Is There A Need Of Intraoperative Cholangiograms In Patients Of Cholelithiasis With And Without Clinical Indication Of Common Bile Duct Exploration While Performing Open Or Laparoscopic Cholecystectomy?

M Dar, M Mir, S Jeelani, A Ganai, M Wani

Citation

Abstract
Background and Objectives: The study has been conducted with the aim to assess the need of intraoperative cholangiogram in patients of cholelithiasis with and without the clinical indication of common bile duct exploration. Design and Setting: Prospective study in patients of cholelithiasis with and without the clinical indication of common bile duct exploration admitted in the surgical wards. Patients and Methods: The study included 485 consecutive patients of cholelithiasis with and without the clinical indication of common bile duct exploration over a period of five years. All these patients were subjected to detailed history and clinical examination and investigations. An intraoperative cholangiogram was performed in all studied patients. Every alternate case was subjected to laparoscopic and open cholecystectomy with or without common bile duct exploration. Data collected was tabulated and the p-value measured. Results: In patients with indication of common bile duct exploration, intraoperative cholangiography could spare 60 out of 140 (42.86%) patients from unnecessary CBD exploration while in patients without indication of common bile duct exploration intraoperative cholangiography could pick stones in the common bile duct in 15 out of 345 (4.34%) patients only, with very significant p-value (p<0.005). Conclusion: Intraoperative cholangiography is applicable in selective cases only where the indications for its use exist to solve the dilemma of an operating surgeon in the form of preoperative status, abnormal biliary tract anatomy or a difficult cholecystectomy due to dense adhesions to get a clear road-map of the ductal system and also to minimize the rate of unnecessary pre- and post-operative endoscopic retrograde cholangio-pancreatography.

INTRODUCTION
Open or laparoscopic, safe cholecystectomy is a challenging job for the surgeon. Though preoperative diagnosis of calculous biliary tract diseases poses no problem, during surgery, biliary calculi are often missed, so that retained stones in the biliary channels are a persistent problem in the management of biliary tract calculi. The need for additional diagnostic methods to improve the results in gallbladder surgery has long been acknowledged to eliminate or minimize the possibility of overlooked stones in the biliary channels, the consequences of which are embarrassing to the surgeon and a source of discouragement to his patient. In 1936, Lahey concluded that previous to 1926 he had left a stone in the common bile duct in one out of every ten patients subjected to cholecystectomy. In an effort to decrease this high incidence, he increased the choledochotomy to 44% (in a series of 200 cases) with a discovery of calculi in 18% of them. As the complications from choledochotomy may be considerable, it is important both clinically and economically for the surgeon to try to reduce these to a minimum by proper scrutiny of the patients. Previously, choledochotomy was performed solely on the basis of traditional indications either because of clinical history, laboratory investigations or the operative findings, the main criteria being: 1. recent or recurrent jaundice, 2. history of acute or chronic pancreatitis, 3. history of intermittent chills or fever in patients with cholelithiasis, 4. preoperative radiological evidence of stones in the bile ducts, 5. laboratory investigations of elevated serum bilirubin, aspartate transaminase (AST), alkaline phosphatase (ALP) and gamma-glutamyl transpeptidase (GGT), 6. operative findings of cystic duct enlargement, a
dilated CBD or palpable stones within the duct, 7. the presence of multiple small stones within the gallbladder, 8. turbid bile aspirated from the duct and 9. recurrent symptoms after biliary surgery. These traditional indications resulted in a high number of unnecessary choledochotomies, thus adding to the morbidity and even mortality in patients with biliary stone diseases. Also there is no provision for unsuspected common bile duct stones (present in up to 5-7%), which are usually missed at the time of operation.

