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Laparoscopic exploration of the common bile duct

Beyond the learning curve

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Abstract
Background: Bile duct clearance at open cholecystectomy had become normal surgical practice before the introduction of laparoscopic cholecystectomy. However, perceived technical difficulties have deterred many surgeons from treating common bile duct stones at the time of laparoscopic cholecystectomy. This has led to a reliance on preoperative clearance of ducts known to have stones and postoperative clearance of ducts found to have stones at operation or those that subsequently develop complications of retained stones.
Methods: The authors describe a series of 120 consecutive bile duct explorations carried out between April 1991 and February 1997 in a series of 1,237 laparoscopic cholecystectomies.
Results: Laparoscopic exploration and clearance of the bile ducts was achieved in 89% of cases in the whole series, and 97% success was attained in the last 60 cases, which also were associated with a decrease in operating time.
Conclusions: We believe that for surgeons familiar with open common bile duct exploration and laparoscopic cholecystectomy, the next logical step is laparoscopic exploration of the common bile duct at the time of cholecystectomy, which is safe and readily mastered.

Key words: Choledocholithiasis — Laparoscopic choledochoscopy

The management of bile duct stones has changed radically since the widespread adoption of laparoscopic cholecystectomy. Initially the majority of surgeons abandoned intraoperative cholangiography and instead relied on endoscopic retrograde cholangiopancreatography (ERCP), either pre- or postoperatively, to treat common bile duct stones.

Surgeons are now faced with a choice of management options. Patients with proven bile duct stones or risk factors such as a history of pancreatitis, jaundice, abnormal liver function tests, or dilated common bile duct on ultrasound may be referred for preoperative ERCP to determine the presence of intraduct calculi. If stones are confirmed, endoscopic sphincterotomy will, in most cases, clear the common duct of stones, and the patient can proceed to laparoscopic cholecystectomy. Alternatively a per-operative cholangiogram is performed at the time of cholecystectomy. If stones are demonstrated, the surgeon may complete the cholecystectomy laparoscopically and refer the patient for postoperative ERCP, complete the cholecystectomy laparoscopically, and await development of symptoms or convert to open cholecystectomy and common duct exploration. Another option is not to screen patients for stones either pre- or intraoperatively. With this management, only patients who are jaundiced have preoperative ERCP, and those who develop symptoms of retained stones have postoperative ERCP. Probably half of the patients with retained duct stones will become symptomatic within 5 years [11].

Finally, when stones are found on per-operative cholangiography, the surgeon may proceed to laparoscopic common duct exploration. With this approach, preoperative ERCP (which is likely to be normal in 50% of patients with indications of common bile duct stones [13, 16] is avoided, and treatment of both gallbladder and common bile duct stones is completed in a single treatment episode. The authors have previously reported the evolution of a laparoscopic technique to treat bile duct stones [8]. In that series 60 patients underwent laparoscopic exploration of the common bile duct (LECBD). The results for the next 60 patients are reported and compared with the first series to assess the way in which this technique has further evolved.

Patients and methods

Between April 1991 and February 1997 there were 120 bile duct explorations in a series of 1,237 consecutive laparoscopic cholecystectomies (9.7%) on one consultant firm until 1994, and subsequently two firms. All patients considered fit for a general anesthetic were included in the study. The decision to explore the duct was based on an abnormal intraoperative

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Table 1. Comparison of LECBD in the first 60 patients and the second 60 patients

	First series (4/1/91–3/31/95)	Second series (4/1/95–2/21/97)	Significance
Median operative time in minutes (interquartile range)	150 (120–180)	130 (90–150)	$z = -2.73$ $p = 0.0064$[a]
Median postop stay (interquartile range)	3	2 (1–5)	$z = -1.43$ NS §
Failure (needing ERCP)	11	2	$p = 0.0188$[b]
Method of exploration (transcystic : CBD)	47 : 13	32 : 28	$p = 0.007$[b]
Conversion to open	3 (5%)	0	NS[b]
Complications	8 (13.3%)	4 (6.7%)	NS[b]
T-tube required	7 (11.7%)	5 (8.3%)	NS[b]
Cystic duct tube	5 (8.3%)	3 (5%)	NS[b]
Unexpected stones	10	11	NS[b]
Median age (interquartile range)	66 (49–73)	64 (52–74)	$z = 0.236$ NS[a]
Sex ratio (M : F)	23 : 37	22 : 38	NS[b]

[a] Mann-Whitney U test.
[b] χ^2 test (with Yate's correction for small numbers).CBD, common bile duct; NS, not significant.

cholangiogram or preoperative ERCP. The majority of cases were carried out by two surgeons (R.W.M. and D.M.).

