

Laparoscopic common bile duct exploration in patients with previous upper abdominal operations

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Backgrounds/Aims: We aimed to evaluate the feasibility of laparoscopic common bile duct exploration (LCBDE) in patients with previous upper abdominal surgery. **Methods:** Retrospective analysis was performed on data from the attempted laparoscopic common bile duct exploration in 44 patients. Among them, 5 patients with previous lower abdominal operation were excluded. 39 patients were divided into two groups according to presence of previous upper abdominal operation; Group A: patients without history of abdominal operation. (n=27), Group B: patients with history of upper abdominal operation. Both groups (n=12) were compared to each other, with respect to clinical characteristics, operation time, postoperative hospital stay, open conversion rate, postoperative complication, duct clearance and mortality. **Results:** All of the 39 patients received laparoscopic common bile duct exploration and choledochotomy with T-tube drainage (n=38 [97.4%]) or with primary closure (n=1). These two groups were not statistically different in gender, mean age and presence of co-morbidity, mean operation time (164.5±63.1 min in group A and 134.8±45.2 min in group B, $p=0.18$) and postoperative hospital stay (12.6±5.7 days in group A and 9.8±2.9 days in group B, $p=0.158$). Duct clearance and complication rates were comparable ($p>0.05$). 4 cases were converted to open in group A and 1 case in group B respectively. In group A (4 of 27 (14.8%) and 1 of 12 (8.3%) in group B, $p=0.312$) Trocar or Veress needle related complication did not occur in either group. **Conclusions:** LCBDE appears to be a safe and effective treatment even in the patients with previous upper abdominal operation if performed by experienced laparoscopic surgeon, and it can be the best alternative to failed endoscopic retrograde cholangiopancreatography for difficult cholelithiasis. (Korean J Hepatobiliary Pancreat Surg 2012;16:154-159)

Key Words: Laparoscopic common bile duct exploration; Previous surgery

INTRODUCTION

Traditionally, the management of common bile duct (CBD) stones required open laparotomy and bile duct exploration which was first performed by Courvoisier and Thomson separately in 1889.¹ Since the introduction of endoscopic retrograde cholangiopancreatography (ERCP) and endoscopic sphincterotomy (EST) in the 1970s, endoscopic management of CBD stones has gained popularity.^{2,3} After the introduction of laparoscopic cholecystectomy (LC) from France in 1987, the mainstream treatment of CBD stones with gallbladder stones is ERCP combined with LC.^{2,3} But, this is generally performed in two stages, which makes the patients uncomfortable not only in clin-

ical but also in an economical respect. It also can result in the need for repeated procedures if it fails, and sometimes surgery is needed.

Recently, laparoscopic skills have developed quite rapidly. In the case of CBD stones, there are many reports involving laparoscopic procedures. Since the introduction of laparoscopic CBD exploration (LCBDE) in 1991, a single-stage approach without attempting ERCP has been suggested. These days, the majority of patients suffering from concomitant gallstones and CBD stones have been managed by a single-stage approach. It has been proven not only feasible but also effective in many reports. This procedure appears to be shorter hospital stay and a similar stone clearance rate, relative cost-effectiveness while pre-

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serving the function of the sphincter of Oddi and less ERCP-related complications.^{4,5} But, in cases with history of prior abdominal operation, the laparoscopic approach had potential difficulties - manipulation of instruments, potential risks of general anesthesia in patients who had medical problems, and technical demands.⁶⁻¹¹

Previous abdominal surgery has been considered as a relative contraindication for laparoscopy.¹²⁻¹⁴ With development of surgical skills and instruments recently, the laparoscopic procedures were performed as a common treatment in CBD stones even in complicated cases. The usefulness of LCBDE has been reported with success rates in the range of 93.3-100% in general patients.¹² The impact of previous abdominal operations on LC and urologic procedures has been studied, and the outcomes were not found to be affected by prior surgery.¹²⁻¹⁶ However, only a few reports about the impact of previous abdominal operations on LCBDE have been published. We aimed to evaluate the feasibility of LCBDE even in patients with previous abdominal surgery by a single surgeon who experienced LC from over 200 cases in patients with upper abdominal operations.

