SAGES Clinical Spotlight Review: Intraoperative cholangiography

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Preamble

The following clinical spotlight review regarding the intraoperative cholangiogram is intended for physicians who manage and treat gallbladder/biliary pathology and perform laparoscopic cholecystectomy. It is meant to critically review the technique of intraoperative cholangiography, alternatives for intraoperative biliary imaging, and the available evidence supporting their safety and efficacy. Based on the level of evidence, recommendations may or may not be given for their use in clinical practice.

Disclaimer

Guidelines for clinical practice and spotlight reviews are intended to indicate preferable approaches to medical problems as established by experts in the field. These recommendations will be based on existing data or a consensus of expert opinion when little or no data are available. Spotlight reviews are applicable to all physicians who address the clinical problem(s) without regard to specialty training or interests, and are intended to convey recommendations based on a focused topic; within the defined scope of review, they indicate the preferable, but not necessarily the only acceptable approaches due to the complexity of the healthcare environment. Guidelines and recommendations are intended to be flexible. Given the wide range of specifics in any health care problem, the surgeon must always choose the course best suited to the individual patient and the variables in existence at the moment of decision.

Guidelines, spotlight reviews, and recommendations are developed under the auspices of the Society of American Gastrointestinal Endoscopic Surgeons and its various committees, and approved by
the Board of Governors. Each clinical spotlight review has been systematically researched, reviewed and revised by the guidelines committee, and, when appropriate, reviewed by an appropriate multidisciplinary team. The recommendations are therefore considered valid at the time of production based on the data available.

**Literature Review**

A systematic literature search was performed on MEDLINE in August 2014. The search strategy was limited to adult English language articles and is shown in Figure 1. A second search was performed in May 2015 and limited to pediatric English language articles.

The literature search identified relevant articles. The abstracts were reviewed by 4 committee members (WWH, MZ, WO, DW) and divided into the following categories:

(a) Randomized studies, meta-analyses, and systematic reviews

(b) Prospective studies

(c) Retrospective studies

(d) Case reports

(e) Review articles

Randomized controlled trials, meta-analyses, and systematic reviews were selected for further review along with prospective and retrospective studies when a higher level of evidence was lacking. Studies with smaller samples were considered when additional evidence was lacking. The most recent reviews were also included. All case reports, old reviews, and smaller studies were excluded when higher level evidence was available. Duplicate publications or patient populations were considered only once. Whenever the available evidence from Level I studies was considered to be adequate, lower evidence level studies were not considered. Newer relevant articles that were published after the
original literature search date during the drafting of this guideline were also included. According to these exclusion criteria, 66 adult articles and 37 pediatric articles were selected for review.

The reviewers graded the level of evidence and searched the bibliography of each article for additional articles that may have been missed during the original search. Additional relevant articles (n=12) were obtained and included in the review for grading. A total of 115 graded articles relevant to this guideline were included in this review. To facilitate the review by multiple reviewers, these articles were divided into the following topics and distributed to the reviewers:

- History of cholangiography
- Indications for intraoperative cholangiography
- Ability of intraoperative cholangiography to reduce bile duct injuries
- Techniques of and equipment needed for intraoperative cholangiography and the use of glucagon
- Outcomes related to intraoperative cholangiography
- Alternative intraoperative methods for assessment of the biliary tree

The recommendations included in this guideline were devised based on the reviewers’ grading of all articles.

**Levels of Evidence/definitions**

Both the quality of the evidence and the strength of the recommendation for each of the guidelines were assessed according to the GRADE system. This uses a 4-tiered system for denoting the quality of evidence (very low (+), low (+ +), moderate (+ + +), or high (+ + + +)) and a 2-tiered system for strength of recommendation (weak, or strong)

**Introduction**

**Statement of Focus**
The intent of this Clinical Spotlight Review is to critically review the literature and describe the technique of intraoperative cholangiography and alternative techniques for intraoperative assessment of the biliary tract.

