PAPER

Laparoscopic Common Bile Duct Exploration

Practical Application

Charles M. Ferguson, MD

Objective: To evaluate the effectiveness of laparoscopic common bile duct exploration in unselected patients.

Design: Consecutive sample.

Setting: Tertiary care general hospital.

Patients: Three hundred and two patients with symptomatic cholelithiasis presenting to a single surgeon during a 5-year period.

Interventions: Laparoscopic cholecystectomy, cholangiography, and common bile duct exploration.

Main Outcome Measures: Successful laparoscopic cholecystectomy and common bile duct exploration.

Results: Three hundred and two consecutive patients underwent cholecystectomy for symptomatic cholelithiasis; 280 of the procedures were successfully completed laparoscopically. Cholangiography was attempted in 269 patients, was successful in 239, and revealed evidence of choledocholithiasis in 25. Preoperative ultrasonography and liver function tests predicted the presence of common bile duct stones in 24% and 32% of patients, respectively. Seven of the patients with choledocholithiasis presented with biliary colic, 7 with biliary colic and jaundice, 8 with acute cholecystitis (3 with gallbladder perforation), 1 with acute cholecystitis and jaundice, and 2 with gallstone pancreatitis. Four of 5 patients underwent successful transcystic exploration with a biliary Fogarty catheter, 12 of 16 patients underwent successful transcystic choledochoscopy and stone basket extraction, and all 4 attempts at choledochotomy and choledochoscopic stone basket extraction were successful, for a total success rate of 80% with laparoscopic common bile duct exploration. One of the failures was converted to an open procedure, and 4 of the failures had successful postoperative endoscopic retrograde cholangiopancreatography and extraction of stones.

Conclusions: Laparoscopic cholecystectomy and common bile duct exploration is a highly successful procedure for the management of common duct stones in an unselected group of patients. Choledochotomy with choledochoscopy is the preferred method of common bile duct exploration.

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THE MANAGEMENT of common bile duct stones in an era of laparoscopic cholecystectomy (LC) remains controversial. For patients suspected of having common bile duct stones, many surgeons would favor preoperative endoscopic retrograde cholangiopancreatography (ECRP) with extractions of stones (ES), although the incidence of negative, and thus unnecessary, ECRP is high. Another option is intraoperative cholangiography with postoperative ERCP if stones are found, but such a plan necessitates reexploration should the sphincterotomy and the extraction fail. Many, therefore, would advocate conversion to an open procedure if common bile duct stones are noted on the intraoperative cholangiogram. To increase efficency of procedures, many surgeons recommend laparoscopic common bile duct exploration (LCDE) as the most efficient means to manage common bile duct stones.

Several series of LCDE performed by expert laparoscopic surgeons with a dedicated team suggest that LCDE is highly successful.[1-5] A single randomized, prospective trial[5] of endoscopic sphincterotomy followed by LC vs LC plus LCDE revealed equivalent success rates and patient morbidity between the 2 groups, but a shorter hospital stay and lower cost with single-stage treatment. Similarly, a retrospective review of patients undergoing LC plus ES vs LC plus LCDE revealed lower cost and morbidity in the single-treatment group.[6] Again, this last retrospective series was from an institution well known for its expertise in laparoscopic surgery. It remains unclear what role LCDE should play in the surgical community.

This study evaluated outcomes in patients managed with the intention of treating all biliary pathological conditions in a totally laparoscopic fashion by a general surgeon in a general hospital setting.

From the Department of Surgery, Massachusetts General Hospital, Harvard Medical School, Boston.

PATIENTS, MATERIALS, AND METHODS

During approximately a 5-year period (January 1, 1992, through April 30, 1997) 302 patients were referred to me for management of cholelithiasis. This number of patients represents 9% of my total operative experience during this period. Beginning January 1, 1992, an attempt was made to manage all biliary stone disease with laparoscopic methods. Fourteen of the 302 patients with biliary disorders were excluded from laparoscopic surgery and thus are not considered further. In 7 of these cases, cholecystectomy was performed as an incidental procedure in an open exploration (ventral hernia repair, hysterectomy, necrotizing pancreatitis, and Whipple operation for pancreatic cancer)[4]; 4 operations were planned as open procedures due to an error in diagnosis (2 small-bowel obstructions, 1 appendicitis, 1 right upper quadrant abscess); 1 case was planned as open due to lack of availability of laparoscopic equipment; and 2 cholecystectomies were planned as open due to the critical nature of illness (acalculous cholecystitis following thoracoabdominal aneurysm repair).

