



Totally laparoscopic management of choledochal cysts using a four-hole method

J.-Y. Jang, S.-W. Kim, H.-S. Han, Y.-S. Yoon, S.-S. Han, Y.-H. Park

Department of Surgery, Seoul National University College of Medicine, 28 Yongon-dong, Chongno-gu, Seoul, 110-744, Korea

Received: 11 August 2005/Accepted: 12 December 2005/Online publication: 23 September 2006

Abstract

Background: Choledochal cyst is a rare benign disease of the biliary tract. However, once diagnosed, it must be excised with the gallbladder because of the risk for cancer developing in the biliary tree, including the gallbladder. This report introduces a new surgical technique for totally laparoscopic excision of choledochal cyst and hepaticojejunostomy using a four-hole method.

Methods: Between October 2003 and May 2005, the authors performed totally laparoscopic choledochal cyst excision for 12 patients. All the patients except one were women, and the mean age was 37.3 years (range, 17–62 years). According to the Todani classification, there were five type Ia cases, four type Ic cases, and three type IV cases. Choledochal cyst excision and Roux-en-Y hepaticojejunostomy were performed laparoscopically using the four-port technique.

Results: The mean operation time was 228 min (range, 150–330 min). No operative or postoperative transfusion was required. An oral diet was started on postoperative day 3. The average length of hospital stay was 5.8 days. There was no major complication associated with anastomosis leakage or obstruction. No patient had an adverse response, as determined by clinical or laboratory evaluation during a 2- to 19-month follow-up period.

Conclusions: Considering that choledochal cyst is common among young women, who are especially interested in cosmetic results in addition to complete resolution of medical problems, the laparoscopic management of choledochal cyst may be an attractive treatment option.

Key words: Choledochal cyst — Hepaticojejunostomy — Laparoscopic surgery

Laparoscopic cholecystectomy is an established procedure. Since the introduction of this technique, there have been many improvements in both the technique and the instruments used. These improvements have allowed surgeons to perform advanced procedures with reduced trauma and faster recovery. Although some pioneers have tried new laparoscopic operations, laparoscopic biliary pancreatic surgery still has limited indications and is not popular, except for cholecystectomy and choledocholithotomy, because of a complicated anatomy, a high risk of complication, and laborious procedures.

The diagnosis of choledochal cyst, a benign disease found in the biliary tract, is rare. Once found, it must be excised with the gallbladder because of the risk that cancer may develop in the biliary tree, including the gallbladder [1, 7, 10]. Choledochal cysts are more commonly diagnosed in young women. This group of patients is especially interested in cosmetic results as well as cure of the disease. In this report, we introduce a new surgical technique for totally laparoscopic excision of choledochal cysts and hepaticojejunostomy using a four-hole method.

Materials and methods

Between October 2003 and May 2005, we performed laparoscopic choledochal cyst excision for 12 patients. All except one patient were women with a mean age of 37.3 years (range, 17–62 years). Table 1 shows the clinical characteristics of the patients. According to the Todani classification, there were five type Ia cases, four type Ic cases, and three type IV cases.

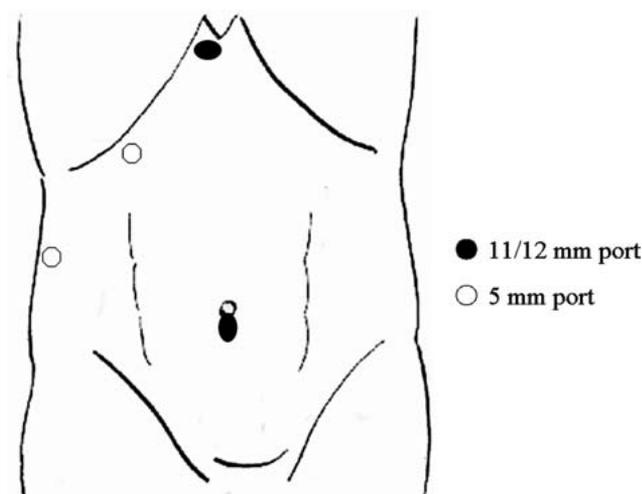
Preoperatively, we performed thin-section spiral computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP), or endoscopic retrograde cholangiopancreatography (ERCP), as per our routine, to confirm the anomalous junction of the pancreatobiliary ducts, and to determine the resection lines of the choledochal cyst and dissection planes.