The methods have already been described [8], but, briefly, the standard four-port approach for laparoscopic cholecystectomy was used. Lateral fundal retraction was applied to expose Calot's triangle, and routine cholangiography was performed, in the first series with three still-plate exposures and, subsequently, with image intensifier screening and recording of serial images. Either transcystic exploration with a 3.6-mm (Olympus URF-P) choledochoscope or exploration via a choledochotomy with a 5-mm (Olympus CHF P10; both Keymed, Southend on Sea, UK) choledochoscope was used depending on the size of the cystic duct and the size of the stones to be removed. Stones were removed by Dormia basket either the 1.2-mm Wilson-Cook (Letchworth, UK) with the 3.6-mm choledchoscope or the 1.6-mm Olympus (Keymed, Southend-on Sea, UK) with the larger choledochoscope.

At the end of the procedure, duct clearance was confirmed by postexploratory choledochoscopy. If a choledochotomy had been performed, both proximal and distal ducts were viewed with the choledochoscope. With transcystic exploration it is usually not possible to visualize the proximal ducts, which are infrequently the site of stones in a Caucasian population. Absence of intrahepatic filling defects on the initial cholangiogram was relied on in conjunction with direct viewing of the distal duct. After transcystic exploration, the cystic duct stump was clipped or closed with an endoloop depending on the size of the duct. Choledochotomy incisions were closed primarily with interrupted polyglactin sutures, and a subhepatic drain was placed. Early in the first series of patients, a T-tube or cystic duct tube was used to maintain access to the biliary tree if the duct was not cleared completely. This was not necessary in the latter series. Statistical analysis was by the χ^2 test for categorical variables or by the Mann-Whitney U test for nonparametric data. A p value of less than 0.05 was considered significant.

Results

Results from this study are summarized in Table 1. Altogether, 120 patients underwent laparoscopic bile duct exploration. The patients have been compared in two groups of 60 patients each. The patient profiles were similar, and there were no procedure-related deaths or deaths within 30 days of operation. There were no major bile duct injuries. Two minor tears in the cystic duct occurred after dilation to facilitate passage of the choledochoscope. Both were repaired by direct suture without complication. In this series there was increasingly successful clearance during the first 40 cases. Subsequently, failure to achieve complete clearance has become infrequent.

There were only two failures to clear the common bile duct of stones in the second series. One patient had multiple stones removed from the common bile duct during successful choledochoscopy, one of which could not be removed and clearing the duct required postoperative ERCP. The other had multiple small stones in a 5-mm common duct with a narrow cystic duct that would not permit passage of the 3.6-mm choledochoscope, and it was judged that a common bile duct 5 mm in diameter was too narrow for choledochotomy. This patient's subsequent ERCP was complicated by pancreatitis. The only complications in the second series were four patients who had prolonged drainage (>3 days) from the subhepatic drain after choledochotomy and primary closure of the common bile duct. All ceased without recourse to ERCP or stenting.

Discussion

With the introduction of a new surgical technique, there is a period of development during which the method is refined. Patients with choledocholithiasis almost always have dilated common ducts as well as dilated cystic ducts through which stones have passed. It is a relatively small step to progress from inserting cholangiogram catheters to inserting the 3.6-mm choledochoscope into a dilated cystic duct. It is probable that reasonable proficiency should be achieved with experience as assistant or principal operator in as few as 10 cases. However, with the development of teaching courses and proctoring by surgeons experienced in the technique, the number of cases required to learn this technique can probably be reduced further.

There are a number of reasons for the increased success with later cases. First, is the improvement in optical equipment. Digital images, the three-chip camera, and high-resolution monitors all have made visibility and interpretation more accurate. Second, introduction of the choledochoscope into the common bile duct is achieved in almost every case, with only one failure in the last 90 cases. This is due largely to the acquisition of the 3.6-mm choledochoscope part way through the first series of 60 cases, an instrument

that can be accommodated by virtually all cystic ducts through which stones have passed. Patients with a dilated common duct and multiple or large stones are better served by choledochotomy than by repeated introduction of the choledochoscope transcystically. Analysis of the failures in the first 60 cases showed that the single factor that would have achieved success was the addition of a choledochotomy as found by Dion et al. [2]. With its wider diameter, the instrument port on the 5-mm choledochoscope permits a larger basket and allows a higher flow of saline irrigation to keep the duct dilated for an optimal view. Common bile duct exploration by choledochotomy also has the benefit of allowing both the proximal and distal ducts to be examined, which usually is not possible with transcystic exploration. The overall operative performance of the surgeons was significantly better in the second series, manifested by shorter operating time, more successful duct clearances, and fewer complications. This is despite a larger proportion of patients undergoing choledochotomy, with the subsequent need for intracorporeal suturing, which prolonged the operating time in the early cases but is now relatively quick to perform. Closure of the incision usually requires only two or occasionally three sutures.

