

CBD Injury During Cholecystectomy: Prevention, Early Recognition, Management and Ethical Disclosure

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ABSTRACT

Common bile duct (CBD) injury remains one of the most feared complications of cholecystectomy. Although uncommon, its consequences may be devastating when recognition is delayed or when repair is attempted without adequate expertise. This manuscript summarises the key deliberations of a surgical panel discussion on CBD injury, with emphasis on prevention, intra-operative warning signs, classification-based management, post-operative detection, delayed repair, referral principles and ethical disclosure to attendants. The central message is that most bile duct injuries arise from misinterpretation of anatomy rather than lack of knowledge. Prevention therefore depends on disciplined adherence to safe cholecystectomy principles, including B-SAFE orientation, identification of Rouviere's sulcus or the R4U line, proper dissection of the hepatocystic triangle, demonstration of the critical view of safety and an intra-operative pause whenever anatomy is uncertain. If injury is suspected, the surgeon should classify the injury, avoid hazardous repair, drain when necessary and refer early to a centre with hepatobiliary expertise. Early recognition, minimal intervention and timely referral remain the cornerstones of good outcomes.

Keywords: Bile duct injury, CBD injury, cholecystectomy, safe cholecystectomy, critical view of safety, Roux-en-Y hepaticojejunostomy, ethical disclosure.

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INTRODUCTION

Cholecystectomy is one of the most commonly performed abdominal operations, yet bile duct injury remains a complication with profound clinical, psychological, medicolegal and socioeconomic consequences. A patient with an unrecognised or poorly managed bile duct injury may progress from an otherwise routine operative course to sepsis, biliary peritonitis, repeated interventions, secondary biliary cirrhosis or a lifelong state of recurrent cholangitis and strictures. In surgical practice, CBD injury is therefore not merely a technical event; it is a test of operative judgement, decision-making maturity, team communication and ethical conduct.

The guiding principle emerging from the panel discussion was that a bile duct injury should be approached with humility and structure. The surgeon must prevent what can be prevented, recognise the injury early when it occurs, stop unsafe dissection, obtain help, control sepsis and bile leak, and refer the patient at the correct time when definitive repair is beyond the surgeon's expertise.

Why CBD Injury Occurs

A major theme of the discussion was that most bile duct injuries occur because of an illusion of visual perception.

The surgeon may believe that the cystic duct has been identified when, in fact, the common hepatic duct or CBD is being dissected, clipped, or divided. This error is more likely in acute cholecystitis, contracted gallbladder, severe fibrosis, impacted Hartmann's pouch stone, obesity, bleeding, poor exposure, distorted Calot's anatomy, or during hurried dissection. The operative field may appear familiar, but the anatomical interpretation is wrong.

For this reason, safe cholecystectomy requires a deliberate strategy rather than reliance on experience alone. Whenever the operative view does not make anatomical sense, the surgeon should pause and reassess rather than continue dissection based on assumption.

Prevention: Safe Cholecystectomy Principles

Prevention begins with correct anatomical orientation before any structure is clipped or divided. The surgeon should first identify fixed landmarks using the B-SAFE approach: bile duct, sulcus of Rouviere, hepatic artery, umbilical fissure and enteric structures. Dissection should remain above Rouviere's sulcus or the R4U safety line. The hepatocystic triangle should be cleared of fat and fibrous tissue, and the lower one-third of the gallbladder should be separated from the liver bed to

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obtain the critical view of safety. Only two structures should be seen entering the gallbladder before clipping or division. When inflammation, fibrosis, bleeding or anatomical distortion prevents safe identification, the surgeon should stop, obtain senior assistance and use an appropriate bail-out strategy such as fundus-first dissection, subtotal cholecystectomy, intra-operative cholangiography, fluorescence imaging or referral. These principles are summarised in Table 1.

When to Suspect That the Duct Is Not the Cystic Duct

- A large duct in a patient without a history of biliary pancreatitis or obstructive jaundice.
- A duct that cannot be fully encompassed by a standard medium/large clip of approximately 9 mm.
- A duct that can be traced without interruption behind the duodenum.
- Presence of another unexpected ductal structure in the field.
- A large artery lies behind the duct, as the right hepatic artery commonly runs posterior to the CBD.

When any of these signs are present, clipping and division should be deferred. The surgeon should clarify anatomy using intra-operative cholangiography or fluorescence imaging where available, seek help from a senior surgeon, undertake a safe bail-out operation, or abandon and refer rather than proceed blindly.

Intraoperative Detection of Bile Duct Injury

- Clear golden-yellow bile in the operative field while the gallbladder and cystic duct appear intact.
- A cholecystectomy specimen showing two ductal openings.
- A clipped “cystic duct stump” retracting behind the duodenum.
- Bile leakage after division of a clipped duct.
- Bile leak from the liver bed after cholecystectomy, suggesting duct of Luschka or accessory duct injury.

Classification-Based Management

Once an injury is detected, it should be classified according to the Strasberg system, as summarised in Table 2. The Strasberg classification remains a practical framework for immediate decision-making. The best time to manage a clearly recognised injury is intra-operatively, provided the operating surgeon has appropriate hepatobiliary expertise and the patient is stable. However, an inadequate primary repair can convert a manageable injury into a complex biliary stricture. When in doubt, drainage and referral are safer than a bad repair.

