

Use of retrograde intra-operative cholangiogram for detection and minimisation of common bile duct injury

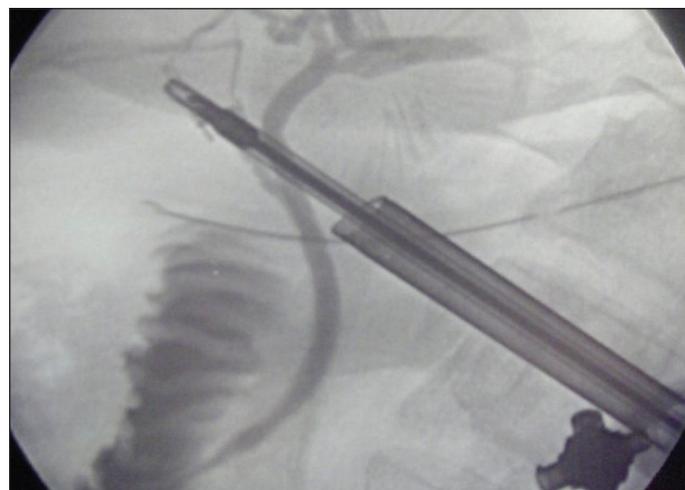
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Lachlan submitted this article to the AMSJ while in his final year of medicine in 2009. During that year, he was awarded the Dr Elaine Katte Prize and the Australian Medical Association Memorial Prize.

Iatrogenic bile duct injury (BDI) is a known complication of laparoscopic cholecystectomy with serious consequences for the health of the patient. Intra-operative cholangiogram (IOC) has been shown to reduce the incidence of a major BDI, and is currently used routinely by the majority of surgeons in Queensland. This case report details the use of a 'retrograde IOC' for the detection of a BDI after inadvertent cannulation of the common bile duct (CBD). Application of this method has the potential to improve patient outcomes in two ways. Firstly, by limiting the degree of damage to the CBD, it may facilitate a simpler and more successful repair. Secondly, it provides a method of laparoscopic confirmation of BDI and, where laparoscopic hepaticojejunostomy is available, can entirely prevent the need for an open procedure.



Intraoperative cholangiogram during a laparoscopic cholecystectomy.

Introduction

Bile duct injury (BDI) remains one of the most feared complications of cholecystectomy, due to the potential for a significant impact on quality of life and increased mortality. [1] This complication is often of particular interest in relation to the laparoscopic approach, as some studies have shown the rates of BDI to be higher with laparoscopic procedures when compared to traditional open surgery. [2,3] One aspect of laparoscopic cholecystectomy and the development of BDI that has remained controversial for more than fifteen years is the routine use of intra-operative cholangiogram (IOC). [2,4] The case of Mr U illustrates BDI during laparoscopic cholecystectomy, where disrupted anatomy made identification of structures difficult. This necessitated conversion to an open procedure for confirmation and ultimately a 90% transection of the CBD requiring definitive repair. This article will further examine the role and technique of IOC, outline current management after BDI and will reflect on these in light of recent technical advances.

Case Report

Mr U, a 69 year old man, presented for elective laparoscopic cholecystectomy five weeks after an initial admission for acute cholecystitis. At the time of first presentation, he was managed conservatively due to concurrent acute renal failure and pneumonia, with resolution of his symptoms three days after onset. Later, at surgery, a four-port approach was used to gain access to the abdominal cavity with the anterior liver edge retracted superiorly for exposure of the gallbladder. The gallbladder was fibrotic and shrunken, with significant adhesions formed with both the omentum and the transverse colon. These adhesions disrupted the normal anatomy, distorting the classic appearance of Calot's triangle during the identification of its contributing structures.

At the neck of the gallbladder, a duct structure was identified which appeared to be entering the gallbladder and scissors were used to open the duct longitudinally. Through this defect the lumen was accessed and a cannula inserted distally using a cholangiocatheter grasper. After flow was confirmed with saline, radio-opaque contrast was injected to perform an IOC. The IOC displayed only the lower biliary tree from approximately the midpoint of the CBD to its communication with the duodenum at the Ampulla of Vater. The cannula was removed and re-inserted, and the retracted gallbladder further manipulated to exclude a positional obstruction of the upper biliary tree. When neither of these measures altered the IOC image, the surgery was converted to

an open procedure to better define the anatomy. Despite the greater access granted by the open approach, the disruption to the normal anatomy remained significant. Further, a prominent Duct of Luschka obstructed a fundus-first dissection. As a visual determination as to the nature of the cannulated duct was still not possible, the cannula was again re-adjusted for another IOC, without success.