CHOLANGIOGRAPHY

Cholangiograms were performed by introducing a cholangiocatheter through a small puncture in the right upper quadrant. A short incision was made in the cystic duct, and the catheter was passed into the common bile duct and secured with a clip around the cystic duct. Two cholangiograms were performed on static film plates after injections of 5 and 10 mL of dilute Hypaque and the intravenous administration of 1 mg of glucagon. Common bile duct stones were documented on intraoperative cholangiography in 25 patients, whose average age was 59 years (range, 24-83 years). Nine were men, 16 were women.

COMMON BILE DUCT EXPLORATION

Common bile duct stones were removed by open common bile duct exploration, LCDE, and ES. Open common bile duct exploration and ES were performed using standard techniques. Laparoscopic common bile duct exploration was performed by transcystic and choledochotomy approaches.

TRANSCYSTIC LCDE

Following cholangiography, a 12-gauge angiocatheter was placed through the incision in the right subcostal region used for the cholangiocatheter. A 5F Fogarty catheter was then passed through the cholangiocatheter and into the common duct via the incision in the cystic duct. The Fogarty catheter was then passed into the duodenum, inflated, pulled back to the ampulla, deflated, and then reinflated in the common duct and used to extract stones. If the stones were not removed, a guidewire was then inserted and serial dilators (Bard, Inc, Covington, Ga) were passed through until the cystic duct was dilated to a diameter of 8 F. A 2-mm choledochoscope was then inserted via the previously established tract and a stone basket used to remove stones under direct vision.

CHOLEDOCHOTOMY LCDE

If the common bile duct was dilated to greater than 1 cm, it was opened just above the duodenum using a knife blade. The 2-mm choledochoscope was then passed into the choledochotomy via the previously established tract and a stone basket was used to extract stones from the proximal and distal ducts.

RESULTS

FAILED LC

Two hundred and eighty-eight patients underwent attempted LC, of which 8 (3%) failed and were converted to open procedures. Six of the conversions were due to severe inflammatory changes, 1 was converted due to intraoperative bleeding from adhesions, and 1 was converted due to failed common bile duct stone extraction. Five of these patients presented with acute cholecystitis, 1 with gallstone pancreatitis, and 1 with gallbladder hydrops. The single patient converted due to bleeding from adhesions had undergone previous upper abdominal surgery. One of these patients developed a postoperative cystic duct leak, as did 1 patient who had undergone successful LC but not LCDE.

DIAGNOSIS OF COMMON BILE DUCT STONES

Preoperative evaluations were not particularly helpful in the diagnosis of common duct stones. Liver function test results (ie, bilirubin and alkaline phosphatase levels) were elevated in only 8 (32%) of the 25 patients. Ultrasonography revealed a dilated duct in 3 patients and a stone in the common bile duct in 3 patients, for a true-positive result in 6 (24%) of 25 patients.

Of the 280 patients undergoing LC, cholangiography was attempted in 269. Of the 11 patients who did not have cholangiography, 2 had preoperative ERCP (1 with ES) before being referred to surgery, 8 had a single stone in the gallbladder, and 1 had acalculous cholecystitis. Of the 269 attempted cholangiograms, 239 (88%) were successful. Reasons for failure of cholangiography were limited exposure (3 patients), small cystic duct (25 patients), and torn cystic duct (2 patients). There were no signs or symptoms of choledocholithiasis following failed or unperformed cholangiograms.

Of the 239 successful cholangiograms, evidence of common bile duct stones was found in 25. Twenty-three cholangiograms revealed definite stones and 2 revealed a dilated duct and no passage of contrast into the duodenum, which is suggestive of common bile duct stones. Seven of these patients presented with biliary colic, 7 with biliary colic and jaundice, 8 with acute cholecystitis (3 with perforation), 1 with acute cholecystitis and jaundice (and gallbladder perforation), and 2 with gallstone pancreatitis.

All 25 patients with positive cholangiograms underwent an attempt at transcystic LCDE using a Fogarty catheter. The attempt was successful in 4 patients. One patient underwent postoperative ES because the choledochoscope was unavailable, and the others went on to either transcystic LCDE with the choledochoscope or to choledochotomy. There were no postoperative complications in this group.

Transcystic LCDE with choledochoscopy was successful in 12 (75%) of 16 patients with extraction of 1 to 9 stones. One of the failures was converted to an open procedure as previously mentioned; the other 3 underwent successful postoperative ERCP with ES. The only postoperative complication in this group was a pulmonary embolus in a previously healthy 64-year-old woman.

Four patients with unsuccessful transcystic LCDE with Fogarty catheter underwent choledochotomy as the common bile duct was enlarged. All 4 of these had successful LCDE, with extraction of 1 to 6 stones. There were no postoperative complications in this group.