To overcome these difficulties in the management of biliary tract diseases, there are many modalities available for both pre- and per-operative detection of biliary tract stones and other diseases. Intraoperative cholangiography is the method used most often to establish the presence of bile duct stones/diseases. Its accuracy approaches other modalities available but is simple, readily available and very economical. It is quicker and readily repeatable and adds only a few extra minutes to the operative procedure. It does not require any special training to perform and can be done with a high degree of accuracy once the surgeon becomes familiar with it. It has proved to be a valuable tool in the surgical management of the biliary tract since its introduction by Mirrizi in 1931. The technique involves radiographic opacification of biliary channels by introduction of contrast dye. It provides invaluable anatomic and pathologic information to the surgeon regarding the biliary tract. Many surgeons now use the findings on intraoperative cholangiogram to help them decide whether or not to explore the duct or to locate the stones before exploration. Unnecessary explorations of the common bile duct, when indications are marginal, may be averted by accurate and precise radiography of the biliary tract. The routine use of intraoperative cholangiogram should improve the end result of biliary tract surgery and eliminate the majority of non-productive or unnecessary choledochotomies done in conjunction with cholecystectomy for benign disease. Routine transcystic duct cholangiography is felt to reduce bile duct injury rates by identifying ductal anomalies in approximately 14% of patients. A road map of the ductal system is provided that helps preventing and identifying an injury to the common bile duct. It achieves safe visualization of hidden or surgically hazardous areas. Also information provided by an intraoperative cholangiogram may avert a second operative procedure for operative injury or overlooked stones. Operative transcystic duct cholangiography is highly effective in detection of unsuspected stones (5-7%) in the common bile duct that are usually missed at the time of surgery and have not been picked up by any preoperative testing. Intraoperative cholangiogram can also be used to delineate any communications with biliary tree of various pathologies of the liver e.g., hydatid cyst cavities, abscess cavities etc., which can then be dealt with at the same time. Apart from detecting retained stones and anomalous biliary channels, intraoperative cholangiography is also helpful in the diagnosis of other pathologies of the biliary tract like diverticula, strictures, parasites e.g., Ascaris, Clonorchis, etc., and neoplasms that may cause intrinsic or extrinsic obliteration. Although the procedure is associated with a false positive rate ranging from 0 to 5%, this can be minimized considerably with experience of the surgeon and routine use of the procedure. The accuracy of intraoperative cholangiography has been enhanced greatly by improvements in imaging offered by newer C-arm fluoroscopic equipment with image enhancement. The use of image amplifier and fluoroscopy reduces the amount of radiation required and promises greater safety for the patient and the operating team.

**PATIENTS AND METHODS**

This prospective study included 485 consecutive patients of cholelithiasis with and without the clinical indication of common bile duct exploration who reported to the Department of General Surgery, Government Medical College, Srinagar, over a period of five years from 1\textsuperscript{st} June 2006 to 31\textsuperscript{st} may 2011, irrespective of age and sex. All these patients were subjected to detailed history and clinical examination and investigations. The intraoperative cholangiogram was performed in all studied patients. Every alternate case was subjected to laparoscopic and open cholecystectomy with or without common bile duct exploration. In our method we used half-diluted 75% Urovideo (an iodine containing dye with meglumine and sodium salts of diatrizoic acid), a 20 ml disposable syringe, a 8-inch polyethylene tubing attached to the syringe on one end and a metal cannula on the other end and a portable C-arm fluoroscopic equipment with image enhancement. Cholangiography was performed with the patient tilted 20\textdegree to the right with a standardized technique via cystic duct catheter prior to any manipulation of the CBD, regardless of any operative findings. For patients in whom laparoscopic cholecystectomy was done, a fifth small port was created with a 14-G needle over the right upper quadrant, the needle was removed after penetrating the abdominal wall, leaving the sheath in-situ. A 5-French catheter was advanced through the sheath and guided through an opening made into
the cystic duct. The cystic duct and the catheter were then snugly clamped with hemoclips. An initial film was obtained after injection of 4ml of the contrast dye, with the second film taken after injection of 8ml contrast. Utmost care was taken to avoid introduction of any air bubbles, as these give a false positive result. The catheter was left in-situ unless cholangiograms were available for interpretation. Presence of filling defect or failure of the dye to enter duodenum were considered to be an indication for CBD exploration. By using the portable C-arm fluoroscopic equipment, we viewed the progression of the dye into the biliary channels under direct vision from the fluoroscopic screen. The dilatation of the biliary channels by obstructing malignant/benign lesions consumed more dye to view the biliary tree fully. Data collected was tabulated and p-value measured.