Operation procedures

Under general anesthesia, the patient was set in a supine position with a 15° reverse Trendelenburg tilt. A 10-mm trocar was inserted through

Table 1. Patients' demographic findings

Age/sex	Todani type	Operative time (min)	Estimated blood loss (ml)	Hospital stay (days)	Postoperative complication
46/F	IVa	330	350	5	
19/F	Ia	220	50	6	
29/F	Ia	260	150	5	Fluid collection
40/F	Ic	280	100	6	
38/F	Ic	200	50	9	Minor bile leakage
45/F	IVa	210	50	5	
36/M	IVb	220	50	5	
24/F	Ia	200	100	6	
62/F	Ic	210	120	6	
43/F	Ia	290	200	7	
48/F	Ia	180	50	5	
17/F	Ic	150	50	5	

**Fig. 1.** Site and size of the trocars for the laparoscopic excision of choledochal cysts.

the infraumbilical port after institution of pneumoperitoneum, which was used mainly as a telescope route. Three other trocars were inserted, as shown in Fig. 1. A 30° telescope was used in all the procedures.

Choledochal cyst excision

First, Calot's triangle was dissected and exposed. Then the cystic artery was ligated using 3-0 silk. From the cystic duct, the hepatoduodenal ligament was dissected along the right choledochal cyst margin, after which the dissection was extended along the supraduodenal margin. The duodenum was retracted downward using an intestinal grasper. The choledochal cyst was retracted upward, and the retroduodenal and intrapancreatic portion of choledochal cyst was dissected using Ultrasonic shears (Ethicon, Somerville, New Jersey, USA) and bipolar bovies to ensure hemostasis of the epicholedochal venous plexus. After the transition area of choledochal cyst at the head of the pancreas had been confirmed, choledochotomy was performed. In addition, to avoid pancreatic duct injury, intraoperative choledochoscopy was performed to identify the site at which the pancreatic duct joined the common bile duct.

Once the transection line of choledochal cyst had been determined, the distal stump was ligated and transected. If the choledochal cyst was large, a 30-mm vascular endo-GIA (USSC, Norwalk, CT, USA) was used. With the distal portion of the choledochal cyst pulled upward, dissection was continued along the medial and posterior margin of choledochal cyst until the hepatic duct was identified. Using Ultrasonic shears, the choledochal cyst then was transected below the bifurcation. Next, the cystic duct was clipped and divided. The gallbladder re-

mained in the gallbladder fossa for liver retraction during the hepaticojejunostomy.

Roux-en-Y loop construction

After the ligament of Treitz had been identified, a small hole was made in the mesentery of the jejunum 50 cm distal to the ligament of Treitz using Ultrasonic shears for the passage of the endo-GIA. When the 30-mm endo-GIA had been inserted through this hole, the jejunum was transected, after which the jejunal mesentery was divided with the Ligasure (USSC). An intracorporeal long tagging suture was performed at both sides of transected limbs for marking and retraction of the limbs.

Hepaticojejunostomy

The Roux limb was brought up to the hepatic hilum in front of the colon. After approximation of the jejunum and hepatic duct, a small incision was made at the antimesenteric side of the jejunum for the end-to-side hepaticojejunostomy. When the stay suture had been positioned at both sides of the anastomosis, the posterior row of the hepaticojejunostomy was performed using interrupted sutures with the aid of Suture Laploop (Sejong, Gyeonggido, Korea). After adequate suturing of the posterior row had been confirmed, the anterior row also was sutured using the interrupted method (Fig. 2). Next, the gallbladder was dissected from the gallbladder fossa using electrocautery.

