International Scholarly Research Network
ISRN Minimally Invasive Surgery
Volume 2012, Article ID 469013, 5 pages
doi:10.5402/2012/469013

*Clinical Study*

# Laparoscopic Intraoperative Cholangiography Interpretation by Surgeons versus Radiologists, A Comparative Study and Review of 200 Cholangiographies

**Hany M. El-Hennawy,[1] Eihab A. El-Kahlout,[1] Elsaid M. Bedair,[2] Ibrahem M. El Omari,[3] Ashraf A. Abdel Aziz,[4] and Ahmed M. Badi[5]**

[1] *Department of General Surgery, Al Khor Hospital, Hamad Medical Corporation, Qatar*
[2] *Department of Radiology, Al Khor Hospital, Hamad Medical Corporation, Qatar*
[3] *Department of Geriatric Medicine, Al Amal Hospital, Hamad Medical Corporation, Qatar*
[4] *Department of Tropical Medicine, Ain Shams University, Egypt*
[5] *Department of General Medicine, Al Khor Hospital, Hamad Medical Corporation, Qatar*

Correspondence should be addressed to Hany M. El-Hennawy, hennawyhany@hotmail.com

Received 14 May 2012; Accepted 31 July 2012

Academic Editors: L. Boni, A. Dezawa, C.-G. Ker, and A. Umezawa



*Introduction*. In some medical centers, LIOC are exclusively interpreted by surgeons. The degree of accuracy of surgeon's interpretation compared to that of radiologist (gold standard) and its clinical significance are not well studied. *Objective*. study whether surgeons are accurate in interpreting IOC or not by comparing the interpretation of LIOC by surgeons to the postoperative interpretation of same cholangiograms by radiologists, and study its clinical significance. *Methods*. A retrospective study of 200 consecutive patients who underwent selective LIOC in Al-Khor community hospital in Qatar during the period from May 2005 till December 2011. A radiology senior consultant blindly reviewed the cholangiograms (Reading B) then we compared these findings (ductal dilatation, defects of filling and passage of contrast into duodenum) to LIOC results that were reported intraoperatively by surgeons for the same patients (Reading A). *Results*. Ductal dilatation was found in (27.5%) of Reading A compared to 19% in Reading B. filling defects were reported in (20.5%) of Reading A compared to 14.5% in Reading B. *Conclusion*. there is significant difference of LIOC interpretation between surgeons and radiologist specially in the detection of defects of fillings although this variability did not affect the clinical outcome.

## 1. Introduction

LIOC is the most frequently applied technique for intraoperative assessment of the biliary anatomy [1]. LIOC is a dynamic procedure; the only real advantage to the surgeon is being able to view the IOC, and specifically the character and movement of any filling defect in real-time, which aids the interpretation of whether there is a stone or air bubble. There is, however, concern that IOCs are not always correctly interpreted. Accurate documentation of the interpretation of LIOC is important from the legal point of view.

## 2. Methods

A retrospective study of 200 consecutive patients who underwent selective LIOC in Al Khor Community Hospital in Qatar during the period from May 2005 till Dec. 2011. Intraoperative cholangiography was performed in patients in whom clinical data (previous history of jaundice, dark urine, acholic stool, or pancreatitis) or laboratory findings: elevation of the alkaline phosphatase, aspartate aminotransferase (AST) and bilirubin levels or a dilated common bile duct (more than 6 mm) on ultrasonography were suggestive

of choledocholithiasis. If a large cystic duct was found intraoperatively or the anatomy of the extrahepatic biliary tree was incompletely delineated, IOC was performed [2]. Fluoroscopic examination using a mobile C-arm image intensifier was performed; the technique entails incision on the anterosuperior aspect of the cystic duct, cystic duct canulation, and injection of contrast medium into the ductal system through the cystic duct via a Cook ureteric catheter (F4) inside a cholangiograsper with satisfactory radiological visualization of the intrahepatic and extrahepatic biliary tree. The contrast that we employed was half-strength Hypaque solution (ionic contrast medium). Glucagon was employed in about 32% of operations. LIOC was performed before surgical division of cystic duct. All of cholangiograms were interpreted by surgeons (reading A). A radiology senior consultant blindly reviewed the cholangiograms (reading B) then we compared these findings to LIOC results that were reported intraoperatively by surgeons for the same patients. An abnormal cholangiogram was defined as any of the following: CBD diameter >10 mm; filling defect(s) in the CBD; inadequate visualization of the lower end of the CBD; and/or no contrast seen in the duodenum. Defects were classified as stone, unsure, or air bubble. The size of the filling defect was rounded to the nearest millimeter [3]. Postoperative management of abnormal LIOC included daily liver function test, abdominal ultrasonography, MRCP, and ERCP.