**Figure 1**

Table 1

<table>
<thead>
<tr>
<th>Cholelithiasis with normal cystic duct and normal CBD</th>
<th>Cholelithiasis with dilated cystic duct and normal CBD</th>
<th>Cholelithiasis with normal cystic duct but dilated CBD</th>
<th>Cholelithiasis with cholelithiasis and previous pancreatitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>USG finding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal cholangiogram</td>
<td>20</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Stones recovered</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Percentage (stones recovered)</td>
<td>24.0%</td>
<td>60.0%</td>
<td>85.15%</td>
</tr>
</tbody>
</table>

**Figure 2**

Table 2

<table>
<thead>
<tr>
<th>Cholangiogram</th>
<th>Clinical/ultrasonographic indication for CBD exploration</th>
<th>Total</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not indicated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>80 (42.80%)</td>
<td>325</td>
<td>405</td>
</tr>
<tr>
<td>Abnormal</td>
<td>400 (57.14%)</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>460 (28.66%)</td>
<td>345</td>
<td>485</td>
</tr>
</tbody>
</table>

**Figure 3**

Table 3

<table>
<thead>
<tr>
<th>Stones</th>
<th>Abnormal cholangiogram according to clinical/ultrasonographic indication for CBD exploration</th>
<th>Total</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovered</td>
<td>Altered (37.5%)</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Not indicated</td>
<td>Altered (62.5%)</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>40</td>
<td>200</td>
</tr>
</tbody>
</table>

p = 0.531 (non-significant)
Is There A Need Of Intraoperative Cholangiograms In Patients Of Cholelithiasis With And Without Clinical Indication Of Common Bile Duct Exploration While Performing Open Or Laparoscopic Cholecystectomy?

Figure 4
Table 4

<table>
<thead>
<tr>
<th>Stone recovery</th>
<th>Clinical/clinical indication for CBD exploration</th>
<th>Total</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indicated</td>
<td>Not indicated</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>14 (50%)</td>
<td>3 (4.34%)</td>
<td>17 (17.59%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$p = 0.005$</td>
</tr>
<tr>
<td>No</td>
<td>14 (50%)</td>
<td>66 (95.69%)</td>
<td>80 (82.47%)</td>
</tr>
<tr>
<td>Total</td>
<td>28 (28.80%)</td>
<td>69 (71.13%)</td>
<td>97 (100%)</td>
</tr>
</tbody>
</table>

Figure 5
Table 5

<table>
<thead>
<tr>
<th>Time consumed (minutes)</th>
<th>No of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10</td>
<td>75</td>
<td>15.37</td>
</tr>
<tr>
<td>10-15</td>
<td>95</td>
<td>19.58</td>
</tr>
<tr>
<td>15-20</td>
<td>95</td>
<td>20.17</td>
</tr>
<tr>
<td>20-25</td>
<td>75</td>
<td>15.47</td>
</tr>
<tr>
<td>25-30</td>
<td>50</td>
<td>10.31</td>
</tr>
<tr>
<td>Mean time (13.35)</td>
<td>485</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 6
Figure 1. IOC with contrast going freely distally

Figure 7
Figure 2. IOC showing intrahepatic and extrahepatic biliary tree
Is There A Need Of Intraoperative Cholangiograms In Patients Of Cholelithiasis With And Without Clinical Indication Of Common Bile Duct Exploration While Performing Open Or Laparoscopic Cholecystectomy?