METHODS

Patients and grouping

From December 2003 to March 2012, 44 patients with a diagnosis of CBD stone underwent LCBDE at the Department of Surgery, Boramae Medical Center, Seoul, Korea. All patients were diagnosed with abdominal computed tomography (CT), received ERCP or magnetic resonance cholangiopancreatography (MRCP), and informed about their health conditions. Among them, 27 patients were without history of previous abdominal surgery, while 17 patients had received various kinds of abdominal operation before. LCBDE were applied to (1) the patients with failed ERCP (n=27): incomplete stone removal (n=22),

failed cannulation (n=5), and (2) the patients who did not have ERCP (n=17): stone factor (multiple, huge, impacted) (n=5), anatomic variation came from gastric resection (n=7), for one-stage treatment (n=5) (Table 1). Among them, we excluded the 5 patients with previous lower abdominal operations who did not meet the criteria in this study.

We divided the remaining 39 patients into two groups; 27 patients without any history of previous abdominal operation were in Group A and 12 patients who underwent previous upper abdominal surgery were in Group B. Both groups were compared to each other with respect to their clinical characteristics (sex, age, body weight and co-morbidity), operation time, postoperative hospital stay, postoperative complication and conversion rate to open surgery.

Operation techniques

Under general anesthesia, the patient was laid in a 15 degree back up and 15 degree right tilt position. We used a four-trocar technique; 11-mm infra-umbilical port for laparoscope, one 11-mm port in subxiphoid for working port and future choledochoscope, one 5-mm port 5cm inferior to the right subcostal margin on the right mid-clavicular line, one 5 mm port on the right flank for assistance. If the previous incision scar was more than 3 cm far from the umbilicus, we used an infra-umbilical port, otherwise we made a camera port 3 cm right lateral to the umbilicus. After exposure of the rectus fascia, upward lifting of the full thickness of the rectus fascia with a Cocher clamp was followed by a careful insertion of a Veress needle. Access into the peritoneal cavity by a Veress needle could be confirmed by free dropping of normal saline and initial low intraabdominal pressure. After insufflations of CO₂ gas to 10 mmHg, we incised the anterior rectus fascia to expose the peritoneal layer. Regurgitation of insufflated CO₂ gas with simple puncture

Table 1. Indications of laparoscopic common bile duct exploration

| Previous operation history (-) (n=27) | | Previous operation history (+) (n=17) | | | |
|---------------------------------------|---|---------------------------------------|---------------------|------------------------------|---|
| Failed ERCP (n=19) | Incomplete stone removal | 16 | Failed ERCP (n=8) | Incomplete stone removal | 6 |
| | Failed cannulation | 3 | | Failed cannulation | 2 |
| ERCP not done (n=8) | Stone factor (huge, impacted, multiple) | 4 | ERCP not done (n=9) | Previous gastrectomy | 7 |
| | For one-stage treatment | 4 | | Stone factor (huge impacted) | 1 |
| | | | | For one-stage treatment | 1 |

of peritoneum could assure the access to the intra-abdominal cavity. Finger dissection was a safe and useful method for clearance of adhesion without bowel injury.

After the identification of CBD, choledochotomy was performed with a vertical incision approximately 1 to 1.5 cm in length with electrocautery. Both edges of the opened common bile duct were stitched-up with Vicryl suture and retracted in the opposite direction for easy entrance of choledochoscope. Through the 5-mm flexible choledochoscope, we identified the CBD stones, and removed them by flushing method with sterile saline, a stone basket, and sometimes crashed them by electrohydraulic lithotripsy.

The choledochotomy site was closed by continuous suture, using vicryl 3-0 with T-tube insertion and chol-

ecystectomy was performed. We ended the operation with a Jackson-Pratt drain insertion into the operation site. All the operations were performed by a single surgeon.

Statistical analysis

Statistical significance was analyzed using the Chi-square test, Student's t-tests. A p -value < 0.05 was considered significant.

