Role for laparoscopy in the management of bile duct injuries

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Common bile duct (CBD) injury is the most serious complication of laparoscopic cholecystectomy. Recently, laparoscopic techniques have been used in the management of postoperative bile leak and CBD injury; this literature has not been reviewed. We reviewed the literature on CBD injury, the approach to its diagnosis and management, and reports of laparoscopic management techniques. We combined this review with our experience in laparoscopic methods to highlight diagnostic and therapeutic options. Laparoscopic techniques can be used to prevent, diagnose and treat CBD injuries. Intraoperatively, CBD injury can be prevented in the case of short cystic duct with the use of a loop ligature or transfixing suture, and it can be diagnosed using intraoperative cholangiography or other visualization techniques. When CBD injury is suspected postoperatively, repeat laparoscopy can be used to control sepsis with abdominal washout; as a diagnostic tool to guide management; and, in some settings, as a therapeutic tool for suturing small duct leaks, drain insertion and postoperative endoscopic retrograde cholangiopancreatography with sphincterotomy. Definitive laparoscopic repair is possible when certain criteria are met. Open surgery should be considered when the CBD is small, the injury occurred more than 72 hours previously, injury or anatomy are complex, port positioning is awkward for repair, or local experience is limited with laparoscopic management. There is an emerging role for laparoscopy in the management of CBD injuries. More case reports and series are needed to show the safety and efficacy of this technique, encourage its wider adoption, and allow outcomes assessment on a larger scale.

La lésion du canal cholédoque est la plus grave complication de la cholécystectomie laparoscopique. Récemment, des techniques laparoscopiques ont été utilisées pour traiter les fuites biliaires postopératoires et les lésions du canal cholédoque; la littérature à ce sujet n'a pas été passée en revue. Nous avons donc entrepris de faire une revue de la littérature publiée sur les lésions du canal cholédoque, les approches diagnostiques et thérapeutiques les concernant, ainsi que des rapports sur les approches thérapeutiques laparoscopiques. Nous avons combiné cette revue à notre expérience des méthodes laparoscopiques pour mettre en lumière les options diagnostiques et thérapeutiques. Il est possible d'utiliser des techniques laparoscopiques pour prévenir, diagnostiquer et traiter les lésions du canal cholédoque. Durant une intervention, on peut prévenir la lésion du canal cholédoque, dans le cas d'un canal cystique court, en recourant à des boucles de fil préformées ou à des sutures par transfixion; et la lésion peut être diagnostiquée par cholangiographie ou autre technique d'imagerie peropératoires. Lorsqu'on soupçonne une lésion du canal cholédoque en postopératoire, on peut répéter la laparoscopie pour vérifier la présence d'infection et procéder à un lavage abdominal, comme outil diagnostique pour guider le traitement et, dans certains contextes, comme outil thérapeutique pour suturer de petites fuites du canal cystique, insérer un drain ou procéder à une cholangiopancréatographie rétrograde endoscopique postopératoire avec sphinctérotomie. Il est possible de procéder à une réparation laparoscopique définitive en présence de certains critères. On envisagera la chirurgie ouverte si le canal cholédoque est petit, la lésion s'est produite plus de 72 heures auparavant, la lésion ou les caractéristiques anatomiques sont complexes, la réparation est rendue difficile par le positionnement du cathéter ou l'équipe locale a une expérience limitée du traitement laparoscopique. On constate le rôle émergent de la laparoscopie pour la prise en charge des lésions du canal cholédoque. Il faudra davantage de rapports et de séries de cas pour en démontrer l'innocuité et l'efficacité, en encourager l'utilisation plus répandue et permettre une évaluation de ses résultats à plus grande échelle.

Laparoscopic cholecystectomy is accepted as the gold standard in the surgical management of gallbladder disease.¹ Despite the widespread application of this approach, the rate of common bile duct (CBD) injury is still reported to be 0%–2.7% for laparoscopic cholecystectomy versus 0%–0.5% for open cholecystectomy; however, this gap has narrowed as expertise with laparoscopic surgery has been gained.²

Bile duct injury is the most serious complication of laparoscopic cholecystectomy and can lead to sepsis, liver failure and even death. In this review, we focus on the role of laparoscopy to diagnose and manage CBD injury.

DEFINITION

For the purpose of this review, we consider CBD injury to include thermal injury, partial laceration or ligation, and complete transection with or without associated vascular injury. It manifests in the form of bile leakage, stricture formation, or complete occlusion.

ETIOLOGY

Common bile duct injury usually occurs intraoperatively. In some cases, it may present in a delayed fashion, such as in the case of thermal injury. The widely accepted approach to help prevent bile duct injury in laparoscopic cholecystectomy is achievement of the critical view of safety.¹ Excess or incorrect traction on the gallbladder while exposing the Calot triangle can tent the CBD superiorly and expose it to injury. Misidentification of the correct anatomy may also occur when there is severe inflammation of the porta hepatis region, such as with acute cholecystitis, impacted stones in the Hartman pouch and Mirizzi syndrome.³ Furthermore, anatomic variations in bile duct anatomy or a short cystic duct (CD) also predispose to ductal injury.