RESULTS

A normal cholangiographic study (figures 1, 2 and 5) was seen in 385 cases, while abnormal cholangiograms were obtained in 100 patients in whom CBD exploration was done; stones (figure 3 and 4) were recovered in only 85 patients and the remaining 15 patients were false positive (tables I, II, III and IV). In patients with indications for CBD exploration in terms of dilated cystic duct, dilated CBD, choledocholithiasis or previous gallstone pancreatitis, abnormal cholangiograms were obtained in 16 patients out of 28 patients (57.14%) and stones were recovered in 14 patients (50%). In these patients, intraoperative cholangiography has helped us to spare 12 out of 28 patients (42.86%) from unnecessary CBD exploration, while in
patients without indication of common bile duct exploration, intraoperative cholangiography could pick stones (figure 3 and 4) in the common bile duct in 15 out of 345 (4.34%) patients only, with very significant p-value (p<0.005) (tables I, II, III, and IV). However, the average time consumed to perform intraoperative cholangiogram per patient was 13.35 minutes (table V). No injuries to the biliary apparatus or adjoining structures occurred during the course of this study. Postoperative cholangiography (figure 6) was normal in all the patients who underwent choledochotomy.

**DISCUSSION**

Surgeons have recognized for years that management of associated common bile duct lithiasis at the time of cholecystectomy can be a potential source of difficulties. Historically, common bile duct exploration provided not only the best assurance of duct clearance but also the best hope that reoperation for retained stones could be avoided and common bile duct exploration was done only in cases wherever indicated by clinical or laboratory parameters. However, with the advent of intraoperative cholangiography by Mirriri in 1931, the concept changed and many of the preceding indications for common bile duct exploration became, instead, the indications for intraoperative cholangiography. The rapid development and widespread acceptance of laparoscopic cholecystectomy, however, has caused the controversy surrounding routine or selective intraoperative cholangiography to resurface. It proves to be a valuable tool in detection of unsuspected or hidden stones in otherwise normal common bile ducts at cholecystectomy in patients having no clinical/ultrasonographic indications to warrant exploration of the common bile duct. These stones would have otherwise been missed by not performing choledochotomies because of absence of the above indications for common bile duct exploration. This unsuspected stone detection rate has been put differently by different authors in their studies. Schulenburg (1969) and Kakos et al. (1972) showed in their studies that routine cholangiograms showed 4.2% and 4% unsuspected stones with false positive rates of 4.2% and 5% and false negative rates of 4.2% and 1%, respectively. Wayne et al. (1976), in a series of 354 patients, found unsuspected stones in 3.67% with a false positive cholangiogram in 0.85%. In a study of 74 patients, Thurston (1974) detected unsuspected CBD stones in 7.7% with a false negative rate of 1.4%. Shively EH et al. (1990) detected an unsuspected-stone positive rate of 5% in 484 patients undergoing peroperative cholangiography and an overall false positive cholangiogram rate of 3%. In our study of 485 patients, we found unsuspected stones in 4.34% and an overall false positive and false negative cholangiography rate of 3.1% and 0%, respectively. Our results of unsuspected stone detection rate are similar to those observed by Schulenburg, Cranley et al. and Kakos et al. They are not consistent with Thurston who detected a higher percentage of unsuspected stones (7.7%) in his 74 patients. This variation may be due to the selection of patients and longer duration of study in their case (7 years). The false positive rate observed in the present study is similar to that observed by Shively et al. (1990). Our results in terms of false positive rate are lower as compared to Schulenburg and Kakos et al., while our false positive results are higher as compared to Wayne et al. Although Gerber et al. (1982) do not favor routine cholangiography in their study, they detected a false negative cholangiogram rate of 0% in their 24 patients. In the present study, we also had a false negative cholangiogram rate of 0%. Faris et al. (1975) and Stuart et al. (1998) also had similar results in their study. Stark et al. (1980) found a false negative rate of 0.2% in their studies. Schulenburg (1969), Kakos et al. (1972), Mullen JT et al. (1976) and