**History of intraoperative cholangiogram**

The history of intraoperative cholangiography (well documented by MacFadyen[1]) goes back to 1918 where Reich is credited with the first report of delineating the anatomy of the biliary tree by using bismuth and petrolatum to identify a biliary fistula[2]. Further advances came in the 1920’s and 30’s with Tenney and Patterson [3] who defined a bile duct stricture and fistula in a patient who had undergone a cholecystectomy and in Ginzburg and Benjamin [4] who injected lipiodol solution into a biliary fistula to identifying common bile ducts stones.

In 1932, Mirizzi reported on the first series of routing IOC’s using lipiodol during cholecystectomy[5] and advanced the understanding of biliary surgery by emphasizing the importance of IOC, delineating the anatomy and function of the Sphincter of Oddi, and the recommendation of leaving T-tubes after exploration of the common bile duct[1]. Twenty years later, Swenson and Fisher reported the first application of IOC to four infants suspected of having biliary atresia. While the initial cholecysto-cholangiogram utilized methylene blue solution injected directly into the gallbladder with a subsequent search for it in the duodenum and proximal hepatic ducts, they subsequently injected “Diodrast” and obtained a plain film of the abdomen, confirming the diagnosis of biliary atresia in 3 of the 4 patients[6].

The initial IOC’s were performed with static films and the procedure required an average of 20-30 minutes to obtain 3-4 images and often had to be repeated[1]. Improvements in IOC came and paralleled the improvements in imaging capabilities. In 1957, Lackner and Volkel [7] reported on a mobile image intensifier followed by Stefanini[8], Grace and Peckar[9], and Whitaker et al. [10] reporting on the use of this coupled with a television fluoroscopy for IOC. Improvements in cameras
and television monitors allowed for better quality images and a higher definition intraoperative fluorocholangiography (IOFC) emerged. Berci et al. reported on a series of patients in 1978 where they used a C-arm mobile intensifier and IOFC obtaining images which have become the current standard for IOC[11].

What are the indications for IOC?

The main goals of IOC are to identify bile duct stones, clarify biliary anatomy, and prevent bile duct injuries [1]. Cholangiography is also a fundamental tool in the evaluation of neonatal jaundice, distinguishing biliary atresia, biliary hypoplasia, and cholestasis from other causes, and permitting therapeutic irrigation of inspissated bile from the ductal system. Indications for IOC during laparoscopic cholecystectomy may include jaundice or a history of jaundice, a history of pancreatitis particularly related to gallstone pancreatitis, elevated liver function tests, a common bile duct larger than 5-7mm in diameter, a cystic duct larger than 3mm in diameter, multiple small gallbladder stones, unclear anatomy, common bile duct stones visualized on preoperative ultrasound, possible bile duct injury or leak, and a short cystic duct[1, 12].

Does routine performance of IOC prevent common bile duct injuries?

Whether IOC should be performed routinely or selectively remains a matter of debate. The SAGES guidelines for the clinical application of laparoscopic biliary tract surgery[13] recommended that IOC may decrease the risk of bile duct injury when used routinely and can allow access to the biliary tree for therapeutic intervention (Level II evidence, grade B recommendation). This guideline called for the development of reliable algorithms to guide surgeons when to perform selective cholangiography[13]. In a more recent guideline from the European Association for Endoscopic Surgery (EAES) regarding the prevention and treatment of bile duct injuries during laparoscopic cholecystectomy, the authors commented that the routine use of IOC remained controversial and that routine IOC could not be recommend based on the available literature[14]. This guideline, however, indicated that IOC allows for
early identification of bile duct injuries as long as they are correctly interpreted [14]. Two recent systematic reviews have addressed this question.