CLASSIFICATION

Bismuth and colleagues⁴ classified 5 types of bile duct injury in 1982 according to location of the injury in the biliary tract, based on patterns that were seen more frequently with open cholecystectomy. In 1995, Strasberg and colleagues¹ expanded the Bismuth classification to encompass injuries seen more commonly with laparoscopic cholecystectomy; the classification is summarized in Table 1.

DIAGNOSIS

Intraoperative identification

If a bile duct injury is identified intraoperatively, it allows the possibility of immediate repair or triage toward appropriate nonoperative therapy. If an injury is suspected,

intraoperative cholangiography can be beneficial in determining the extent of the problem and can help guide definitive repair. Repair (laparoscopic or open) should be attempted only by surgeons with adequate training in bilioenteric reconstruction. Video-recording cases can be helpful in identifying injuries during postoperative review if a patient presents with complications.

Postoperative presentation

The preoperative presentation of a patient with a CBD injury can vary. Subjectively, these patients often report abdominal pain or distension, nausea, fever and malaise. Objectively, they may show evidence of obstructive jaundice, sepsis, or documented bile leakage.^{1,2,5} For patients with bile peritonitis, it is important to implement a rigorous workup, including cholangiography via magnetic resonance cholangiopancreatography (MRCP), percutaneous transhepatic cholangiography (PTC), or endoscopic retrograde cholangiopancreatography (ERCP). Likewise, control of bilomas or bile peritonitis is imperative.

Investigations

The well-known radiologic and endoscopic modalities available to investigate biliary disease each have advantages; these are summarized in Figure 1.

Intraoperative

Intraoperative cholangiography is typically used on a selective basis when there is a question of common duct stones, when anatomy is difficult to delineate, or when ductal injury is suspected and confirmation for location is desired.⁶ Intraoperative cholangiography can be highly accurate in the diagnosis of bile duct injuries where there is intraoperative suspicion. In our practice, we routinely position the patient and the surgical bed to permit easy introduction of the C-arm for fluoroscopic cholangiography should the need arise.

Postoperative

The role of exploratory laparoscopy in the diagnosis and treatment of bile leak in the postoperative period following

Table 1. Strasberg et al.¹ classification of bile duct injury

Type	Definition
A	Cystic duct leak or leak from small liver bed duct
B	Occlusion of part of the biliary tree
C	Transection without ligation of aberrant right hepatic ducts
D	Lateral injuries to major bile ducts
E1	Low on common hepatic duct, with stump > 2 cm
E2	Proximal on common hepatic duct, with stump < 2 cm
E3	Involves hilum but spares hepatic ductal confluence
E4	Disruption of left and right hepatic ducts
E5	Any injury involving an aberrant right sectoral hepatic duct

laparoscopic cholecystectomy has increasingly been reported in the literature.^{5,7-9} Returning to the operating room early following surgery allows for the drainage of a biloma or intra-abdominal collection, clipping of any accessory ducts or an insecure cystic duct, inspection of the biliary anatomy with potential treatment (i.e., releasing a clipped CBD), or placement of a drain to control the leak conservatively. We discuss this topic in further detail below, in the management section.

Another option as an adjunct to the above is performing “drain tube cholangiography” through a tube placed percutaneously or intraoperatively for conservative management of a bile leak. This can be useful in identifying whether a persistent opening remains in the biliary tree, indicated by extraductal extravasation of contrast.

MANAGEMENT OF CBD INJURIES

The presence of a CBD injury has important short- and long-term implications for the patient. Fortunately, there are several management strategies available to help these patients. Although conservative measures, such as ERCP, CBD stenting or abdominal drainage, can be useful, we focus on the laparoscopic techniques that can be applied in this situation.

Laparoscopic techniques may play a role in 3 settings for the management of CBD injuries: in the initial operation to confirm a suspected injury, in the postoperative period when the patient presents with a symptomatic leak, and when the diagnosis is established and definitive repair is planned.

Initial operation

Intraoperatively during any cholecystectomy, active effort should be made to avoid a CBD injury. The “critical view

of safety” should be established before clips are deployed in the Calot triangle. Failure to identify the anatomy or achieve the critical view may be an indication for conversion to open surgery; however, subtotal cholecystectomy with removal of all stones from the gallbladder is another method for definitively managing gallbladder inflammation and preventing an injury.

The presence of a short cystic duct can be particularly challenging. In our experience, this scenario is addressed well with the use of a transfixing suture or loop ligature to achieve secure closure of the cystic duct stump. Some surgeons use endomechanical staplers in this setting; however, we feel the aforementioned techniques allow better tissue control and visualization when operating close to key biliary structures.⁶

If a CBD injury is suspected intraoperatively, intraoperative cholangiography should be used to confirm the diagnosis. In cases of limited injury, we advocate leaving a drain in place with a view to treating the injury conservatively with a biliary stent. In all other cases, definitive repair is achieved with hepaticojejunostomy or hepatico-duodenostomy, discussed below. The hepatic arteries should be carefully visualized to ensure there is no vasculobiliary injury in every case.

