

Controversy regarding routine intra-operative Cholangiography in preventing common bile duct injury during Cholecystectomy

Ever since laparoscopic cholecystectomy became the gold standard method of treatment of symptomatic cholelithiasis, the incidence of iatrogenic bile duct injury has increased significantly, being between 0.3% to 0.7% as compared to 0.1% for open cholecystectomy.¹ The incidence of bile duct injury at about 0.5% appears to be low but, in fact, it is highly significant when the potential for morbidity and mortality is considered and the fact that well over 750,000 laparoscopic cholecystectomies² are performed in the USA annually, for instance.

The primary etiology of biliary injury is failure to correctly interpret the biliary anatomy in 71% to 97% of cases.³ Major bile duct injury most commonly results from the failure to correctly distinguish the bile duct from the cystic duct. Thus, the common bile duct is mistaken for the cystic duct. The underlying factors in the pathogenesis of cholecystitis have to do with the potential for inflammatory contraction to distort biliary anatomy and the confounding result of aberrant anatomy.

The scientific literature is awash with various methods proposed and described to prevent iatrogenic bile duct injury.⁴⁻⁷ Some of the methods include infundibular method, fundus-first/dome-down technique, anatomical landmark technique, laparoscopic ultrasound technique, intra-operative cholangiography, pre-operative magnetic resonance imaging and near infrared fluorescent technique. All these methods have pros and cons. The gold standard method remains the 'critical view of safety,' described by Strasberg in 1995, which involves dissecting the Calot's triangle and identifying the cystic artery and extrahepatic biliary ducts.⁸ Various articles have been published advocating the adoption of the critical view of safety technique and has

become mainstream in most centers around the world.⁹⁻¹² Nevertheless, in case of severe inflammation of the porta hepatis and the gallbladder neck, scarce evidence exists that the critical view of safety, challenging in such circumstances, is helpful.¹³ It is necessary to use other adjunctive methods, which may involve change of surgical approach and use of intra-operative imaging techniques. In this author's opinion, the next best technique is to call for a second opinion.

Despite the wide variety of methods available to reduce the risk of bile duct injury, the incidence of bile duct injury has remained constant even with most of the surgeons being beyond the learning curve. Thus, important questions to be asked include: Is it the problem of surgeon? Is it a technique problem? Moreover, how do we reduce the incidence further? Perhaps the problem is that surgeons are, more often than not, unwilling to deploy certain methods that may limit the chances of injury.

Since 1931 when Mirizzi introduced the routine use of Intra-operative Cholangiography (IOC), its role in cholecystectomy has been controversial. Most surgeons practice IOC infrequently and selectively today. Consequently, there is an increasing number of young surgeons who have not acquired this skill today. Surgeons who are in-experienced, low-volume surgeons and those who have the greatest opportunity to train others are less likely to perform IOC. However, there are some who make the argument to use this technique liberally if not routinely.

Intra-operative Cholangiography is an essential surgical skill that all surgeons who perform laparoscopic cholecystectomy should have in their armamentarium. It has been demonstrated that the risk of bile duct injury is 50% to 70%

lower when Intra-operative Cholangiography is used;^{14,15} more so when the surgeon is inexperienced. The recent Consensus Conference on the prevention of BDI examined the role Intra-operative Cholangiography in preventing bile duct injury. The analysis of 14 studies involving over 2.5 million subjects shows a significant decrease in bile duct injury with the use of Intra-operative cholangiography.¹⁶ The guideline put forth a recommendation the use of Intra-operative cholangiography liberally in patients with acute cholecystitis or history thereof. Intra-operative cholangiography should be performed, in a significant percentage, by surgeons and this technique be taught younger surgeons in order to reduce chances of bile duct injury, reduce the chances of missed stones, avail the opportunity for training and to preserve an essential skill set. Specifically, IOC should be performed routinely in situations where patients are at high risk of having CBD stones (e.g., pre-operatively high liver enzymes, biliary pancreatitis, dilated CBD and intra-operatively discovered CBD stone), and in patients who had gastric bypass since there is an altered biliary anatomy that may prohibits post-operative ERCP.