The first study evaluated eight randomized controlled trials and did not find any benefit of IOC for the prevention of bile duct injuries [15]. In this study, they commented that the Level 1 evidence was of moderate to poor quality and that none of the studies were insufficiently powered either alone or in combination to demonstrate the benefit of IOC [12]. The second systemic review evaluated articles relating to bile duct injuries and reported a protective effect of IOC on bile duct injuries during cholecystectomy, however, reviewed evidence that was not Level 1 [16]. A nationwide cohort analysis of Medicare patients undergoing cholecystectomy in from 1992-1999 found that the risk of bile duct injury was increased when IOC was not used after controlling for patient and surgeon experience factors and suggested that the routine use of IOC may decrease rates of common bile duct injuries [17].

Another study evaluated the value of IOC during laparoscopic cholecystectomy using Texas Medicare claims data from 2000-2009 and reported no statistically significant association between IOC and common bile duct injury when confounders were controlled for [18, 19].

Two studies have evaluated the effect of cholangiograms on early detection of bile duct injuries. Data from the Swedish national registry on gallstone surgery reported a 29% lower rate of common bile duct injury when IOC was used as well as a 62% reduction in the risk of death [20]. Data from a single high volume teaching center reported that routine use of IOC during laparoscopic cholecystectomy was associated with a low incidence of bile duct injuries and that IOC facilitated the detection and repair of these injuries at the same surgical procedure [21].

In the pediatric literature, there are no randomized, prospective trials to assess the utility of IOC in preventing bile duct injury. However, the most robust guidance comes from a large retrospective cohort study in pediatric patients that did not identify a benefit for IOC in preventing bile duct injuries in this population [19, 22]. Utilizing the California Patient Discharge Database to query for children under
18 who underwent a cholecystectomy, Kelley-Quon, et al identified a cohort of 6931 children. IOC was performed in 30% of children and the overall incidence of bile duct injury was 0.36%. Notably, the incidence of injury increased with younger age, and was not lower in centers with higher use of IOC or higher surgical volumes[19]. There was a trend towards increased likelihood of a bile duct injury in hospitals with a tendency for routine IOC used (odds ratio 12.92, 99% CI 1.31-127.15). The authors conclude that independent of surgeons who perform routine IOC, the performance of an IOC in this population may be a marker of a more difficult procedure of aberrant surgical anatomy, and they advocate for additional research into the indication for the IOC on those who use it selectively.

**Recommendation**

Surgeons should use IOC liberally, be familiar with its indications, and become facile with the technique and interpretation of cholangiogram images. While IOC may decrease the risk of bile duct injury its routine use remains controversial; further high quality evidence is needed before routine IOC can be recommended.

Quality of evidence: +++, weak

**Which is the best technique for IOC?**

Several IOC techniques have been described that have evolved over time based on available technology. No particular technique has been proved to be superior and all techniques have been reported to give an adequate assessment of the biliary tree. Most experts agree that the critical view of safety should be obtained first during laparoscopic cholecystectomy when possible before performing IOC [23].

Two main fluoroscopic based techniques have been proposed to evaluate the biliary tree during laparoscopic cholecystectomy[1].

Intraoperative cholangiography starts by obtaining the critical view of safety [23] and identifying anatomy. A clip is placed on the cystic duct/infundibular junction to prevent flow of bile from the
gallbladder or contrast into the gallbladder during IOC. A small incision is then made on the anterior surface of the cystic duct just below the clip and can be confirmed by the presence of bile. A cholangioclamp with cholangiocatheter is then inserted either via one of the right subcostal ports or via a small stab incision is made in the right upper quadrant and a needle or guiding sheath is advanced percutaneously into the abdomen angling towards the cystic ductotomy. At this time a cholangiogram catheter of the surgeon’s choice can be advanced into the cystic ductotomy and secured with a clip, balloon, cystic duct holding device, or umbrella mechanism.