These common duct explorations were difficult and tedious, particularly in the presence of multiple stones. Operative time averaged 123 minutes, with a range of 50 to 225 minutes. Average hospital stay was 3.9 days (range, 1-17 days); preoperative stay averaged 1 day (range, 0-5 days) and postoperative stay 2.92 days (range, 1-12 days). For this analysis, the operative day is counted as a day of hospitalization regardless of whether the patient's actual time in the hospital was less than 24 hours.

COMMENT

This study is the retrospective review of my experience in trying to manage all biliary tract disease in a laparoscopic fashion, including common bile duct stones. From its inception, the plan has been to perform routine intraoperative cholangiography and if stones are found, to perform intraoperative common bile duct exploration. As experience has grown and equipment has improved, there has been an evolution in techniques, making it difficult to evaluate the various techniques in terms of success rate. Three techniques were used over the course of this study—transcystic use of the Fogarty catheter, transcystic choledochoscopy, and choledochotomy with choledochoscopy.

Fogarty catheter exploration has the advantage of being safer and simpler to perform. It is usually performed in patients suspected of having common bile duct stones while the operating team waits for the cholangiograms to be developed and returned, thus preventing the waste of operating room time. If stones are seen on the cholangiogram that cannot be extracted by Fogarty catheter, then the surgeon moves on to another technique. The disadvantage of the Fogarty technique is the low success rate; in this series, all 25 patients underwent an attempt, but only 4 were successful, for a success rate of only 16%. Other authors[7-9] report higher success rates (up to 50%), especially with the use of fluoroscopy or fluoroscopically guided stone baskets. Unfortunately, fluoroscopy can be quite cumbersome and difficult to schedule in my hospital, thus my reliance on static films.

Transcystic choledochoscopy has the advantage of being safer and technically simple. The operative techniques are new to general surgeons but easy to learn by anyone familiar with endoscopy. The success rate in this series (75%) is not as high as that reported by others,[1,5,10] but should be understood in the context of a single general surgeon working with a variety of surgical residents and nursing staff, rather than a dedicated team of specialists working together on all cases. My experience is probably more reflective of what is possible in the larger surgical community.

Choledochotomy with LCDE is the LCDE technique preferred by many experts[5,7] owing to the improved access to the common bile duct compared to other techniques. This results in improved success rates—100% in this series. However, choledochotomy does require the ability to accurately suture the choledochotomy closed, and there is a risk of bile leakage. Finally, most surgeons would agree that T-tube drainage should be performed following choledochotomy, and there is a risk of dislodgement of the T tube.[1]

The question remains of how best to manage common bile duct stones. It seems clear from various other series that the detection of common bile duct stones by ultrasonography or biochemical assay is inaccurate, rarely exceeding a 40% true-positive result.[1,11,12] If one is to rely on preoperative ERCP and ES to manage common bile duct stones, one will have to accept a large number of normal ERCPs, with the attendant morbidity and mortality. Cuscheri et al[5] have tried to address this issue in a prospective, multicentered trial. Randomization of 207 patients to ES followed by LC vs LC with LCDE revealed no difference in morbidity between the 2 groups, but a longer hospital stay in the ES group despite a higher conversion rate in the single-treatment arm. This would suggest a lower cost in the single-treatment arm, although this was not examined. Similarly, Liberman et al[6] performed a rigorous analysis of 76 patients treated for choledocholithiasis at Cedars-Sinai Medical Center, Los Angeles, Calif. Fifty-nine patients underwent LC plus LCDE and 17 underwent LC plus ES. Those patients who underwent single-stage treatment had decreased hospital stay, decreased morbidity, and decreased cost compared with those patients who underwent 2-stage treatment. These findings agree with an earlier randomized study by Neoptolemos et al[13] involving ES and open cholecystectomy, and it certainly conforms to the general principle that 2 procedures present more opportunities for morbidity than 1.

Given this information, it seems as if LC with LCDE, in the hands of experts, is a safe, effective, and cost-efficient method to care for patients with common bile duct stones. The optimum management of an individual patient will depend on the patient's presentation, the surgeon's experience, and the availability of experienced interventional endoscopists in the individual's community. This series demonstrates that LCDE can be an effective treatment by the average general surgeon, using ES and open CDE as backup procedures should the laparoscopic procedure prove unsuccessful.

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Corresponding author: Charles M. Ferguson, MD, Department of Surgery, Massachusetts General Hospital, Harvard Medical School, 15 Parkman St, Suite 465, Boston, MA 02114.