Although BDI is not a common occurrence, the likelihood that this complication had occurred was now quite high. As such, the cannula was removed from the distal stump and instead inserted into the proximal stump to perform a 'retrograde IOC.' This immediately imaged the upper biliary tree, confirming placement of the cannula within the CBD. Unfortunately, despite only an initially small lateral duct incision, the resulting manipulation and repeated cannulations extended this to approximately a 90% transection. With the CBD imaged via IOC, the anatomy could be better defined and the gallbladder was removed, although the objective at this stage had shifted to minimising bile leak and arranging for repair. An externalised 8 French feeding tube was inserted into the proximal CBD stump and a drain was placed in the subhepatic space prior to closure. Mr U was subsequently transferred to a tertiary hepato-pancreatico-biliary unit for construction of a Roux loop hepaticojejunostomy and was discharged home five days later.

Discussion

Two issues warrant consideration in this case: the role of routine IOC, and minimizing the impact of BDI. Since it was first described, opponents to the routine use of IOC argue that there is insufficient discernable benefit regarding BDI to justify the additional cost and time. [4] This may however be a consequence of small absolute numbers limiting the statistical power of some analyses, particularly given that others have shown that performing an IOC decreases the incidence of major BDI by as much as 40% to 50%. [2,5] Additionally, as many as 69% of cases of iatrogenic BDI are reportedly missed during the initial cholecystectomy, [1] where the use of IOC would allow for early definitive management of these patients. Interestingly, given this debate, a survey of surgeons in Queensland found that 82% currently almost always attempt an IOC in elective cholecystectomy, while less than 4% rarely attempt it. [6]

The majority of cases of BDI in laparoscopy occur when the CBD is mistakenly identified as the cystic duct. [7] In these situations,

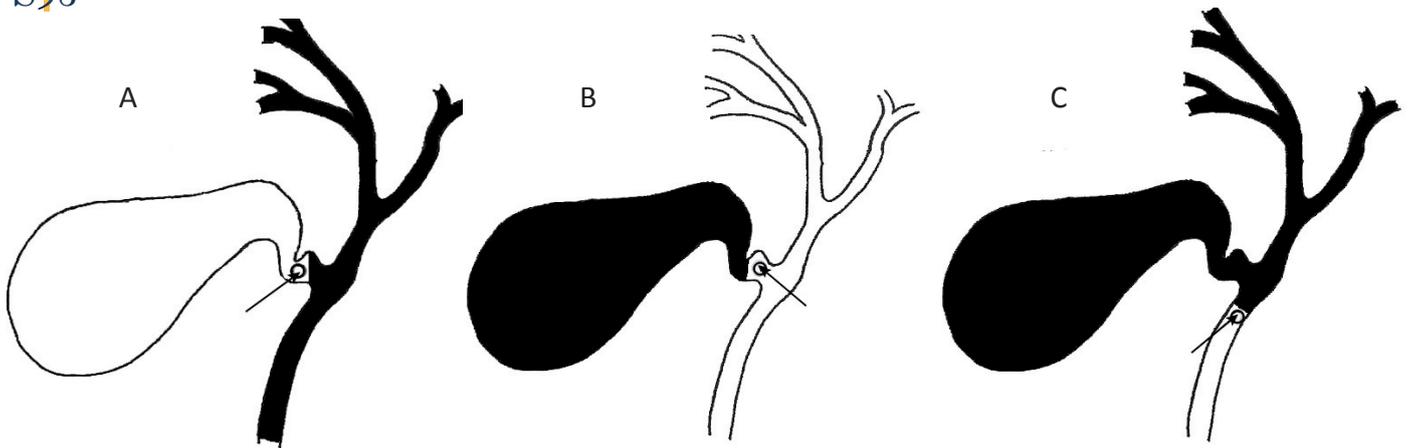


Figure 1. Intra-operative cholangiogram images of the biliary tree. A: Traditional IOC with antegrade flow after cannulation of the cystic duct. B: Retrograde IOC with retrograde flow after cannulation of the cystic duct. C: Retrograde IOC with retrograde flow after cannulation of the common bile duct.

the injury takes one of two forms: either a Strasberg D or Strasberg E type injury (Table 1). While the use of IOC does not prevent the damage from occurring per se, it does have a marked impact on the ultimate outcome. In limiting the degree of damage to the CBD, IOC allows for success with a less radical repair and ensures that suitable early management is implemented to guard against bile leak and the associated peritonitis or sepsis. [7,8]