Once the cholangiocather is secured in place, a mobile C-arm fluoroscope is covered with a sterile drape and positioned over the right upper quadrant of the patient. The bed, which should be positioned and able to accommodate a C-arm, can be adjusted to have the patient in Trendelenburg position and slightly to the right which may facilitate placement of the C-arm. Respirations can be held after discussion with the anesthesiologist to obtain a satisfactory image. Diluted dye is then injected through the cholangiogram and fluoroscopic images are obtained. Although stressed less than the actual technique of IOC, correct interpretation of the cholangiogram is paramount in helping to prevent bile duct injury and evaluate for common bile duct stones. Correct biliary anatomy, filling of the duodenum without evidence of common bile duct filling defects, and filling of the right and left hepatic ducts should be visualized during IOC.

An alternative fluoroscopic method for evaluating the biliary tree is cholecystocholangiography whereby the catheter is placed directly into the gallbladder and distended with dye which then flows into the cystic duct. More commonly used in the infant and pediatric population where the cystic duct may be very small and more difficult to cannulate[24], a variety of techniques for gallbladder access have been described, including exteriorization of a portion of the gallbladder fundus through a 5 mm port site [25]for cholecystostomy, percutaneous puncture of the gallbladder with or without fixation to
the abdominal wall[26, 27], and use of specialized clamps to fixate the gallbladder and facilitate cholecystocholangiography[28].

There has been one randomized controlled trial that evaluated two techniques for IOC. In this trial, 59 patients were randomized to IOC using a clamp device that helps insert a 5mm catheter into the cystic duct or a clamp device that is placed through the right mid-subcostal port and clamps across the neck of the gallbladder with a 19 gauge needle that can be introduced into the gallbladder[29]. They reported no advantage of one catheter over the other and that both clamps facilitated IOC in just over 10 minutes and that surgeon preference should dictate which cannulation technique they should use[29].

Several proposed techniques have been reported to aid in IOC in difficult cases but have not been thoroughly tested. In cases where the cystic duct may be obstructed by stones, fibrosis, or tortuous valves of Heister, maneuvers such as milking the stones from proximal in the cystic duct or using a guide wire to help facilitate catheter insertion may be used[1, 30]. For patients with short, thickened, or dilated cystic ducts that may not be amenable to clip placement and control of the cholangiocatheter, a technique of using a vessel loop to encircle the catheter and cystic duct has been reported as an alternative method of securing the cystic duct to reduce the risk of a cystic duct stump leak[31].

**Recommendation**

There is no evidence to suggest that one of the available IOC techniques is superior to another. Surgeons should therefore use the technique they are most comfortable and familiar with, taking patient anatomy into consideration.

Quality of evidence: +, weak

**Is there a benefit in using Glucagon during IOC?**
The use of glucagon has been advocated as a useful adjunct for IOC and is commonly used. There are various reports in the literature relating to implications of glucagon on the sphincter of Oddi as well as the clinical significance of its use for cholangiography will no real consensus.

Several studies have reported on the beneficial effects of glucagon on relaxation of the sphincter of Oddi and improved visualization of cholangiography with its use [32-40] while others have reported no discernible benefit to its use [41-43]. One study evaluated the use of 1 or 2mg of intravenous glucagon and reported that a dose of 1mg is equally as effective as 2mg during cholangiography[36]. Proponents of the use of glucagon cite the ease of use and relatively low incidence of side effects. Only one reported major side effect was noted and reported in a 60 year old male with an unsuspected pheochromocytoma that had an intraoperative cardiac crisis as glucagon can also provoke catecholamine release[44]. They recommended that appropriate pharmacologic catecholamine antagonist be available when administering glucagon to help prevent this potential side effect[44]. For clinical use, the most valuable role for glucagon involves cases where the common bile duct does not empty into the duodenum, when attempting to flush small CBD stones into the duodenum, or when performing a transcystic common bile duct exploration.

While there are small series that describe the use of glucagon in pediatric patients undergoing IOC, all are in patients in whom the IOC was positive for a stone and an attempt was being made at laparoscopic common bile duct exploration[30, 45]. There is a single case report utilizing both glucagon and N-acetylcysteine to flush the biliary tree in a two month old with obstruction without complication and with successful clearance of the stones and inspissated bile[46].