RESULTS

During the study period, a total number of 44 patients underwent LCBDE initially for CBD stones in our hospital. This population comprised 24 (54.5%) males and 20 (45.5%) females with a mean age of 67.5±14.0 years (range, 34 to 90 years). There were 17 cases with previous operation history. Of 17 cases, 10 had upper abdominal operation for gastric disease (n=9) and temporary jejunostomy (n=1), 2 underwent laparoscopic cholecystectomy and another 5 cases had gynecologic procedures via low midline incision (n=2) and open appendectomy with McBurney incision (n=3) which were excluded in this study (Table 2).

Preoperative status is presented in Table 3. In terms of male to female ratio, mean age, body weight, there were no significant differences. 15 cases in group A and 10

Table 2. Types of previous abdominal operations in group B

| Incision | Operation | Number |
|-----------------------|---------------------------------|--------|
| Upper midline | Gastrectomy (total, subtotal) | 7 |
| | Primary repair of gastric ulcer | 2 |
| | Feeding jejunostomy | 1 |
| Laparoscopy (3 holes) | Laparoscopic cholecystectomy | 2 |
| McBurney | Appendectomy* | 3 |
| Low midline | Hysterectomy* | 2 |

Group B, presence of upper abdominal operation

*Not included in this study

Table 3. Characteristics of patients in both groups

| | Group A (n=27) | Group B (n=12) | p -value |
|--------------------------------|-------------------|------------------|------------|
| Gender (M : F) | 13 : 14 | 8 : 4 | 0.322 |
| Age (years) | 66.5±15.0 (34-90) | 70.3±7.9 (56-82) | 0.061 |
| Weight (kg) | 58.2±11.0 | 53.9±15.1 | 0.667 |
| Co-morbidity | 15 (55.6%) | 10 (83.3%) | |
| Cardiovascular accident | 10 | 7 | |
| Diabetes mellitus | 5 | 2 | |
| Liver disease | 1 | 1 | |
| Pulmonary disease | 1 | 5 | F |
| Laboratory data | | | |
| WBC (/μl) | 9,732.3±3,731.5 | 11,607.5±4,261.1 | 0.367 |
| AST (U/L) | 181.7±366.7 | 217.6±215.4 | 0.184 |
| ALT (U/L) | 128.0±140.2 | 103.9±69.0 | 0.180 |
| Total bilirubin (mg/dl) | 5.0±5.1 | 2.0±1.0 | 0.045 |
| Clinical & radiologic findings | | | |
| Fever | 5 (18.5%) | 1 (8.3%) | 0.532 |
| Jaundice | 4 (14.8%) | 0 (0%) | 0.197 |
| Abdominal pain | 25 (92.6%) | 12 (100%) | 0.376 |
| CBD size in CT scan (mm) | 17.4±7.0 | 15.2±3.6 | 0.032 |

Group A, absence of previous abdominal operation; Group B, presence of upper abdominal operation; AST, aspartate transaminase; ALT, alanine transaminase; CBD, common bile duct; CT, computed tomography

cases in group B had an additional underlying disease such as hypertension, cerebral disease, diabetes mellitus, chronic liver diseases, pulmonary disease like tuberculosis or pneumonia without a significant difference between the two groups ($p=0.151$).

The mean operation time was 164.5 ± 63.1 minutes in group A and 134.8 ± 45.2 minutes in group B, but there was no significant difference ($p=0.180$). For estimated blood loss (EBL), there was no significant difference (79.6 ± 205.4 ml in group A and 31.3 ± 36.6 ml group B, $p=0.103$) though it showed more blood loss in group A than in group B. No significant difference in the post-operative hospital stay was observed between the two groups ($p=0.158$). There were no complications due to port placement in either group. In 3 patients, minor bile leakage was shown during postoperative cholangiography at postoperative 7 days. But no additional procedure was needed for the management of the minor bile leakage. There was no mortality and no postoperative bleeding or bowel leakage. A total of 5 cases were converted to open surgery (4 in group A and 1 in group B). The reasons for open conversion in group A were severe intra-abdominal adhesion in 2 cases, an excessively small size of the abdominal cavity which impeded manipulation of the laparoscopic instrument, and lastly for possible unexpected injury to CBD during dissection. In group B, just one case was converted to open surgery due to severe inflammation (Table 4 and 5).