Data does not support the use of Intra-operative cholangiography routinely in all patients. Most of the studies on routine Intra-operative Cholangiography use were population based or retrospective and were open to bias.^{17,18} Sheffield et al demonstrated that centers that do routine Intra-operative cholangiography recorded a 6-fold rise in bile duct injuries in cases where Intra-operative cholangiography was not used because of severe inflammation obscuring the anatomy. This demonstrated inability rather than unwillingness to do Intra-operative cholangiography in those cases.¹⁸

The bottom line is correct identification of the biliary anatomy by the surgeon as the critical step in prevention and Intra-operative cholangiography is a technique for doing so,⁸ in much the same way as the critical view of safety and other techniques. Strasberg stressed the significance of correct anatomical identification,

rather than technique, by giving an analogy of a hunter and an animal. The hunter must identify the head and torso of the animal correctly before firing the shot. Unfortunately, regardless of implementing the above approaches and techniques, the incidence of biliary injury has remained unchanged.

There is an increasing number of authors who propose the routine use of fluorescent cholangiography intraoperatively instead. Ishizawa et al, first published the use of near-infrared fluorescent cholangiography (NIFC) to better visualize the biliary tree during liver and biliary surgeries, in 2009.¹⁹ It is a novel technique that uses a fluorescent dye (indocyanine green) which when activated by near-infrared light allows structures to be detected properly during surgery, that may not otherwise be visualized with white light alone. Ishizawa demonstrated the cystic duct in all 52 patients examined and the cystic duct-common hepatic duct junction was delineated in 50 patients using the NIFC. This novel technique has a chance to re-revolutionize biliary surgery because of its numerous advantages over conventional imaging techniques like pre-operative Magnetic Resonance cholangiopancreatography and intra-operative cholangiography.²⁰ There have been various publications that have described the value of this technique in visualization of the extrahepatic biliary ducts and there is virtually no doubt about its profound accuracy and feasibility.

There are many reasons why NIFC should be used routinely to enhance the safety of laparoscopic cholecystectomy. It does not require radiation and indocyanine green does not cross the placental barrier in significant quantities and, therefore, can be used in pregnant patients. It is easy to use and provides the surgeon with a direct image that does not require interpretation as it does in Intra-operative cholangiography. There is no need to cannulate the cystic duct as in Intra-operative cholangiography. It gives the surgeon some tactile feedback since the structures that are lighting up can be touched in real time. It does not require extensive dissection as

is done during implementation of critical view of safety method to avoid bile duct injury. It is relatively cheap and easy to perform. Dip et al, did a cost analysis and effectiveness comparison between NIFC and IOC in 2014 and found that NIFC was less expensive than IOC (US\$14.10±4.31 vs. US\$ 778.43±0.40; $p < 0.0001$).²⁰ NIFC should be used routinely, not as a replacement of critical view of safety or IOC techniques, but as critical complement to prevent bile duct injury occurrence.

One shortfall of NIFC is the inability to assess the bile duct for presence of stones. Though NIFC certainly has promise, the technology has not spread widely throughout hospitals around the world. Further prospective studies in large numbers of patients with obesity, acute cholecystitis or other difficult gallbladder scenarios need to be carried out to evaluate the effectiveness of NIFC in reducing bile duct injuries.

Conclusion:

To rarely or not perform IOC in any surgical practice means that many stones or anatomic anomalies may be missed, and the latter may potentially lead to bile duct injury during laparoscopic cholecystectomy. In addition, generations of young doctors may miss the opportunity for training in a fundamental surgical skill and the chances of maintaining an essential skill set may be lost. On the other hand, a series of studies have failed to show evidence for practice of routine IOC. Currently, the routine use of NIFC is being investigated. The new technique has the potential to improve visualization of biliary ducts while obviating some of the problems inherent in the use of IOC, and at the same time increasing the safety profile of hepatobiliary surgery.

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