*Recommendation:*

Glucagon may be useful during IOC to allow small stones or contrast to pass into the duodenum by relaxing the sphincter of Oddi. Given its low side effect profile, ease of use, and potential improvement
in visualization during IOC glucagon administration should be considered by surgeons when indicated during IOC.

Grade: +, weak

**What equipment is needed to perform IOC?**

The technique of IOC has evolved since its first description with many advances to make the procedure simpler, more reproducible, and efficient.

IOC can be performed with limited equipment and there are several different catheters that a surgeon may choose based on their preference and experience. Many of the current IOC catheters and cannulas have a kit with all equipment needed but can entail some or all of the following: a catheter or cannula, a syringe, introducer needle/sheath, and a 3-way stopcock. As kits can often be costly, cholangiography can also be performed quite cheaply by using a 3 French ureteral catheter and a reusable cholangiogram clamp instrument. Additional equipment may be needed such as a clip applier depending on the catheter being used in cases where the catheter needs to be secured in the cystic duct—as most surgeons use a clip applier during laparoscopic cholecystectomy this is often already available. Dye is also needed to perform the IOC and type of dye will vary based on institutional protocols. Saline is also useful to flush the duct prior to and after dye administration. In cases of a small or tortuous cystic duct, a selection of hydrophilic wires may prove beneficial. Mobile C-arms/fluoroscopy is now common in most operating rooms and greatly facilitate IOC. Sterile covers for the C-arm are needed. As mentioned previously glucagon may be used in some cases and can be administered by anesthesiology. As the IOC involves radiation exposure, surgeons and operating room personnel should have protection from either using lead aprons and neck protectors or lead shield protectors.
As mentioned earlier, there is no available literature that demonstrates superiority of one technique or equipment over another [29] and, therefore, techniques and equipment should be left up to surgeon preference.

**Recommendation:**

Instrumentation needed for IOC includes a mobile C-arm or other fluoroscopy capability, radiopaque dye, and a cholangiogram catheter or cannula of the surgeon’s choosing. Radiation protection in terms of aprons/neck protectors or shields which surgeons/personnel may stand behind should be routinely used. In the absence of clear evidence for the superiority of specific equipment or IOC technique, the choice of equipment and technique are left at the discretion of the surgeon.

Grade: +, weak

**What is the sensitivity and specificity of IOC for detecting Bile Duct Pathology?**

Cholangiography can be a straightforward technique but is not attainable in all cases due to various reasons relating to anatomy. Reported successful cholangiography rates for both pediatric and adult patients range from 82%-97% with the majority of studies citing success rates over 90% [15, 21, 29, 30, 47-59].

The sensitivity of IOC for detecting CBD stones ranges from 75%-100% while the specificity ranges from 76.2-100% with most reports citing greater than 90% sensitivity and specificity. The positive predictive value of IOC ranges from 94.5%-100% and the negative predictive value ranges from 91.4%-100%. Accuracy of IOC has been reported to range from 92.2%-99% in detecting stones [50, 54, 59-65].

In the infant population where IOC is performed to elucidate the etiology of persistent neonatology, the success rate is significantly lower and directly correlates with the size and appearance of the gallbladder. If the gallbladder is visibly highly atretic as in biliary atresia, some authors no longer persist in attempting a cholangiogram and proceed with the Kasai procedure directly with 100% accuracy[25, 26],
though one cohort reported an IOC success rate of 86% in this same population[66]. In infants with normal sized gallbladders, retrospective case series from four different authors all report 100% sensitivity and specificity for evaluation of bile duct patency[12, 25, 26, 66].

*Recommendation:*

IOC has a high sensitivity, specificity, positive and negative predictive value and accuracy for detecting CBD stones and neonatal biliary pathology. Surgeons should use this technique freely when indicated and become familiar with its interpretation.