## 3. Results

From May 2005 till Dec. 2011, 200 LIOC were performed, 105 females and 95 males with average age 35.0 ± 7.0 years. The commonest admission diagnoses for these patients were acute cholecystitis (40.5%), chronic cholecystitis (27.5%), acute biliary pancreatitis (18.0%), and persistent biliary colic (13.5%). The most common indications for this procedure were abnormal preoperative ultrasonography (77.5%), elevation of serum chemistry levels (67.5%), history of jaundice or pancreatitis (27.5%), and abnormal operative findings including unclear anatomy or dilated cystic duct (20.0%). In 5 patients (2.5%), the biliary tract imaging was incomplete because of an inability to cannulate the cystic duct due to the presence of a prominent Heister valve. We compared the IOC reports that were interpreted by surgeons (Reading A) to that reported by radiologist (Reading B). We did not report any bile duct injuries. Normal LIOC was reported in 72.5% of reading A and in 81% of reading B. Ductal dilatation was found in (27.5%) of Reading A compared to 19% in Reading B. Filling defects were reported in (20.5%) of Reading A compared to 14.5% in Reading B. Single filling defect was found in 38 patients in reading A compared to 28 patients in reading B. All the defects were in CBD in both readings. 78% of the defects were more than 2 mm and less than 6 mm in reading A compared to 79% in reading B. Radiologist reported CBD stricture in 4 patients. Discrepancy of LIOC interpretation was found in 16 patients (29.6%) out of 54 patients with abnormal LIOC in reading A. Despite intraoperative visualization of the intrahepatic biliary radicals in all patientsonly 15% of reading A reports commented on the intrahepatic biliary radicals (visualization and dilatation). There was no significant difference between the two groups in reporting passage of contrast to the duodenum. Two patients underwent preoperative endoscopic retrograde cholangiopancreatography for suspected common bile duct stones. LIOC for these 2 patients were negative in both readings (A and B). Postoperatively 12 patients (6%) showed transient abnormalities in liver functions. Seven patients with abnormal LIOC underwent MRCP which showed no abnormalities in three patients (2 of them discharged with normal liver functions and the third patient showed increasing liver enzymes and referred to ERCP which detected stones). The remaining four patients showed stones and referred for ERCP which detected stones. Seventeen patients (8.5%) have been referred for ERCP 3–5 days following LC because of common bile duct stones seen on operative cholangiography or persistently elevated liver enzymes. Abnormal ERCP (CBD stones) with abnormal LIOC (true positive LIOC) was found in 5 patients (2.5%) in reading A compared to 8 patients (4%) in reading B. Normal ERCP with normal LIOC (true negative LIOC) was found in 3 patients (1.5%) in reading A compared to 4 patients (2%) in reading B. Abnormal ERCP with normal LIOC (false negative LIOC) was found in 3 patients (1.5%) in reading A compared to 2 patients (1%) in reading B. Normal ERCP with abnormal LIOC (false positive LIOC) was found in 6 patients (3%) in reading A compared to 3 patients (3%) in reading B. All endoscopic procedures were carried out by experienced endoscopists using standard ERCP techniques and equipment. For patients with abnormal ERCP endoscopic papillotomy was performed with 2 to 2.5 cm cutting wire papillotomes and all biliary stones were removed with 8.5 to 14 mm balloons (Table 1).