Relaparoscopy

When a patient presents in the postoperative period with evidence of bile leak or peritonitis, laparoscopy can be a useful diagnostic and therapeutic tool.⁹

The first step at relaparoscopy is to perform extensive washout of the abdominal cavity to help control and treat the sepsis and to allow for identification of the source of the bile leak.^{5,7} Although the most likely

Fig. 1. Investigation options and advantages for suspected bile leak. CT = computed tomography; ERCP = endoscopic retrograde cholangiopancreatography; MRCP = magnetic resonance cholangiopancreatography.

source is somewhere in the biliary tree, the small bowel and, in particular, the duodenum should be inspected to rule out inadvertent injury there, which could give rise to a similar presentation.

In situations where bile is leaking from a small defect in the cystic duct, common hepatic duct, or CBD, laparoscopic peritoneal lavage is often the only surgical intervention needed to control the spillage and prevent severe sepsis.^{5,7} Endoscopic retrograde cholangiopancreatography and sphincterotomy, with or without biliary stenting, can help to ensure low pressure in the biliary tract, which will allow the defect to seal itself with time. There are several reports of leaks from small ducts in the gallbladder bed, the duct of Luschka, or small accessory hepatic ducts being successfully controlled with laparoscopic suturing.^{8,9}

An option during this procedure is to place a drain, which can help to control or prevent the progression of sepsis. This method can be used to treat the injury conservatively, or to stabilize the patient while definitive repair is planned.

At this point of the procedure, the surgeon must make a judgment call on whether to proceed with immediate repair or to delay repair of the injury, depending on the location and extent of injury, the patient's overall stability and local expertise. Although treatment of CBD injury at a tertiary centre is not an absolute recommendation in our opinion, it is a very reasonable option.

Definitive repair

Bilioenteric anastomosis in the form of hepaticojejunostomy or hepaticoduodenostomy is the definitive treatment for a severe CBD injury and has shown good long-term results.¹⁰

In the index operation, if a bile leak is found intraoperatively, the source should first be elucidated through careful inspection and the use of suction and irrigation to examine the gallbladder fossa for accessory ducts, the liver surface for any tears, and the extrahepatic biliary tree for inadvertent injury. The diagnosis can be confirmed with intraoperative cholangiography. The arterial supply to the duct should be examined; an injury there often requires open reconstruction if there has been minimal delay between identification of the injury and repair.

If the leak is from a very small CBD lesion, it may be amenable to conservative management with a Jackson-Pratt drain to achieve a controlled leak. Postoperative ERCP with sphincterotomy can be used as an adjunct to ensure low pressure in the biliary system and to promote healing. In selected cases of an aberrant or liver bed bile duct leak where the duct orifice is very small (≤ 2 – 3 mm) and cholangiography shows it to be draining only a small section of the liver, that duct orifice may be simply ligated.⁸ The criteria for laparoscopic repair are the same as those used for open repair. If the injury is fresh

(≤ 72 h), we prefer early repair with laparoscopic bilioenteric anastomosis. We prefer an open approach if the duct is small (< 3 mm), if anatomy or injury complexity precludes straightforward repair, or if port positioning is awkward for laparoscopic repair. Any free bile should be suctioned and the abdomen irrigated to control sepsis. A surgical drain is not always necessary, but it is our practice to leave one routinely.

In situations where the operating surgeon does not feel comfortable performing the repair, the CBD can be stented or cannulated and an abdominal drain placed to stabilize the patient and control sepsis while they are transferred to a tertiary care centre for delayed repair. In this setting, laparoscopic repair is feasible if inflammation in the porta hepatis is not too extensive.

If there is a healthy duct with good arterial blood supply, we perform an end-to-side bilioenteric anastomosis. If there is any concern regarding the blood supply, a side-to-side repair incorporating the anterior wall of the bile duct near the biliary bifurcation is favoured.

CONVERTING TO OPEN SURGERY

Up to 15% of laparoscopic cholecystectomy cases are converted to open laparotomy. This conversion may be done when an injury is recognized intraoperatively but is not amenable to laparoscopic management or when the operating surgeon is not comfortable repairing the injury laparoscopically. Common bile duct injuries repaired with minimal delay have a much more favourable outcome; performing timely repair should be prioritized over delay for laparoscopic repair.¹¹

During laparoscopic cholecystectomy, if a surgeon encounters bleeding that is not easily controlled, we recommend conversion to open surgery to prevent concomitant biliary and vascular injury. In most cases, bleeding that seems impossible to control laparoscopically is readily controlled during laparotomy. In challenging cases, conversion to laparotomy can prevent injury to the bile duct, duodenum, or other structures.

CONCLUSION

Laparoscopic techniques can be used to avoid, diagnose and treat CBD injuries, and early evidence shows this can be safe. In the initial operation, subtotal cholecystectomy can be useful in avoiding injury where there is severe inflammation or obscure anatomy. A bile leak or fresh injury can be assessed at the index operation to help plan for immediate versus delayed repair. In the postoperative period, relaparoscopy can allow for identification of CBD injury, drainage of intra-abdominal collection, and exclusion of injury to surrounding structures, which can guide the decision between conservative management and early or late definitive repair.

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