Grade: ++, Strong

**How long does it take to perform IOC?**

One argument against the routine use of IOC has been that it prolongs the duration of laparoscopic cholecystectomy. Reports of timing for IOC vary based on technique, experience with the procedure, and setting (teaching hospital or not). Reported duration of laparoscopic IOC ranges from 4.3-18 minutes [15, 26, 29, 54, 55, 57, 58, 62, 63, 67, 68]; longer duration of the procedure is associated with limited availability of fluoroscopy, inadequate surgical skill, and infrequent use of the procedure [69].

*Recommendation:*

IOC during laparoscopic cholecystectomy minimally prolongs the duration of the procedure in experienced hands. Limited use of IOC and unfamiliarity with the procedure by surgeons and operating room personnel can, however, considerably prolong the procedure indicating a need for its more frequent use.

Grade: ++, weak

**Alternatives to intraoperative assessment of the biliary tree**

*Are there other operative modalities that can be used instead of IOC to evaluated CBD/Anatomy?*
There have been two main reported alternative intraoperative techniques to intraoperative cholangiogram to evaluate the biliary tree and include laparoscopic ultrasonography and infrared fluorescent cholangiography.

**Laparoscopic Ultrasound**

Laparoscopic ultrasound assessment of the biliary tree has emerged as an alternative to IOC and attempts to improve upon some of the potential drawbacks of IOC including radiation exposure, operative time, and failure rate. Various techniques have been described for laparoscopic ultrasound assessment of the biliary tree but are traditionally done using the same laparoscopic ports as a standard 4 port cholecystectomy. A flexible ultrasound device is then placed through the epigastric or umbilical port. The fundus of the gallbladder is retracted cephalad and the US probe is placed over the common bile duct where the junction of the right and left hepatic ducts as well as the cystic duct junction can be visualized. The US probe can then follow the common bile duct down to the duodenum to evaluate for common bile duct stones and other pertinent anatomy.

Laparoscopic ultrasound has been adopted by many surgeons as an alternative to intraoperative cholangiogram and numerous studies with various methodologies have reported on the safety and efficacy of this technique. To date, many of the studies have had small sample sizes which have limited the comparisons to IOC. A recent meta-analysis has evaluated laparoscopic ultrasonography compared to IOC to evaluate if it is a comparable intraoperative imaging modality[70]. The primary outcome was the presence or absence of common bile duct stones; studies were excluded for the following reasons: no comparison to IOC on the same patient population, open cases, ultrasound performed by novices (less than 20 cases), no prospective data collection, and if they did not provide enough data for sensitivity, specificity, true positive, true negative, false positive, and false negative[70]. Based on the 11 studies that met the inclusion criteria the pooled sensitivity for detecting common bile duct stones for IOC was 0.87 (95% CI 0.77-0.93) and pooled specificity of 0.99 (95% CI 0.98-0.99) while laparoscopic
ultrasound had a pooled sensitivity of 0.87 (95% CI 0.80–0.92) and specificity of 1.00 (95% CI 0.99–1.00) [70]. This well done meta-analysis reports that laparoscopic ultrasound is an accurate means of intraoperative assessment for common bile duct stones in comparison to IOC [70]. It is important to note that this study did not evaluate laparoscopic ultrasound as a tool to correctly identify biliary anatomy or help prevent common bile duct injuries, and, to date, there has been no conclusive data on this topic. One multicenter review of the use of laparoscopic ultrasound in 1,381 patients that reported no major bile duct injuries concluded that this technique may help prevent bile duct injuries [71].

Some potential benefits of laparoscopic ultrasound have been reported including a decrease in time as well as a potential for decreased cost [72, 73]. Reported times for laparoscopic ultrasound averaged ranged from 6.6—11.6 minutes compared to average times for intraoperative cholangiogram ranging from 10.9–17.9 minutes with all studies reporting shorter time using the laparoscopic ultrasound [54, 62, 63, 67, 68, 74]. Laparoscopic ultrasound has been applied to the pediatric population as well, and shows promise in identifying microlithiasis in the setting of a normal IOC [75].