## 4. Discussion

LIOC is a safe and accurate method for the assessment of bile duct anatomy and stones [4]. Attention should be paid to the legal implications of documentation of the biliary anatomy. This seems evident for IOC because it is part of the radiology studies in the patient medical file. Documentation of the biliary anatomy can be used by the surgeon to substantiate measures taken to ensure safety [5]. Although surgical practice has largely settled on selective instead of routine use of operative cholangiography, if properly interpreted, cholangiography can limit the frequency and severity of bile duct injuries [6]. Special attention should be paid to the learning curve for interpreting IOC, as some studies report high proportions of incorrectly interpreted cholangiograms. For example, Way et al. [7] demonstrated that 34/43 (79%) routine cholangiograms that showed bile duct injury were incorrectly interpreted [1]. Woods et al. reported 53 patients, Incorrect interpretation of the IOC occurred in at least eight patients, with no identification of the proximal biliary tree in six [8]. Also, Way et al. studied 60 routine operative cholangiograms, 43 demonstrated the bile duct injury. Nine were correctly interpreted when the surgeon noted that the proximal ducts did not opacify. In two of these cases, the surgeon

Table 1

| Variables | Number (%) | |
|---|---|---|
| Age (years) | | |
| 20–<40 | 109 (54.5) | |
| 40–60 | 79 (39.5) | |
| More than 60 | 12 (6.0) | |
| Gender | | |
| Males | 95 (47.5) | |
| Females | 105 (52.5) | |
| Admission diagnosis | | |
| Acute cholecystitis | 81 (40.5) | |
| Chronic cholecystitis | 55 (27.5) | |
| Biliary pancreatitis | 37 (18.0) | |
| Persistent biliary colic | 27 (13.5) | |
| Indication of IOC | | |
| History of jaundice or pancreatitis | 55 (27.5) | |
| Preoperative elevated chemistry | 135 (67.5) | |
| Preoperative ultrasonographic abnormalities | 155 (77.5) | |
| Operative findings | 40 (20.0) | |
| Training | 2 (1.0) | |
| Cystic duct cannulation | | |
| Successful | 195 (97.5) | |
| Unsuccessful | 5 (2.5) | |
| IOC findings | Surgeon readings | Radiologist reading |
| Duct dilatation | 55 (27.5) | 38 (19.0) |
| Filling defects | 41 (20.5) | 29 (14.5) |
| (1) Initially | 17 | 14 |
| (2) After Dormia basket manipulation | | |
| Choledochal cyst | 0 (0.0) | 0 (0.0) |
| Strictures | 0 (0.0) | 4 (2.0) |
| Failure of passage of dye into duodenum | | |
| (1) Initially | 24 (12.0) | 24 (12.0) |
| (2) After Dormia basket manipulation | 11 (5.5%) | 11 (5.5) |
| Congenital anomalies | 0 (0.0) | 0 (0.0) |
| Contrast leakage | 4 (2.0) | 4 (2.0) |
| IOC complications | | |
| Ductal injuries | 2 (1.0) | |
| Perforation | 0 (0.0) | |
| Mild transient chemistry abnormalities | 12 (6) | |
| Postoperative course | | |
| Discharge | 183 (91.5) | |
| ERCP | 17 (8.5) | |
| MRCP | 7 (3.5) | |
| Reoperation | 0 (0.0) | |
| ERCP | | |
| Preoperative | 2 (1.0) | |
| Postoperative | Surgeon readings | Radiologist reading |
| Total | 17 (8.5) | 17 (8.5) |
| (1) Abnormal ERCP with abnormal LIOC (true positive) | 5 (2.5) | 8 (4.0) |
| (2) Normal ERCP with normal LIOC (true negative) | 3 (1.5) | 4 (2.0) |
| (3) Abnormal ERCP with normal LIOC (false negative) | 3 (1.5) | 2 (1.0) |
| (4) Normal ERCP with abnormal LIOC (false positive) | 6 (3.0) | 3 (3.0) |

Table 1: Continued.

| Variables | Number (%) |
|---|---|
| Postoperative MRCP | |
| (1) Abnormal MRCP with abnormal LIOC (true positive) | 4 (2.0) |
| (2) Normal MRCP with abnormal LIOC (false positive) | 3 (1.5) |

Total number of cases is 200.
ERCP: endoscopic retrograde cholangiopancreatography; LIOC: laparoscopic intraoperative cholangiography; MRCP: magnetic resonance cholangiopancreatography.