Skillings et al. (1979) detected false negative results of 4.2%, 1.4%, 2.13% and 5.4%, respectively, in their individual studies which are higher as compared to our results; the disparity may be due to the technique applied in the procedure. Kakos et al. (1972) have got a high yield of stone recovery ranging from 71-90% on exploration of ducts with positive cholangiograms. This is in accordance with our study of positive duct exploration of 85% (17 out of 20 patients). McCormick et al. (1974) got a positive duct exploration rate of 77.7%, lower results as compared to ours, the difference may be due to the smaller number of patients in their case. Faris et al. (1975) got a positive duct exploration rate of 71.5% in their series of 400 patients. The disparity with our results can be due to the fact that the study was carried out for a longer duration (1957-1972) and the data was obtained from different operating surgeons. Our results are also in accordance with Levine et al. (1983) who got a positive duct exploration rate of 84% in 166 patients with positive cholangiograms. Stark et al. (1980) got a positive yield of 63.8% from duct exploration. Skillings et al. (1979) also got a positive yield of 62.16%. Both studies were based on review of records of patients who had undergone cholecystectomy with intraoperative cholangiography. Flowers et al. (1992) got a true positive yield of 75% on ductal exploration in their study. The results
obtained by other authors may be different from our study due to the retrospective nature of their studies. Our results are truly in accordance with Richardson et al.\textsuperscript{21} (1999) who got true positive cholangiograms of 85%. Also almost similar results have been obtained by Hammarstrorn et al.\textsuperscript{22} (1998) who got a positive duct exploration of 88% in their study of 279 patients. Taking the dilated biliary ducts, especially cystic or common bile duct or both, into consideration, the stone recovery from such ducts in the present study was variable depending on whether these parameters were considered separately or in combination. We got a stone yield of 60% in patients with dilated cystic as well as dilated common bile ducts, but 50% only when dilated common bile duct alone was taken into consideration without cystic duct parameter. Wu Sc et al.\textsuperscript{23} (2005) described a positive exploration rate of 53.1% in patients with dilated common bile ducts (finding on abdominal ultrasonography) upon intraoperative cholangiography. These results are in accordance with 50% positive exploration from such ducts in the present study. Cranley et al.\textsuperscript{11} (1980) confirmed a stone-positive exploration rate of 57.6% in patients with dilated common bile duct. This is almost similar to our results of 50% in the present study. Taylor et al.\textsuperscript{24} (1983) also got similar results of 58.13% in patients with dilated common bile duct upon cholangiography. Livingston et al.\textsuperscript{25} (2005) resorted to selective cholangiography in patients with ultrasonographic evidence of common bile duct dilatation and detected stones in 30.15% of these patients. He did not find any co-relation with common bile duct stones in patients with gallstone pancreatitis. In our study with a stone pick up rate of 50% in dilated ducts, we could not get any stones out of the ducts in 25 patients with previous history of gallstone pancreatitis, maybe because most small stones responsible for pancreatitis may have passed spontaneously and hence were not picked up by intraoperative cholangiography. Mullen et al.\textsuperscript{16} (1972), however, demonstrated stones in 10% of patients with history suggestive of gallstone pancreatitis. In patients with ultrasonographically documented choledocholithiasis and stones palpable in the common bile duct, the cholangiogram was abnormal in all the 5 patients and stone extraction rate was 100% in these patients in the present study. Shively et al.\textsuperscript{10} (1990) also got 100% stone extraction in such patients in their study. Intraoperative cholangiography has proved to be a valuable tool in preventing injuries by proper identification of anatomy and detecting any associated congenital or acquired abnormalities. In our study cholangiography has helped us to correctly identify the anatomy in Calot’s triangle whenever difficulties would arise. In two patients there was a communication (acquired) between gallbladder and common bile duct (Mirizzi’s syndrome). In this patient the gallbladder was fibrosed and shrunken with gross distortion. In both of these patients injury to the nearby structures was avoided by timely use of intraoperative cholangiography. Schulenburg et al.