DISCUSSION

As LC has become the gold standard for treatment of benign gallbladder disease with the development of skills and devices for laparoscopic procedures, the trend of treat-

ment for CBD stones has changed and various options are now prevalent. These options are ERCP with or without EST, LCBDE or open CBD exploration and radiologic intervention. With the advances in endoscopic and laparoscopic technology, ERCP followed by LC has become the mainstream treatment for patients with concomitant GB and CBD stones in most centers.

However, ERCP has potential serious complications such as pancreatitis, cholangitis, duodenal perforation and life-threatening hemorrhage.¹⁷ The stone clearance rate of ERCP is reported as 75% notwithstanding the repeated sessions and additional procedures for the difficult CBD stones. Moreover, ERCP fails in 3% to 10% of all patients. The superiority of the LCBDE with LC exists in the context of a single session procedure for concomitant GB and CBD stone and preservation of the function of sphincter of Oddi which prevents ERCP related complications and post-procedural pain. Therefore, LCBDE can be the best alternative to failed ERCP for difficult cholelithiasis,^{18,19} although an experienced laparoscopic surgeon is mandatory. LCBDE is well indicated in 'difficult cholelithiasis' which was defined by Tai et al.¹⁷ as a failure of endoscopic stone retrieval for the following reasons; (1) *access and cannulation difficulty*, (2) *difficult nature of CBD stones in the aspect of number or size*, (3) *the presence of ERCP-related complications*, and (4) *contraindication of EST*.

In the early period of laparoscopic surgery, the laparoscopic approach was contraindicated for patients with history of prior abdominal operation. However, not only with the development of surgical skills and instruments but with the accumulated experience of laparoscopic surgeons, complicated laparoscopic procedures can be overcome with or without previous operations.²⁰⁻²² Several concerns that make surgeons hesitate about the laparoscopic approach in previously operated abdomen include (1) possible risk of injury to organs

Table 4. Comparison of operative results in both groups

| | Group A (n=27) | Group B (n=12) | p-value |
|------------------------------------|---------------------------|--------------------------|---------|
| Operation time (min) | 164.5±64.3 | 134.8±45.2 | 0.180 |
| Estimated blood loss (ml) | 79.6±205.4 | 31.3±36.6 | 0.103 |
| Open conversion (n) | 4 (14.8%) | 1 (8.3%) | 0.312 |
| Postoperative hospital stay (days) | 12.6±5.7 (range: 7-30) | 9.8±2.9 (range: 7-18) | 0.158 |
| Duct clearance | 21 (77.8%) | 9 (75.0%) | 0.849 |

Group A, absence of previous abdominal operation; Group B, presence of upper abdominal operation

Table 5. Postoperative complications

| | Group A | Group B |
|----------------------------|-----------|----------|
| Postoperative complication | 3 (11.1%) | 1 (8.3%) |
| Biliary stricture | 1 | 0 |
| Wound problem | 1* | 0 |
| Bile leakage | 1 | 1 |

Group A, absence of previous abdominal operation; Group B, presence of upper abdominal operation

*A case of open conversion

adjacent to the previous incision wound during insertion of the Veress needle or trocar (2) curtain-like severe adhesion that prevent access to the target organ from the prior operation as well as present inflammatory processes in spite of barely establishing pneumoperitoneum (3) risk of bowel injury during adhesiolysis and (4) higher probability of conversion to open surgery.