divided the CBD before a static film was developed. In 28 cases the proximal biliary tree was not opacified during the cholangiogram or the common duct was narrowed at the point where the catheter entered, but the significance of these findings was overlooked. In six cases the cholangiograms were thought to be normal, but the catheters were actually in the RHD instead of the cystic duct [7]. False-positive results of IOC are a well-recognized problem, with a 0.6% to 6.1% incidence (mean, 3.1%) in open cholecystectomy reports and 1% to 4% in reported LC experiences. Our incidence was 3% false positive and 1% false negative LIOC. Selective IOC reduces the incidence of false-positive findings that result in unnecessary common bile duct explorations [9, 10]. The ability to identify unsuspected stones or the lack of them remains the greatest technical success, defined as the ability to obtain a cholangiogram of sufficient quality to allow interpretation, which appears to be over 90% in most hands. The reported success rate for laparoscopic common bile duct exploration (LCBDE) was over 92% using a variety of techniques. These include flushing of the CBD with the use of IV glucagon, which is especially useful when the common bile duct stones are smaller than 2 mm, when sludge is present, or sphincter spasm is the cause of the retained stones; balloon manipulation with biliary Fogarty catheters; use of Dormia baskets to capture the stone; choledochoscopy; and lithotripsy. Transcystic approach is preferred over the transductal approach in cases with smaller stones <6 mm or smaller bile duct <6–10 mm because of the higher success rate and lower complication rate in these circumstances [11]. In our study, LIOC technique started with routine flushing of CBD with normal saline solution so we did not documented any small filling defects less than 2 mm. Transcystic approach was performed in all patients with success rate of 72%. The use of IOC has a high sensitivity of 93.9%, a specificity of 89.7%, and positive and negative predictive values of 98.7% and 97.6%, respectively, in the detection of ductal stones. The reported incidence of false-positive cholangiograms still ranges from 2% to 16% [5]. False-positive cholangiograms commonly result from misinterpretation of filling defects and artifacts (air bubbles), which have the radiological appearance of stones, resulting in unnecessary choledochotomy. All criteria, when present independently, yielded numbers of positive cholangiograms which we considered acceptable. Jaundice at the time of surgery and a stone visualized on imaging were the most sensitive criteria. The presence of multiple predictors further increased the positive yield for IOC [12]. Haglund recommended the evaluation of LIOC by two experts to avoid wrong interpretation [13]. LIOC is a dynamic study and a radiologist sometimes cannot give a critical comment on four or less small sized printouts of more than 100 shots taken during the procedure and viewed only during the surgery; for example, moving air bubble might be interpreted by the radiologist as a stone. The high incidence of biliary duct dilatation in our study (27.5%) may be due to many limiting technical factors such as the difference in the magnification power used, the lack of fixed reference landmark to which we can accurately measure and compare the diameter of biliary ducts, injection of contrast material under pressure or the inappropriate exposure of the biliary tree on the cholangiograms. The only clinical significance of a dilated duct is that it may imply the previous passage of stones. If the CBD is clear of stones, surely that is the only important consideration for the surgeon intraoperatively. Patients with an abnormal IOC and referred for ERCP (n 17), about 50%, have a normal postoperative ERCP. None of the parameters evaluated in this retrospective study helped identify patients who merit further evaluation by ERCP. Postoperative ERCP is not a suitable gold standard for calculating false positives and negatives; it was only used in a small number, and stones may have appeared in, or disappeared from, the CBD in the interval since surgery. The argument could be made that in patients with an abnormal IOC less invasive methods such as endoscopic ultrasound or magnetic resonance cholangiopancreatography could be used postoperatively if symptoms arise to assess for possible retained stone [14]. The difference in LIOC interpretation between both groups did not affect the clinical course and outcome of the patients in our study because in our center the referral for postoperative ERCP depends on many factors besides the abnormal LIOC: persistent or increasing liver enzymes, abnormal postoperative ultrasonography, or MRCP. In our study we had no bile duct injuries documented by LIOC because in all patients contrast study was performed before surgical division of cystic duct.