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DISCUSSION

Mark E. Stoker, MD, Jefferson, Mass: My initial impression is that this is a fairly small series of patients. My own series now is 150 common bile duct explorations. Dr Phillips' series in Los Angeles is now well over 200. The importance of this paper is exactly what Dr Ferguson has emphasized, that his practice is very much a standard practice of a general surgeon. Those 300 cases over 5 years of laparoscopic cholecystectomy is about 60 cholecystectomies a year. I do 200 cholecystectomies a year and 75% of my practice is doing laparoscopy, so my doing this and the average general surgeon out there doing this may be a bit of a different thing.

Dr Ferguson very humbly refers to himself in his manuscript and in his last slide as an average general surgeon, and I might state off the record that is probably a first for the Massachusetts General Hospital. [laughter] His practice and the numbers you have heard very much reflect that. It is also very important to note that he describes every patient that presented to him, so this is not a selected series.

In the manuscript you report the Fogarty catheter was only successful 4% of the time, so why do you bother with that? With a Fogarty catheter through the cystic duct, my concern is that you take a common bile duct stone and make it a common hepatic duct stone, which via the cystic duct is more difficult to extract. When you do a choledochotomy, have you considered primary closure of the common duct? I have taken to almost exclusively doing a closure primarily without a T tube and have had very good results. I have also found it to be quite a bit simpler than placing a T tube. I use laser lithotripsy as an adjunct to bile duct exploration. I believe that your hospital has such a device. Have you used it? If so, what are your results? And if you have not used it, why not? And also, you did not mention anything about completion cholangiography. Do you perform a cholangiogram following common bile duct exploration? And what have you done to follow these patients as far as their possible incidence of retained common duct stones?

Charles G. Mixter III, MD, Exeter, NH: Your instance of unsuspected stones seems somewhat higher than the usual cholangiographic series and I wonder, number one, did you try to strip the cystic duct of stones before you did a cholangiogram? Because we occasionally inject a stone into the common bile duct during the cholangiogram.

Second, I was wondering why we seem to be somewhat less successful at stone extraction than our ERCP friends using fairly similar techniques. We've had the same experience at Exeter.

John C. Russell, MD, New Britain, Conn: We've looked at the statewide experience in Connecticut with management of biliary calculi and the role of cholangiography, ERCP, and common bile duct exploration in conjunction with laparoscopic cholecystectomy vs open cholecystectomy. We have found on a statewide basis a somewhat different pattern of practice. While preoperative ERCP certainly is not routinely done anymore, the vast majority of patients who were found via cholangiography to have common duct stones are managed by postoperative ERCP rather than by laparoscopic common duct exploration. My question for the author is: given the fact that when your patients failed laparoscopic common duct exploration all were successfully managed by postoperative endoscopic sphincterotomy, what is your rationale, on a cost-effectiveness basis, for doing laparoscopic common duct exploration, with the additional time in the operating room and the resulting expense, rather than simply going straight to postoperative ERCP?

Dr Ferguson: First, Dr Stoker, you are completely right. There is nothing special about this experience that I have described and that is exactly why I wanted to describe it. To answer the last question first, if every general surgeon is willing to do this, in fact, they will find that they can do it. The little bit of information we have from a prospective series would suggest that in fact this does cost less than doing a postoperative ERCP, so I think it is a reasonable thing to do and I do think that the average general surgeon can do it.

Why do the Fogarty catheter? It is so much more cumbersome in the hospital to use a fluoroscopy unit with a C-arm than to do the cholangiograms on static film plates and proceed to explore the duct with the Fogarty catheter on someone I suspect has stones while I'm waiting for the films to come back. There is a small risk of pulling stones into the common hepatic duct with that procedure, but that is something that is often talked about and I've never seen happen; so that I don't really think that is a legitimate risk.

Primary closure of the common bile duct: I can't completely give up the heritage that I have inherited from my hospital; I'm bound by tradition and feel obligated to put a T tube in the common bile duct rather than do a primary closure. There is no other good reason.

I have not had any experience with laser lithotripsy and that probably is, to be honest, based on the difficulty of trying to get it set up and functioning in the hospital. Again, one of the big differences between my kind of experience and your kind of experience is that I don't have a dedicated team of people that I'm working with every time. In general there is one person in the operating room who knows about the equipment in terms of doing a common duct exploration and that one person is me. So I'm not sure I have the wherewithal to add the complexity of laser lithotripsy.

I don't generally perform completion cholangiograms. I've usually done a choledochoscopy and examined the entire biliary tree with a choledochoscope, and I have felt that that has been adequate. The follow-up has been purely on a clinical basis, and that is a real failing in the series.

Dr Mixter, the incidence of unsuspected stones is similar to what everyone else has reported. My overall incidence of stones is 9% and the incidence of unsuspected stones, which I didn't put in here but is in the manuscript, is 5%; which is really not much different from most other series.