\textsuperscript{6} (1969) described anomalies of the cystic, hepatic and common bile ducts in 20.9% in a series of 1000 patients by performing intraoperative cholangiography and was able to pick up these anomalies and thus to avoid injuries to the biliary ducts. Intraoperative cholangiography is not performed to look for stones only, but also to prevent or identify bile duct injuries by its timely application. In the present study, during intraoperative cholangiography in our patients, no biliary tract injury was encountered. This is consistent with Campenhout et al.\textsuperscript{26} (1993) who also did not have any biliary tract injury in any of their 107 patients discussed in the study. Ciulla et al.\textsuperscript{7} (2007), in their study of intraoperative cholangiography (IOC) in 169 patients, detected an injury rate of 0.5% and concluded that properly performed IOC can minimize the extent of injuries by their timely detection. Moosa et al.\textsuperscript{27} (1992), in their study of laparoscopic cholecystectomy, reported six patients with injuries to the common bile duct (1%). The advantages of a good and meticulous IOC procedure should be to avoid unnecessary ductal explorations in those patients where there are clinical/biochemical or radiological indications for such an exploration and to increase the positive yield from such explorations. This will be of great help to decrease the morbidity associated with such an unnecessary procedure in these patients. Intraoperative cholangiography should clearly identify those patients in whom the procedure of choledochotomy is inevitable. Shively et al.\textsuperscript{10} (1990) prevented unnecessary duct exploration in 12% of their patients with clinical/laboratory/radiological indications for such an exploration. Similarly, Schulenburg\textsuperscript{6} (1969), in a study of 1000 patients, also prevented unnecessary duct explorations in 55% based on intraoperative cholangiography. Gerber et al.\textsuperscript{12} (1982) were also able to prevent such an unproductive choledochotomy in 38.70% of their patients with the help of IOC. Kurukulasuriya et al.\textsuperscript{3} and Moosa et al.\textsuperscript{27} (1992) observed a significant reduction in non-productive choledochotomies. In our study, we were able to save 42.86% of our patients from unnecessary choledochotomies who were otherwise having clinical or sonographic indications for duct exploration. The additional operative time required in obtaining an adequate study, and
the subsequent costs incurred, have prompted other arguments for or against the routine use of operative cholangiography. Since obtaining this study is a technical procedure, the limiting factor in the time efficiency of its use is the familiarity with the technique. The proficient expertise of the team that includes the surgeon, his or her associates, the scrub technician, the anaesthesiologist and the radiology personnel is required for a timely and accurate result. While the extra time consumed by intraoperative cholangiography as measured by various authors is variable from 10 to 33 minutes, in our study of 485 patients in whom routine IOC was done, we found the extra time consumed by the procedure ranging from 5 minutes to 30 minutes. The time consumed by the procedure was longer initially, but with the familiarity with the procedure it dropped with an overall average of 13.35 minutes. In this respect, our study is in accordance with Hermann et al.\(^2\) (1965), Flowers et al.\(^2\) (1992) and Wayne et al.\(^4\) (1976). Buddingh et al.\(^2\) (2011) concluded in their study that implementation of routine IOC policy was followed by fewer major bile duct injuries and higher rates of intraoperative management of common bile duct stones.

**CONCLUSION**

Hence we concluded in our study that intraoperative cholangiography is a very useful addition to the armamentarium of the biliary surgeons and its application is in selective cases only, where the indications for its use exist to solve the dilemma of an operating surgeon in the form of preoperative status, abnormal biliary tract anatomy or difficult cholecystectomy due to dense adhesions, to get a clear road-map of the ductal system and also to minimize the rate of unnecessary pre- and post-operative endoscopic retrograde cholangio-pancreatography. Hence, intraoperative cholangiography helps in prevention of biliary tree injury because “an ounce of prevention is worth a pound of cure”.

**References**

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