Immediate Post-operative Detection

A post-operative bile duct injury may present with an unsettled patient, abdominal pain, tachycardia, peritonitis, bilious drain output, or bile discharge from port sites. Importantly, not all acute bile duct injuries produce a bile leak. A clipped and

Table 1: Core principles and practical application of safe cholecystectomy for prevention of bile duct injury

<i>Principle</i>	<i>Practical application</i>
B-SAFE orientation	The surgeon should identify fixed anatomical landmarks before clipping or dividing any ductal structure.
Rouviere’s sulcus/R4U line	Dissection should remain above the safety line and away from the common bile duct and hilar plate.
Hepatocystic triangle dissection	Fat and fibrous tissue should be cleared adequately so that structures entering the gallbladder are demonstrated.
Critical view of safety	Only two structures should be seen entering the gallbladder, and the lower part of the gallbladder should be separated from the liver bed before division.
Intra-operative pause	A short time-out or 5-second rule before clipping can prevent catastrophic misidentification.
Bail-out options	Fundus-first cholecystectomy, subtotal cholecystectomy, senior help, intra-operative cholangiography, indocyanine green imaging or referral should be considered when anatomy is unsafe.

Table 2: Strasberg classification of bile duct injury and suggested management

<i>Type</i>	<i>Injury pattern</i>	<i>Suggested management</i>
A	Minor leak from the cystic duct stump or duct of Luschka	Clip or ligate if seen; drain. ERCP with sphincterotomy and stenting may be required post-operatively.
B	Occluded aberrant duct	A small segment may be observed; a larger duct greater than 3 mm generally requires Roux-en-Y hepaticojejunostomy.
C	Transected aberrant duct with leak	Ducts less than 3 mm may be ligated; ducts greater than 3 mm generally require Roux-en-Y hepaticojejunostomy.
D	Lateral injury to major duct with maintained continuity	Small healthy defect may be repaired over T-tube; large defect, devascularisation or near-complete transection should be managed by Roux-en-Y hepaticojejunostomy.
E	Complete transection or major injury	Proceed with repair only if adequately trained. Otherwise, stop dissection, place a drain, document findings and refer early.

divided bile duct or accessory duct may initially present with obstruction rather than leakage. A high index of suspicion is essential when recovery after cholecystectomy deviates from the expected course.

Post-operative Management

The initial aim after post-operative diagnosis is not necessarily definitive reconstruction. The priority is to investigate, control contamination, drain collections, treat sepsis, maintain nutrition and convert an uncontrolled bile leak into a controlled biliary fistula. Drainage may be achieved by re-laparoscopy, opening the ports with lavage, open drainage, or ultrasound-guided percutaneous drainage depending on the clinical situation. ERCP with endoscopic sphincterotomy and stenting is useful for type A injuries, selected type D injuries, cystic duct stump leaks and stump blow-out associated with CBD stones.

Definitive early reoperation beyond the first 48 hours carries high failure rates in many settings because inflammation, tissue friability and sepsis make reconstruction unsafe. Delayed repair, usually after at least 12 weeks, allows inflammation to settle and the final extent of biliary stricture to declare itself. Roux-en-Y hepaticojejunostomy remains the gold standard for major bile duct injury and should be performed by a surgeon experienced in biliary reconstruction. The panel emphasised the maxim: "First repair is the best repair."

Ethical Disclosure to Attendants

Disclosure is a clinical responsibility and should be performed in a structured, compassionate and documented manner. The conversation should occur in a quiet private setting, preferably in a place where institutional recording is available. It should be conducted in person, with the surgeon seated, and should include key family members and senior team members.

The discussion should begin with empathy before technical detail. The surgeon should use clear language such as "bile duct" rather than abbreviations such as CBD. A suitable explanation is: "During gallbladder surgery, there is a small tube called the bile duct that carries bile from the liver to the intestine. Despite careful surgery, this duct has been injured." The seriousness of the problem should be acknowledged without panic. It is appropriate to state that this is a known but uncommon complication of gallbladder surgery. It is inappropriate to blame assistants, juniors, equipment, or to use dismissive phrases.

The family should be told what has been done so far, whether the injury was recognised intra-operatively or post-operatively, and what the immediate plan is. The surgeon should explain stabilisation, drainage, ERCP, surgery, or referral as applicable. When referral is indicated, it should be framed positively: "The best outcomes happen when this repair is done by specialists in bile duct injuries. We are arranging this promptly." The conversation must be documented in the medical record, including who was present, what was explained, questions asked and the agreed plan.

Practical Algorithm

- Recognise early: suspect injury when the clinical course, anatomy, or bile leak is abnormal.

- Stop early: avoid further unsafe dissection or blind repair when anatomy is unclear.
- Drain early: control bile contamination and sepsis.
- Refer early: transfer major injuries to an experienced hepatobiliary centre.
- Repair at the right time: definitive repair should be done by the right surgeon, at the right centre, and at the right stage of inflammation.

Take-home Message

"Recognise early, stop early, refer early." Early recognition, minimal intervention and timely referral remain the cornerstones of good outcomes in bile duct injury.

CONCLUSION

CBD injury during cholecystectomy is a preventable, recognisable and manageable complication when approached with discipline. Prevention depends on safe cholecystectomy principles and willingness to use bail-out strategies. Management depends on classifying the injury, avoiding poorly planned repair, controlling sepsis and seeking hepatobiliary expertise when required. Ethical disclosure, documentation and family communication are integral components of good surgical practice. The first opportunity to repair a major bile duct injury is often the best opportunity; therefore, it must not be compromised by haste, pride, or inadequate expertise.

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