Site selection for the initial trocar is of importance with respect to both patient's safety and exposure of the biliary tract. Li et al.²⁰ reported that the blind puncture of a Veress needle is safe if the previous scar is more than 3 cm from the umbilicus, whereas the Hasson (open) technique is recommended if the scar is less than 3 cm from the umbilicus. In addition, we think the blind access with the trocar is not recommended even more than 3 cm from the previous scar, because the small bowel can be adherent to the innocent abdominal wall more than 3 cm from the previous incision in our experience. We applied the Veress needle method in almost all cases even less than 3 cm from the previous scar. Grasping the full layer of fascia of the rectus muscle with a Kocher clamp can facilitate abdominal wall lifting for safe insertion of the Veress needle. Confirmation of safe access into the peritoneal cavity can be achieved by free dropping of normal saline through the Veress needle followed by identifying initial low intraabdominal pressure after connecting CO₂ gas. Mechanical insufflation of CO₂ gas can detach multiple loose adhesions of bowel loops from the abdominal wall, which prevents possible injury to other organs not adherent to the previous scar. As usual, a simple puncture with the Veress needle to the adherent small bowel does not appear to cause serious problems, and injury from the Veress needle seems to be easily healed unless the bowel loop is severely distended. Hanney et al.²³ reported two cases of aortic injury during use of the Hasson cannula and supported the Veress needle technique. Dunne et al.²⁴ compared the Veress needle and Hasson technique for establishing pneumoperitoneum, which showed no significant difference between the technique chosen and incidence of complications. As aforementioned, we utilized an open technique with finger dissection after establishing pneumoperitoneum with a Veress needle (modified Hasson technique), which enabled avoidance of serious complications possibly encountered at the stage of entrance to the abdominal cavity.

As noninvasive methods, Viscera slide ultrasound and

magnetic resonance imaging (MRI) have been suggested, and they can be considered for detecting intra-abdominal adhesions to the abdominal wall and adhesion-free areas so as to prevent injuries during the creation of pneumoperitoneum.^{22,25} They may serve as a diagnostic tool for future planning of laparoscopic surgery assuming that the clinical efficiency and economic feasibility are verified.

Once the abdominal cavity has been accessed, adhesiolysis should be performed enough to insert a second trocar to aid in acquisition of a view around the initial port, followed by retraction, and further dissection. Rather than adhesiolysis of all intra-abdominal adhesions, it is recommended to remove the adhesions interfering with the approach to the operative field or laparoscopic procedures. Excessive use of electrocautery should be refrained to prevent unwitting burn injury during dissection. Additionally, it should be considered that imprudent dissection with mere presumption of adhesion pattern beyond the visible area may give rise to unexpected injury to organs.

Once an upper gastrointestinal operation has been performed, especially biliary tract operations, dense adhesions around the hepatoduodenal ligament and upward adhesion of the 2nd portion of the duodenum are usually observed during re-exploration in laparoscopic fashion. Identification of the gallbladder is most crucial for sequential dissection along the right side of the common bile duct for bile duct exploration. If cholecystectomy has been performed in a previous operation, hepatic hilum should be approached by freeing the lateral parietes and beginning dissection on the right side along the lateral inferior border of the liver.²⁰ Resultant down positioning of the transverse colon and duodenum enables finding of the common bile duct, hence the following procedure can be continued. In our opinion, complete dissection of the left side of the common bile duct is not recommended for prevention of injury to hepatic artery or portal vein injury. Clearance of the anterior aspect of the common bile duct seems to be enough for the exploration with choledochoscopy and other procedures for stone removal. We usually stitch up the opened edge of the bile duct for lateral retraction in the opposite direction, and this procedure fixes the common bile duct and allows easy access of choledochoscope into the bile duct lumen.

In some cases, we encountered rather tedious situations owing to abundant muddy stones spilled out through the

opened bile duct. It took much operation time to clear up the sludge and stones from the abdominal cavity and the patient would suffer from postoperative fever. Accordingly, a patient with a highly fragile stone does not appear to be indicated for LCBDE.

The problem of T-tube insertion is still debatable and primary closure of the bile duct after exploration with or without biliary stent is in vogue at the moment.^{19,26-30} We inserted T-tubes in all cases as a route for identification and removal of the possible residual stones.

In summary, postoperative data of LCBDE in the patients with previous upper abdominal operation on operation time, conversion rate, postoperative complication rate was comparable to those in the patients without previous history. With these results, LCBDE can be described as safe, minimally invasive procedures in the patient with previous abdominal operation as far as an experienced laparoscopic surgeon is available, and it can be the best alternative to failed ERCP for difficult cholelithiasis.

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