outcomes that minimally invasive surgery has shown to have".*¹⁷

In acute cholecystitis management and treatment scenarios, many considerations have an essential role, and the surgeons need to consider the following:

- (i) timing of the procedure (better perform surgery within three-seven days from the beginning of the symptoms),
- (ii) having appropriate surgical skills,
- (iii) following the Tokyo 2018 guidelines regarding the severity of the cholecystitis episode,¹⁸
- (iv) accurate technique in dissecting and recognise the biliary tract anatomy taking into account the CVS,
- (v) excellent and deep knowledge of the biliary tract anatomy and variations,
- (vi) possibility to perform IOC as soon as any doubt on the biliary tract anatomy arises,
- (vii) where possible, use the ICG Fluorescence; this new technique is paving the way to a safer LC in complicated cases,
- (viii) liaison with a tertiary HPB centre is of paramount importance if it is not available in the trust,

(ix) refer the patient to the HPB centre quickly if the surgeon is not skilled enough to repair the injury or manage it.

The IOC for early detection and correction of LC-induced BDI should always be carried out as soon as the suspect of damage is highlighted. It could also be used during the surgeon's learning curve when the risk of injury is known to be the greatest. Adequate exposure to the operative field is paramount to realizing the correct anatomy of the biliary tract variations.

Optimal visualization of the portal structures is also essential. A frontal view of the porta hepatis should be achieved using a 30° angle laparoscope. Exposure to Calot's triangle is critical for correctly identifying the vital structures. Experts have underlined the importance of lateral traction on the gallbladder infundibulum to open Calot's triangle. Clear visualization of both the cystic duct and the choledochal should be obtained during clip placement and transection of the cystic duct. Overuse of electrocautery must be avoided during the Calot's triangle dissection. Another important principle is a low threshold for conversion to OC, especially when the anatomy remains unclear during the surgical dissection. In complicated cases involving inflammatory changes, aberrant anatomy, or excessive bleeding, conversion to laparotomy is not considered a failure but a good and wise surgical judgment to ensure the patient's safety.

CONCLUSION

Managing patients with BDI is a challenging field with often dismal medicolegal projections. An accurate action map—starting from the point of clinical suspicion of the occurrence of such injury and ending at the time of the definite treatment—is more than necessary. The surgeon has many procedures in his armamentarium to avoid it nowadays. Although the possibility of BDI has reduced in the last decade, the injury event is always around the corner under challenging situations like chronic cholecystitis. Timing is paramount to deciding when to operate, and the new techniques to better study the common bile duct anatomy in case of unclear anatomy or anatomy variations must be fundamental in the surgeon's armamentarium to reduce the possibility of injury. We have learned a lot from our experience. We understood that even though damage to the biliary tract can always happen, we need to be prepared to manage it quickly, doing the most for the patient without wasting time with procedures that can damage the biliary tract even worse. We also learned that a tertiary HPB centre is paramount and should be involved as soon as possible when the surgeon is not skilled enough to carry out a biliary tree reconstruction. More than 70-years have passed since the "Lord Avon Saga", but we need to bear in mind that the possibility of BDI is still a tragic event that, when it happens, can seriously compromise the quality of life of the patient.

CONSENT

The patient has given his consent to publish the case. The patient signed off the consent in Italian. He also signed off the permission to publish his case report in English.

ACKNOWLEDGEMENTS

RML and EP contributed to the drafting and the compilation of the case report. MC, MP, and ID contributed to the selection and study of the literature and the bibliography selection. RML and EP contributed to analysing the most recent guidelines regarding acute cholecystitis management. MP has contributed with photos and videos. MC, MP, and Prof. LA (Tertiary HPB Centre in Milan) revised and approved the final version of the paper.

CONFLICTS OF INTEREST

No competing interests were disclosed.

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