Jejunojejunostomy and extraction of specimens

Jejunojejunostomy was performed between the jejunum (50 cm distal to the hepaticojejunostomy) and the transected upper limb using a side-to-side method. The two limbs were approximated side by side, and the stay suture was placed and tied. After small incisions had been made at the antimesenteric sides of the jejunum, the endo-GIA was inserted and fired. The opening of the jejunum for the stapler was closed with interrupted sutures using Suture Laploop (Sejong). A Jackson-Pratt drain was placed near the anastomotic site. The resected choledochal cyst and gallbladder were put in a Lab-bag (Sejong) and extracted through the umbilical port site. The wound then was closed.

Results

During the study period, we performed laparoscopic excision of choledochal cysts for 13 patients. However, we experienced one open conversion case involving a 30-year-old woman with a type Ia choledochal cyst (Fig. 3). During the dissection of the choledochal cyst, the narrow distal component was transected by the upward

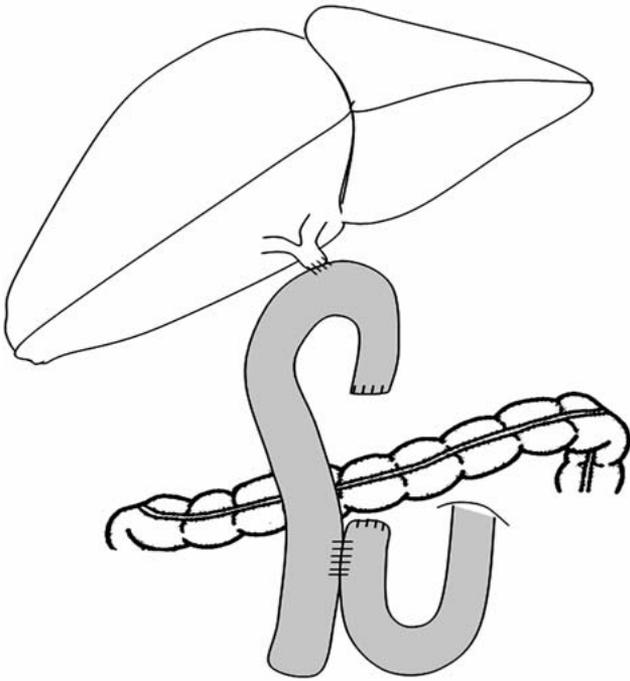


Fig. 2. Schematic drawing of the antecolic Roux-en-Y hepaticojejunostomy.

traction of the cyst. We then had to open the abdomen and finish the operation.

Except for the one aforementioned patient, the operation was completed laparoscopically for all the remaining 12 patients. The mean operation time was 228 min (Table 1). The operation time was 330 min for the first case, but accumulated experience has shortened it. The time range for the most recent cases was 150 to 200 min. There was no operative or postoperative transfusion requirement. An oral diet could be started on postoperative day 3. The average length of hospital stay was 5.8 days (range, 5–9 days).

Although there was no serious complication, two minor complications occurred. In a 29-year-old woman, who was discharged on postoperative day 5, readmission to hospital was required because of fever and right upper quadrant pain. On the radiologic workup, complicated fluid (not bile) collection around the subphrenic area was detected. An additional 5 days of hospital care were required for conservative management including percutaneous drainage and antibiotics. One other noted problem involved a patient who experienced a minor bile leak for a few days. During the follow-up period of 2 to 19 months, no additional problems were detected.

Discussion

Choledochal cysts are relatively rare in Western countries, including the United States. Reported rates range from 1 case per 2,000,000 live births to 1 case per 100,000 to 150,000 live births. Choledochal cysts are more prevalent in Asian countries than in the United States and other Western countries. More than 33% of