The surgeon is therefore faced with the therapeutic choices outlined at the beginning of this article. Preoperative ERCP is certainly an accurate method of detecting bile duct stones [1]. Unfortunately, only 50% of those patients with positive risk factors will have bile duct stones because of their poor predictive value, and many patients will have unnecessary normal studies [3]. At ERCP it is also possible to remove stones from the ducts with the aid of a sphincterotomy. This technique is safe in the hands of experienced endoscopists, although there is an inherent risk of major bleeding in 2–4% of cases with an overall mortality of 1%, which has changed little in the past 10 years [4, 18]. There are approximately 40,000 cholecystectomies performed in the United Kingdom each year [16], of which 10–12% of the patients will have stones in the bile ducts [9]. Widespread use of this approach would result in 8,000 patients undergoing ERCP, only half of which will be proven to have common bile duct stones [13].

If a policy of laparoscopic cholecystectomy with cholangiography to identify common bile duct stones for postoperative ERCP and sphincterotomy is employed, the 4,000 unnecessary preoperative ERCPs are eliminated, but the number of patients exposed to the risks of sphincterotomy is unchanged. To these will be added a small proportion of failed postoperative endoscopic sphincterotomies who are symptomatic and will require a further operation to clear their common duct [6], either by laparoscopic or open choledochotomy. Ignoring the possibility of common duct stones and awaiting the development of symptoms will minimize the number of ERCPs and sphincterotomy-related complications. This policy would probably result in 2,000 patients undergoing ERCP and sphincterotomy. Pancreatitis remains a well-recognized complication of both ERCP and sphincterotomy that may occur in approximately 5% of cases [5]. This is uncommon with supraduodenal exploration of the common bile duct, either open or laparoscopic, probably because there is no disruption of and much less trauma to the papilla using this technique.

Laparoscopic common bile duct exploration has the considerable benefit of treating both the gallbladder and bile duct stones in a single episode without a plethora of preoperative investigations aimed at trying to predict the presence of common duct stones, or a heavy reliance on ERCP, either pre- or postoperatively. Most hospitals have a 5-mm choledochoscope suitable for use via large-diameter cystic ducts or a choledochotomy. A desirable addition is the 3.6-mm choledochoscope, which is much easier to introduce into the cystic duct. An additional camera and a digital mixer to combine both images on one screen are useful, but not essential. Longer operating time may increase treatment costs, with approximately 40 min added to the time of a normal laparoscopic cholecystectomy and cholangiogram. This increase can be minimized if the choledochoscopes are sterilized before the case and if the theater team is familiar with the procedure. These costs will be partially offset by avoiding the cost of ERCP, estimated at $1,300 to $3,000.

How frequently does a surgeon need to perform explorations of the bile duct to maintain the necessary technical skills? General surgeons who carry out 50 or 60 laparoscopic cholecystectomies annually will have five or six patients each year with common bile duct stones. This means they may need to explore a bile duct five times per year, which may not be often enough. As with many surgical procedures, it is suggested that bile duct surgery and laparoscopic cholecystectomy should be performed by only one or two surgeons in each district to increase case volume. This has, to an extent, happened already with the introduction of laparoscopic cholecystectomy, and in our unit both surgeons carry out more than 120 laparoscopic cholecystectomies each year, exploring the bile duct approximately once each month.

In a comprehensive survey of methods in Italy between 1992 and 1993, Morino et al. [12] found that only 6% of patients with choledocholithiasis were treated by the single-stage laparoscopic approach, and these were confined to units with a laparoscopic interest. Most cases were treated by open exploration or ERCP followed by laparoscopic cholecystectomy. These authors found little difference in morbidity or mortality between groups, whereas Liberman et al. [10] found that the single procedure had significantly lower morbidity, and length of hospital stay, with consequently lower costs than those for staged endoscopic sphincterotomy and laparoscopic cholecystectomy.

Choledochoscopy and bile duct clearance at the time of laparoscopic cholecystectomy has been advocated by other authors in the United States [7, 14, 17] and Australia [15] who have achieved comparable results. With appropriate training, we believe that laparoscopic common bile duct exploration at the time of laparoscopic cholecystectomy will prove to be the safest and most effective method of treating common bile duct stones.

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