The traditional application of IOC is to cannulate the distal opening of the duct accessed by lateral ductotomy. From the cystic duct, radio-opaque dye fills the biliary tree (Figure 1A) providing information on both anatomy and filling defects due to strictures or choledocholithiasis. [2] The dilemma occurs when only the lower ducts are imaged. While this may indicate CBD cannulation, it may also be due to the insertion of the cannula into the cystic duct advanced so far as to enter the CBD, or simply occlusion of the proximal CBD due to stricture or surgical retraction. As in this case, such reasoning may lead the surgeon to manipulate the cannula and surgical field in an attempt to obtain unobstructed flow of the dye into the upper tree, with the potential to worsen the injury. An alternative is the technique adopted later in this case where, when presented with an inability to image the upper biliary tree, the cannula is instead inserted into the proximal opening and a retrograde IOC performed. Placement of the catheter in the cystic duct or CBD produces two different images (Figures 1B and 1C), allowing a determination as to whether a BDI has occurred.

Table 1. Strasberg classification of bile duct injuries. [3]

| Class of injury | Description | Possible circumstance of injury |
|-----------------|---|---|
| A | Leak from small ducts still in continuity with the biliary tree | Presence of small accessory ducts from liver bed or cystic duct |
| B | Injury to a sectoral duct with obstruction to drainage of that part of the biliary tree | Presence of an aberrant right hepatic duct |
| C | Injury to the sectoral duct with bile leakage from that duct which is not in continuity with the tree | Presence of an aberrant right hepatic duct |
| D | Partial lateral injury to the common bile duct | Lateral injury in preparation for insertion of catheter for IOC [2, 10] |
| E | Ranges from stricture to complete obstruction to the common bile duct | Complete transection in preparation for dissection of gallbladder [10] |

This potentially has the advantage of minimising any further damage to the bile duct which could occur during manipulation or repeated recannulation of the distal stump.

Ultimately, this may influence the options and success of the repair process as the degree of injury determines the management options available. If the CBD has undergone only a lateral injury during cannulation (Strasberg D), then management either by suture over a T tube or during endoscopic retrograde cholangio-pancreatography (ERCP) is likely to be successful. [7] This is in comparison to a complete transection (Strasberg E), for which the current accepted treatment in most cases is the creation of a Roux-en-Y hepaticojejunostomy. [8] Although studies have demonstrated success rates of more than 90% for a Roux-en-Y, [9,10] failures have occurred after more than seven years [9] and thus ongoing follow-up is essential.

Furthermore, it has been demonstrated that in specialised centres, a laparoscopic hepaticojejunostomy can be employed successfully for repair of major BDI [11] with repairs of more minor injuries already suited to minimally invasive repair, particularly endoscopic stenting. [1] Therefore, at the time of injury, a retrograde IOC could be performed laparoscopically in preference to conversion to an open exploration. Although not adopted in this case, this may provide the patient an opportunity to avoid an open operation entirely and with that, benefit from the advantages commonly associated with minimally invasive techniques, including decreased post-operative pain and better cosmetic results. [12]

While the retrograde application of IOC does offer many advantages, its feasibility for application in clinical practice may face a number of readily identifiable hurdles. For example, in order to image upstream from the site of the ductotomy, proximal clips need to be removed, risking bile leakage and escape of gallstones into the peritoneal cavity. Additionally, if the cannula is correctly placed but the cystic duct is obstructed by an impacted gallstone – not an altogether unexpected finding in patients undergoing cholecystectomy – the inability to achieve free flow may prompt repeated cannulation attempts, resulting in the very damage this technique seeks to avoid. Fortunately, a completely obstructed proximal duct is very unlikely to occur without significant derangement to pre-operative liver function tests. Finally, while cannulation of the proximal stump was readily achieved after conversion to open access in this case, suitable anatomy, particularly during laparoscopy, may not always be present. In summary, while this approach may not be suitable in all cases, its utilisation should be attempted given the potential advantages to both surgeon and patient.

Conclusion

In laparoscopic cholecystectomy, particularly where the normal anatomy is disrupted, IOC has been shown to decrease major iatrogenic injury to the bile duct. When a standard IOC fails to image the upper biliary tree, the laparoscopic cannulation of the proximal stump for a retrograde IOC should be attempted. Where successful,

this would allow for rapid detection of a BDI and the institution of early damage minimisation measures and definitive repair. This may ultimately provide a better prognosis through preventing extension beyond a lateral injury and avoidance of an open procedure entirely, as laparoscopic hepaticojejunostomy is now technically feasible.

Conflict of interest

None declared.

References

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Consent

Informed consent was obtained from the patient for publication of this case.

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