**Recommendation:**

Laparoscopic ultrasound is a feasible alternative intraoperative method compared to intraoperative cholangiogram for detection of common bile ducts stones. Laparoscopic ultrasound may have some advantages over intraoperative cholangiogram, including decreased time to perform the technique.

Grade: +++, Strong

**Near-Infrared Fluorescent cholangiography**

Fluorescent cholangiography was first described in 2009 and involves the preoperative intravenous injection of indocyanine green (ICG) and is based on the concept that ICG is excreted exclusively into the bile and that protein-bound ICG emits light with a peak wavelength of 830 nm when illuminated with near-infrared light [76-79] [62-65].
Various devices and methods have been reported for fluorescent cholangiography but all are based on the administration of ICG either intra-biliary or intravenously and the use of a specialized camera system which uses near-infrared light to allow the surgeon to view the fluorescing ICG and evaluate the biliary anatomy. For this spotlight, the review of fluorescent cholangiography will be limited to the use during laparoscopic cholecystectomy. The structures that are reported that can be identified during laparoscopic fluorescent cholangiography before the dissection of Calot’s triangle include the cystic duct, common hepatic duct, common bile duct and the junction of the cystic duct with the common hepatic duct. Reported rates of visualization of these structures range from 71.4-100% for the cystic duct, 33.3-100% for the common hepatic duct, 25-100% for the cystic duct/common hepatic duct junction and 50-100% for the common bile duct[76, 77, 80-86]. There are no data on its use in the pediatric population.

One study looked at identification of the biliary tree both before and after dissection of Calot’s triangle using ICG and found that fluorescent imaging visualized the cystic duct, CD-CHD, CHD, and CBD in 69.6 % to 95.1% of the patients[87]. This was a 2-3 fold increase in identification of biliary anatomy when compared to no dissection at all[87]. Acute inflammation and thickness of the tissues (>5-10mm) overlying the triangle and porta hepatitis were a limiting factors[87]. However, BMI was found to not be a statistically significant variable. In patients where IOC was not successful, the fluorescent imaging was successful in 80% of the cases in identifying the extrahepatic biliary anatomy[87](Narula et.al).

Recently, the use of fluorescent cholangiography during robotic traditional and single site cholecystectomies has been reported. Several authors have reported on case series ranging from 44-184 cases reporting the safety and efficacy of this technology during robotic cholecystectomy[83, 85, 86].

The use of fluorescent cholangiography to detect biliary stones is limited. Detection of simulated common bile duct stones in a mouse model using fluorescence has been reported[88]. Osayi
et al. looked at 82 patients and found that fluorescent imaging was unable to identify choledocholithiasis and sludge; hence, IOC remains the gold standard in this setting[87].

One study has evaluated the cost and operative time of fluorescent cholangiography with intraoperative cholangiogram in 45 patients compared to historical controls[89]. They reported a lower individual median cost per patient (13.97 ± 4.3 vs 778.43 ± 0.4 USD, p=0.00001) and faster procedure times (0.71 ± 0.26 vs 7.15 ±- 3.76 minutes, p<0.0001) for fluorescent cholangiography compared to intraoperative cholangiogram[89].

Recommendation:

Fluorescent cholangiography is a novel emerging technique that is feasible and safe for use during laparoscopic cholecystectomy. Ranges for identification of various anatomic structures vary and the technology has not been evaluated under varied biliary pathologies. There is currently insufficient evidence for use of fluorescent cholangiography to evaluate for common bile duct stones, reduce bile duct injuries, or to evaluate efficacy compared to intraoperative cholangiography and its role for use has yet to be truly defined. Fluorescent cholangiography may able to be performed with less time and expense than conventional intraoperative cholangiograms.

Grade: +, weak

References:


