

# The Role of Endoscopic Retrograde Cholangiopancreatography and Cholangiography in the Laparoscopic Era

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## Objective

The authors reviewed the results of endoscopic retrograde cholangiopancreatography (ERCP) and intraoperative cholangiography in a series of patients who underwent laparoscopic cholecystectomy.

## Summary Background Data

The indications for preoperative and postoperative ERCP and intraoperative cholangiography as adjuncts to laparoscopic cholecystectomy are evolving. The debate regarding the use of selective or routine intraoperative cholangiography has intensified with the advent of laparoscopic cholecystectomy.

## Methods

The authors reviewed the records of 343 consecutive patients who underwent laparoscopic cholecystectomy during a 1-year period. Historical, biochemical, and radiologic findings for the patients who underwent ERCP and intraoperative cholangiography were analyzed.

## Results

Three hundred forty-three patients underwent laparoscopic cholecystectomy during the period reviewed. Preoperative ERCP was performed in 42 patients. Twenty-seven of these patients (64%) had common bile duct (CBD) stones, which were cleared with a sphincterotomy. Intraoperative cholangiography was performed for 101 patients (29%). Three cholangiograms had false-positive results (3%), leading to two CBD explorations, in which no CBD stones were found, and one normal ERCP. Six patients underwent postoperative ERCP, three for the removal of retained CBD stones (0.9%), all of which were cleared with a sphincterotomy. Fifteen patients had gallstone pancreatitis, six of whom had CBD stones (40%) that were cleared by ERCP. There were 33 complications (10%) and no CBD injuries.

## Conclusion

The use of routine intraoperative cholangiography is discouraged in view of its low yield and the significant rate of false positive cholangiogram results.

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The indications for preoperative and postoperative endoscopic retrograde cholangiography (ERCP) and intraoperative cholangiography as adjuncts to laparoscopic cholecystectomy are changing. The modalities are useful in assessing the common bile duct (CBD) for the presence of stones.

Methods of clearing the CBD of stones include preoperative ERCP followed by laparoscopic cholecystectomy, laparoscopic cholecystectomy with intraoperative duct exploration,<sup>1-6</sup> and laparoscopic cholecystectomy followed by postoperative ERCP.

Laparoscopic duct exploration permits a definitive one-stage procedure to be performed by the surgeon. However, this is a technically demanding feat, and a limited number of surgeons have the necessary experience. Therefore, reliance on ERCP is more feasible in most centers.

An important and controversial issue is the routine *versus* selective use of intraoperative cholangiography during laparoscopic cholecystectomy. Philosophies have ranged from the use of routine cholangiography in all cases to the selective use of cholangiography when there is suspicion of CBD stones or when the anatomy is unclear.<sup>7-13</sup> In the current study, we evaluated our experience with cholangiography.

The incidence of common duct stones in gallstone pancreatitis has been debated.<sup>14,15</sup> Acosta reported an incidence of impacted ampullary stones in up to 63% of cases.<sup>16</sup> Kelly found CBD stones in 5% to 8% of cases of gallstone pancreatitis.<sup>17</sup> We reviewed the cases of gallstone pancreatitis to determine the incidence of CBD stones associated with gallstone pancreatitis.

## METHODS

We reviewed the records of 343 consecutive patients who underwent laparoscopic cholecystectomy over a 1-year period at an academic medical center. Patients who underwent open cholecystectomy from the outset were excluded from the study. The 29 patients (8%) who required conversion to open cholecystectomy were included in the current study.

The technique used for access to the peritoneal cavity was the Hassan (open) technique in 123 cases and the Verres (closed) technique in 220 cases. The patient population consisted of 251 females (73%) and 92 males (27%). The average age of patients was 56 years among

**Table 1. PREOPERATIVE ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY**

History of jaundice	55%
Elective bilirubin	66%
Elevated alkaline phosphatase levels	61%
CBD dilatation	26%
HIDA: no flow into duodenum	20%
Combination of parameters	84%

CBD = common bile duct; HIDA = hepato-iminodiacetic acid.  
\* N = 42.

males and 51 years among females. Twenty-six parameters were scrutinized, including a history of jaundice, biochemical values, imaging studies, and complications.

Endoscopic retrograde cholangiopancreatography was performed before surgery for 42 patients and after surgery for 6 patients. Patients were selected for preoperative ERCP based on enzyme abnormalities and CBD dilatation seen on ultrasonography.

One hundred one intraoperative cholangiographies were performed. Sixty one were done in cases involving no enzyme abnormalities. The remaining 40 procedures were performed for enzyme abnormalities and CBD dilatation, as indicated by ultrasonography.

## RESULTS

Three hundred forty-three laparoscopic cholecystectomies were reviewed in the current study. Two hundred eighteen (64%) involved laparoscopic cholecystectomy alone, and 96 (28%) involved laparoscopic cholecystectomy and intraoperative cholangiography. Twenty-nine patients (8%) required conversion from laparoscopic cholecystectomy to open cholecystectomy, including 5 patients who underwent intraoperative cholangiography before conversion.

The most common reason for conversion was acute inflammation and adhesions. Two conversions were made because of uncontrollable cystic arterial bleeding. No conversions were necessary for bile duct injury.

Endoscopic retrograde cholangiopancreatography was performed before surgery for 42 patients and after surgery for 6 patients. There were no set criteria for the decision to choose ERCP, only the surgeon's judgment. The characteristics of the patients who underwent preoperative ERCP included history of jaundice (55% of patients), hyperbilirubinemia (>2.0 mg/dL) (66% of patients), elevated alkaline phosphatase (> 150 mg/dL) (61% of patients), sonographic evidence of CBD dilatation (26% of patients), and cholecintigram scan revealing no flow into the duodenum (20% of patients) (Table 1).

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Of the 42 patients who underwent preoperative ERCP, 7 (16%) had the isolated parameters mentioned above. Eighty-four percent had a combination of abnormalities. Twenty-seven of the 42 patients who underwent preoperative ERCP had CBD stones (64%). Thirty-three percent of the ERCPs were negative (*i.e.*, no CBD stones were released) and one was unsuccessful.

One hundred one intraoperative cholangiograms were performed; 61% of these had no abnormal parameters, 4% were done for an elevated bilirubin, 6% for elevated alkaline phosphatase, 7% for elevated SGPT, 2% for elevated amylase, 2% for history of jaundice, and 18% for a combination of abnormalities, including sonographic evidence of CBD dilatation (Table 2).

Ninety-five cholangiograms showed negative results, and six results were initially interpreted as positive. Ultimately, only three results were true positives (indicating the presence of CBD stones). One was associated with an isolated alkaline phosphatase elevation, the second evidenced multiple enzyme abnormalities, including a dilated CBD, and the third revealed residual debris after ERCP. There were 3 cholangiograms with false-positive results (3%), which led to two CBD explorations, which showed no CBD stones, and one normal ERCP.

Six patients underwent postoperative ERCP, three of which were done for retained stones. One ERCP followed positive results of an intraoperative cholangiography and the stones were cleared, and one followed a positive result on cholangiography, but no stones were found. Finally, one was done for cystic duct leak. The CBD was stented and the leak eventually healed.

Nine patients had intraoperative cholangiography after having had a preoperative ERCP. Six intraoperative cholangiographies showed negative results; two of the nine were false-positive results and led to open CBD explorations in which no stones were found, and one revealed residual small debris which was ultimately followed with no symptoms to date.

Fifteen patients had gallstone pancreatitis (amylase > 250 U/L/mL). Six patients (40%) had CBD stones, which were cleared by ERCP, and patients had negative ERCP results, three had negative cholangiography results, and for one patient, the CBD was not examined. All six patients with CBD stones had an associated liver function abnormality. In patients for whom liver functions normalized prior to undergoing an ERCP, no CBD stones were found.

There were 33 complications in this series, 17 of which were minor, including atelectasis, urine retention, wound infection, and hematomas.

Major complications included one cystic duct leak, three cases of retained CBD stones, and an enterotomy

**Table 2. INTRAOPERATIVE CHOLANGIOGRAMS\***

No abnormal parameters	61%
Elevated bilirubin levels	4%
Elevated alkaline phosphatase levels	6%
Elevated SGPT levels	7%
Elevated amylase levels	2%
History of jaundice	18%

SGPT = serum glutamic pyruvic transaminase.

\* N = 101.

that was oversewn without any subsequent sequelae. There were no CBD injuries in the current series.

## DISCUSSION

In this era of minimally invasive surgery, the management of the CBD is controversial. The goal is to effectively assess and clear the CBD of stones in the least invasive manner. Furthermore, the optimal use of intraoperative cholangiography must be realized. The use of intraoperative cholangiography was debated in the open cholecystectomy era and remains controversial in the laparoscopic era. In the current study we attempted to address these issues.

Laparoscopic CBD exploration is an adjunct to laparoscopic cholecystectomy that is difficult to perform. A number of laparoscopic surgeons have reported success with laparoscopic duct exploration and stone extraction.<sup>1-6</sup> These results are encouraging, because they support the use of a definitive one-stage procedure. However, the skills and equipment necessary for this procedure are not available to most surgeons. Therefore, preoperative selection of patients at risk for choledocholithiasis and reliance on ERCP to clear the stones are vital to most surgeons. It is important to perform preoperative ERCP when CBD stones are suspected, because the consequences of a failed postoperative ERCP would mean a return to the operating room for open CBD exploration.

Voyles et al. defined criteria for a subset of patients at no or low risk for choledocholithiasis for whom cholangiography is not indicated.<sup>8</sup> In our review, 64% of preoperative ERCPs revealed CBD stones. This compares favorably with the 47% to 55% rate of preoperative ERCPs in which stones are found.<sup>5,18</sup>

Barkun et al.<sup>19</sup> described an optimal model that predicted a 94% probability of CBD stones.<sup>4</sup>

Proponents of routine cholangiography, such as Cuschieri, maintain that unsuspected CBD stones are revealed by routine intraoperative cholangiography and

that anatomic anomalies, which may predispose to CBD injury, are delineated.<sup>7</sup>

In our review, only one cholangiogram of 101 revealed an unsuspected CBD stone, which was subsequently cleared by ERCP. This patient had an isolated preoperative elevated alkaline phosphatase level. The other patient for whom cholangiography led to clearance of a CBD duct stone had had preoperative elevation of hepatic enzymes levels and sonographic evidence of ductal dilatation. Using our criteria, we determined that this patient was a candidate for preoperative ERCP.

It is important to note that there were three cholangiograms whose results were interpreted as positive, which led to two open CBD explorations and to one postoperative ERCP. Ultimately, no stones were found. Therefore, the liberal use of intraoperative cholangiography should be discouraged. This is particularly important to remember so as to avoid unnecessary open procedures and the inherent risk of duct exploration.

Operative cholangiograms have been reported to be falsely positive in 2% to 4% of patients.<sup>8</sup> False-positive cholangiogram results lead to additional manipulation and associated risks of CBD injury, bile leaks, and pancreatitis.

Berci reported a 41% incidence of unsuspected CBD stones found on routine intraoperative cholangiography that he subsequently cleared laparoscopically.<sup>20</sup> McSherry commented that many false-positive results were likely included in this group.<sup>21</sup>

One must consider the number of CBD stones that are missed by failure to perform cholangiography. We missed three stones (1%), all of which had manifested within 1 week of surgery, and all were cleared by postoperative ERCP. In two of these cases, the patients had normal preoperative parameters, and the third did not have liver function tests assessed before surgery. Remember, however, that 3% of the cholangiograms had false-positive results, leading to unnecessary open CBD explorations and ERCP. That which is gained by routine cholangiography is balanced by an increased false-positive rate of intraoperative cholangiography.

The use of cholangiograms after ERCP should also be discouraged. In the current series, this was done for nine patients, two of whom underwent unnecessary CBD exploration and one who had residual debris left in place with no symptoms. The six remaining patients had no CBD stones. Therefore, the yield was 0%.

Gallstone pancreatitis is a significant risk factor for CBD stones. Forty percent of the patients with significant hyperamylasemia (>250 U/L) had CBD stones. All of these patients had associated liver function abnormalities, including individual enzyme elevations. The patients for whom liver functions normalized before ERCP did not have CBD stones. Therefore, we advocate preop-

erative ERCP for patients with hyperamylasemia and persistent liver function abnormalities. The yield is low for patients with isolated hyperamylasemia, and in such cases a cholangiogram may be considered.

Our study does not support the thesis of Berci et al. that intraoperative cholangiography prevents CBD injury.<sup>9</sup> Although intraoperative cholangiography was performed in 101 cases, it was not in 242 cases. Neither group had CBD injury. In fact, the surgeons at our center have stated that visualization of landmarks, that is, cystic duct/infundibulum junction and triangle of Callot, are more important in the prevention of injury. There were 33 minor complications, including, atelectasis, wound or urinary infection, and hematoma.

In summary, ERCP should be performed before surgery for all patients with a high probability of CBD stones, including gallstone pancreatitis with associated liver function abnormalities. In cases where preoperative ERCP results are negative, intraoperative cholangiography is not beneficial and can even be detrimental. Postoperative ERCP is useful for finding overlooked CBD stones. Most importantly, routine intraoperative cholangiography leads to a significant incidence of false-positive results, leading to unnecessary open procedures and CBD manipulation, thus we discourage its use.

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