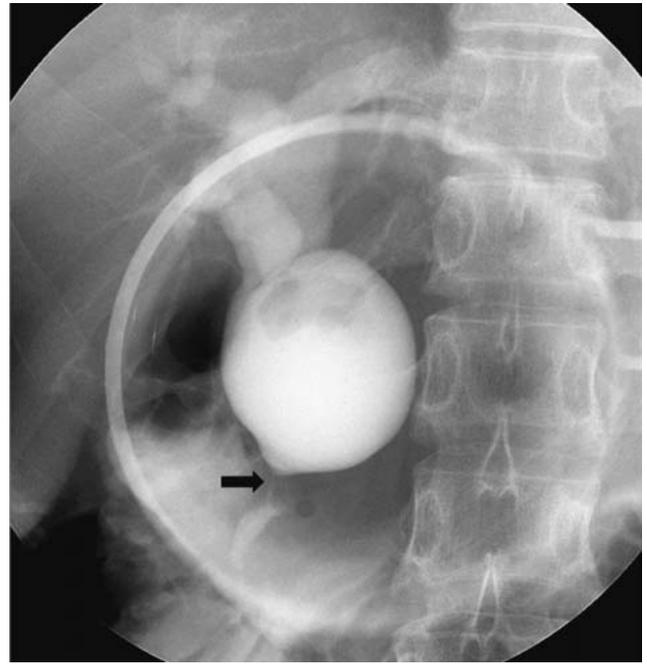


Fig. 3. Preoperative cholangiography of the open conversion case. The narrow distal component (*arrow*) was transected by the upward traction during the dissection of the choledochal cyst.

all reported cases are in Japan, for which Miyano and Yamataka [7] have reported an incidence as high as 1 case per 1,000 population. According to the large multicenter study in Korea [5], the incidence of choledochal cysts is 0.3%, and the estimated incidence of anomalous pancreatobiliary ductal union, thought to be the etiology of choledochal cysts, is 4.1%. We estimate that the incidence of choledochal cyst in East Asia is similarly higher than that of Japan.

The clinical presentation of a choledochal cyst in children is very different from its presentation in adults. In children, the main symptoms of choledochal cyst are a mass, jaundice, and perforation. However with increasing age, the manifestation of choledochal cyst includes stones, pancreatitis, and biliary tract cancer, including gallbladder cancer.

Combined biliary tract cancer is the most serious complication of choledochal cysts [1, 10]. According to the world's largest study, conducted in Japan [10], the occurrence rate of biliary tract cancer is 10.6% in adult patients. The gallbladder is the most common site of cancer. Our hospital, over a period of 15 years, has had nine cases of biliary tract cancer in a group of 77 patients with choledochal cysts. The incidence of biliary tract malignancy in our institution is therefore 11.7% [11]. These disastrous complications, including biliary tract cancer, justify the early resection of choledochal cysts even if there are no specific symptoms.

Choledochal cysts are most commonly diagnosed in young women, who are especially interested in cosmetic results as well as cure of the disease. For this group, laparoscopic management of choledochal cysts is a very attractive treatment option.

Farello et al. [3] first reported laparoscopic resection of a choledochal cyst leaving a small portion of the cyst.

However, the limitation of technique and available instruments as well as the tedious work involved has made laparoscopic management of choledochal cyst unattractive.

Nevertheless, type II choledochal cysts theoretically are potentially good candidates for laparoscopic surgery [6]. Many clinicians believe that a simple excision of the extrahepatic bile duct diverticulum is sufficient for the type II choledochal cyst. This procedure resembles laparoscopic cholecystectomy. However, type II choledochal cyst is very rare. Most choledochal cysts need both hepaticojejunostomy and excision of the bile duct.

We believe that excision of choledochal cysts is feasible using an ultrasonic dissecting instrument and a tilted telescope or flexible scope that provides a good visual field. However, to date, hepaticojejunostomy is not a popular approach for the laparoscopic management of choledochal cyst.

Tanaka et al. [9] reported a relatively large number of cases for which laparoscopic management of choledochal cysts was used. According to the report, the investigators performed a minilaparotomy to create a Roux-en-Y hepaticojejunostomy after laparoscopic dissection of the choledochal cyst. This approach was used to avoid technical difficulty and complications.