## 5. Conclusion

Comparing dynamic study interpretations by surgeon to radiologist comments on static cholangiograms may be the reason of the significant difference LIOC interpretation. Fortunately, this difference has little clinical importance as the management plan in patients with LIOC with filling defects depends primarily on postoperative clinical and laboratory status. Special attention should be paid to the learning curve for interpreting IOC. We recommend surgeons to fill a Check

list standard LIOC report to avoid missing data and to improve documentation. Further interaction and cooperation between both surgeons and radiologist is recommended for better outcome of LIOC.

## References


[1] K. T. Buddingh, V. B. Nieuwenhuijs, L. van Buuren, J. B. F. Hulscher, J. S. de Jong, and G. M. van Dam, "Intraoperative assessment of biliary anatomy for prevention of bile duct injury: a review of current and future patient safety interventions," *Surgical Endoscopy*, vol. 25, pp. 2449–2461, 2011.

[2] B. L. Robinson, J. H. Donohue, S. Gunes et al., "Selective operative cholangiography: appropriate management for laparoscopic cholecystectomy," *Archives of Surgery*, vol. 130, no. 6, pp. 625–631, 1995.

[3] P. D. Kondylis, D. R. Simmons, S. K. Agarwal, K. A. Ciardiello, and R. B. Reinhold, "Abnormal intraoperative cholangiography: treatment options and long- term follow-up," *Archives of Surgery*, vol. 132, no. 4, pp. 347–350, 1997.

[4] S. Y. Azary, H. Kalbasi, A. Setayesh et al., "Predictive value and main determinants of abnormal features of intraoperative cholangiography during cholecystectomy," *Hepatobiliary and Pancreatic Diseases International*, vol. 10, no. 3, pp. 308–312, 2011.

[5] K. T. Buddingh, A. N. Morks, H. O. ten Cate Hoedemaker et al., "Documenting correct assessment of biliary anatomy during laparoscopic cholecystectomy," *Surgical Endoscopy*, vol. 26, pp. 79–85, 2012.

[6] D. R. Fletcher, M. S. T. Hobbs, P. Tan et al., "Complications of cholecystectomy: Risks of the laparoscopic approach and protective effects of operative cholangiography: a population-based study," *Annals of Surgery*, vol. 229, no. 4, pp. 449–457, 1999.

[7] L. W. Way, L. Stewart, W. Gantert et al., "Causes and prevention of laparoscopic bile duct injuries: analysis of 252 cases from a human factors and cognitive psychology perspective," *Annals of Surgery*, vol. 237, no. 4, pp. 460–469, 2003.

[8] M. S. Woods, L. W. Traverso, R. A. Kozarek et al., "Biliary tract complications of laparoscopic cholecystectomy are detected more frequently with routine intraoperative cholangiography," *Surgical Endoscopy*, vol. 9, no. 10, pp. 1076–1080, 1995.

[9] J. S. Barkun, G. M. Fried, A. N. Barkun et al., "Cholecystectomy without operative cholangiography: Implications for common bile duct injury and retained common bile duct stones," *Annals of Surgery*, vol. 218, no. 3, pp. 371–379, 1993.

[10] B. W. Pace, J. Cosgrove, B. Breuer, and I. B. Margolis, "Intraoperative cholangiography revisited," *Archives of Surgery*, vol. 127, no. 4, pp. 448–450, 1992.

[11] B. Kharbutli and V. Velanovich, "Management of preoperatively suspected choledocholithiasis: a decision analysis," *Journal of Gastrointestinal Surgery*, vol. 12, no. 11, pp. 1973–1980, 2008.

[12] J. Horwood, F. Akbar, D. Katherine, and R. Morgan, "Prospective evaluation of a selective approach to cholangiography for suspected common bile duct stones," *Annals of the Royal College of Surgeons of England*, vol. 92, no. 3, pp. 206–210, 2010.

[13] U. Haglund, "Bile duct injuries - X-ray reduces the risk, but gives no guarantee. Unconsciously wrong interpretation is avoided if two experts make the evaluation," *Lakartidningen*, vol. 100, no. 48, pp. 3973–3975, 2003.

[14] M. P. Spinn, D. S. Wolf, D. Verma, and F. J. Lukens, "Prediction of which patients with an abnormal intraoperative cholangiogram will have a confirmed stone at ERCP," *Digestive Diseases and Sciences*, vol. 55, no. 5, pp. 1479–1484, 2010.