Currently, only a few surgeons actively attempt laparoscopic choledochojejunostomy or hepaticojejunostomy [2, 4, 8]. With the accumulation of laparoscopic techniques and improved instruments, hepaticojejunostomy is now a feasible procedure. We believe that hepaticojejunostomy can be performed safely except for cases in which a very narrow hepatic duct is found. In previous reports [2, 9], the conversion rate was reported to be 10% to 37%. In our series, we experienced one conversion in 13 cases (7.7%). In this one case, the patient had a very narrow distal common bile duct with an anomalous pancreaticobiliary ductal union. During the distal dissection of the choledochal cyst, a 1- to 2-mm-sized distal bile duct was torn by the pulling force of the choledochal cyst during dissection. Therefore, very careful dissection is needed to avoid the rupture of choledochal cysts or injury to the pancreatic duct, especially in patients with a narrow component of the bile duct or anomalous pancreaticobiliary ductal union. To avoid injury to the pancreatic duct, we routinely perform preoperative MRCP or ERCP and intraoperative cho-

ledochoscopy. This approach helps to delineate the anatomy of the bile and pancreatic ducts.

Although long-term follow-up evaluation is essential to clarify the safety of these procedures, we experienced only minor immediate complications. In comparison with reports describing a 5- or 6-port technique, we use only 4 ports, thereby offering the additional benefit of a good cosmetic result. In conclusion, laparoscopic management of choledochal cyst using a four-hole method is a safe and feasible procedure that provides a high level of satisfaction to the patients cosmetically and functionally.

References

1. Benjamin IS (2003) Biliary cystic disease: the risk of cancer. *J Hepatobiliary Pancreat Surg* 10: 335-339
2. Chowbey PK, Soni V, Sharma A, Khullar R, Baijal M (2005) Laparoscopic hepaticojejunostomy for biliary strictures: the experience of 10 patients. *Surg Endosc* 19: 273-279
3. Farello GA, Cerofolini A, Rebonato M, Bergamaschi G, Ferrari C, Chiappetta A (1995) Congenital choledochal cyst: video-guided laparoscopic treatment. *Surg Laparosc Endosc* 5: 354-358
4. Han HS, Yi NJ (2004) Laparoscopic Roux-en-Y choledochojejunostomy for benign biliary disease. *Surg Laparosc Endosc Percutan Tech* 14: 80-84
5. Kim MH, Lim BC, Park HJ, Lee SK, Kim CD, Roe IH, Kim YT, Song SY, Kim JH, Chung JB, Shim CS, Yoon YB, Min YI, Yang US, Kang JK (2000) A study on normal structures, variations, and anomalies of the Korean pancreaticobiliary ducts: cooperative multicenter study. *Korean J Gastrointest Endosc* 21: 624-632
6. Liu DC, Rodriguez JA, Meric F, Geiger JL (2000) Laparoscopic excision of a rare type II choledochal cyst: case report and review of the literature. *J Pediatr Surg* 35: 1117-1119
7. Miyano T, Yamataka A (1997) Choledochal cysts. *Curr Opin Pediatr* 9: 283-288
8. Shimura H, Tanaka M, Shimizu S, Mizumoto K (1998) Laparoscopic treatment of congenital choledochal cyst. *Surg Endosc* 12: 1268-1271
9. Tanaka M, Shimizu S, Mizumoto K, Yokohata K, Chijiwa K, Yamaguchi K, Ogawa Y (2001) Laparoscopically assisted resection of choledochal cyst and Roux-en-Y reconstruction. *Surg Endosc* 15: 545-552
10. Tashiro S, Imaizumi T, Ohkawa H, Okada A, Katoh T, Kawaharada Y, Shimada H, Takamatsu H, Miyake H, Todani T, Committee for Registration of the Japanese Study Group on Pancreaticobiliary Maljunction (2003) Pancreaticobiliary maljunction: retrospective and nationwide survey in Japan. *J Hepatobiliary Pancreat Surg* 10: 345-351
11. Yoon YS, Kim SW, Jang JY, Choi MG, Park YH (2004) A new surgical classification of Todani type I and IV choledochal cyst. *Korean J HBP Surg* 8: 31-39