

# Laparoscopic left hepatectomy in patients with intrahepatic duct stones and recurrent pyogenic cholangitis

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**Backgrounds/Aims:** Recently many studies have been reported the early results of a hepatectomy for various intrahepatic lesions. Also various types of laparoscopic hepatectomies are being performed in many centers. Some reports about the safety of laparoscopic parenchymal dissection of the liver have been published. In this study, we reported our experiences of laparoscopic left hepatectomies in patients with an intrahepatic duct (IHD) stone with recurrent pyogenic cholangitis (RPC), and investigated whether the total laparoscopic parenchymal dissection is as safe as open surgery. **Methods:** From April 2008 to December 2010, 25 patients had been admitted for left IHD stones with RPC. Preoperatively, the type of surgery was decided with the intention of treating each patient. Initially 10 patients underwent a laparoscopy-assisted left hepatectomy and the next 15 patients underwent total laparoscopic left hepatectomy as our experience grew. Demographics, peri- and postoperative results were collected and analyzed comparatively. **Results:** The mean age, gender ratio, preoperative American Society of Anesthesiologists (ASA) score, accompanied acute cholangitis and biliary pancreatitis, and the number of preoperative percutaneous transhepatic biliary drainage (PTBD) inserted cases were not different between the two groups who had undergone laparoscopy-assisted and totally laparoscopic left hepatectomy. The operation time, intraoperative transfusions and postoperative complications also showed no difference between them. The postoperative hospital stay did not show a significant difference statistically. **Conclusions:** In this study, we concluded that a laparoscopic left hepatectomy can be adapted to the patients with a left IHD stone with RPC. Also laparoscopic parenchymal dissection is safe and equivalent to an open procedure. (Korean J Hepatobiliary Pancreat Surg 2012;16:105-109)

**Key Words:** Intrahepatic duct stone; Recurrent pyogenic cholangitis; Laparoscopic left hepatectomy

## INTRODUCTION

Although an intrahepatic duct (IHD) stone is a pathologically benign condition, its progression can severely limit the social activity of patients. Furthermore, patients can die of cholangitis or biliary sepsis unless they are appropriately treated. Also, as cholangiocarcinoma can be seen in about 10% of the cases, it must be treated inclusively at the point of diagnosis.<sup>1-4</sup>

The treatment must include complete removal of stones and the resolution of the IHD stricture and cholestasis. In this way, postoperative complications, especially recurrent cholangitis, can be decreased.<sup>5</sup> Thus various modalities of treatment including percutaneous transhepatic cholangioscopic lithotripsy and laparoscopic IHD exploration were used to treat a patient with an IHD stone. But, as these

modalities are often incomplete, repeated and combined procedures to remove the stones completely are required. If ductal strictures and recurrent pyogenic cholangitis (RPC) were concurrent with IHD stone, a definitive hepatectomy is necessary.

There has been a tremendous advancement of laparoscopic instruments and techniques compared to the past 20 years. Various types of laparoscopic hepatectomies are performed in many centers worldwide. But, most patients with IHD stone have perihepatic adhesions and alterations of normal anatomical structures due to chronic recurrent inflammation. Furthermore, a choledochotomy is often required to remove the stones completely. Therefore, laparoscopic procedures are more difficult than open surgery.<sup>5</sup>

In this study, we reviewed our left laparoscopic hepatectomy experiences to investigate whether this operative

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method can be adapted for patients with left IHD stone with RPC and the laparoscopic parenchymal dissection of the liver can be performed safely as an open procedure.

## METHODS

From April 2008 to December 2010, 49 cases of laparoscopic hepatectomies were performed among a total of 158 hepatectomies. Fourty patients underwent anatomical resections and the remaining underwent non-anatomical resections. Of these patients, 25 patients were admitted for IHD stone with RPC (Fig. 1). The type of operation was decided preoperatively. Ten initial patients underwent a laparoscopy-assisted left hepatectomy and the next 15 patients had a total laparoscopic left hepatectomy. Most data were collected retrospectively but the operative data were collected prospectively.

Under general anesthesia with lithotomy position, the port for the laparoscope was located just below the umbilicus and two additional working ports were placed in the right upper abdomen along the right anterior axillary line and around the Cantle's line. An assistant port was placed at the left upper abdomen, and if needed, another assistant port was inserted more laterally. Then the patient was placed in an approximate 20-degree left sided tilt down reverse in Trendelenburg position. After the cholecystectomy, the falciform ligament, the coronary ligament and the left triangular ligament were divided by the Harmonic Scalpel<sup>®</sup> (Johnson & Johnson, CO, US). In most patients, the left hepatic vein was isolated with a careful dissection. The left hepatic artery and the portal vein were isolated from the hepatoduodenal ligament, and then ligated by a closed 4-0 loop-stitch and the Hem-O-Lok<sup>®</sup> (Teleflex Medical, CO, US). Then hepatic

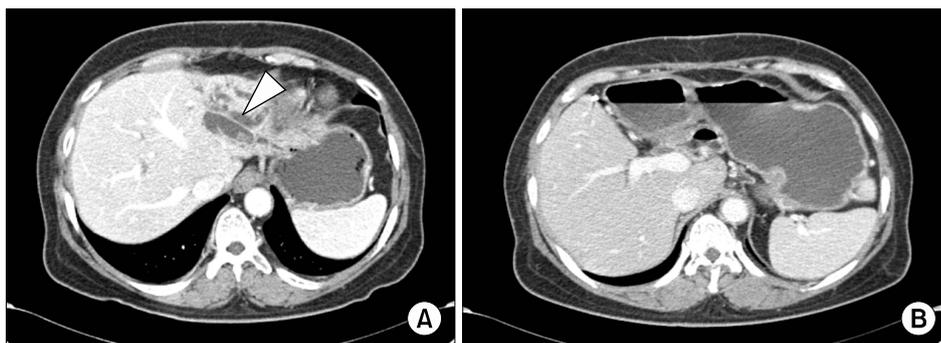
parenchymal dissection was performed along the Cantle's line by the Harmonic Scalpel<sup>®</sup> superficially and the Cavitron Ultrasonic Surgical Aspirator<sup>®</sup> (CUSA<sup>®</sup>, Valleylab, Boulder, CO, US) deeply. After proper parenchymal dissection was performed, the bile duct was divided from the left hepatic vein by the Endo-GIA<sup>®</sup> (Ethicon, Davis & Geck, and US Surgical, US). Finally, the left hepatic vein was ligated using the Endo-GIA<sup>®</sup> after complete parenchymal dissection.

For the performance of the laparoscopy-assisted procedure, hepatic mobilization and ligation of the hepatic artery and the portal vein was done using laparoscopic procedures. After making about a 10 cm-length incision on the upper midline, parenchymal dissection was performed mainly by the CUSA<sup>®</sup>. The left hepatic duct and the left hepatic vein were ligated by the Endo-GIA<sup>®</sup>.

If the patient had common bile duct (CBD) stones, an additional choledochotomy would be required to extract the stones and a T-tube would be inserted.

## RESULTS

Among 25 patients, the initial 10 patients were underwent the laparoscopy assisted left hepatectomy, and the next 15 patients were totally laparoscopic left hepatectomy as our experience expanded. The mean age was 62.4 (range: 39-85) years and the incidence was higher in female (Male : Female=1 : 2.6). The mean body mass index (BMI) was 23.0 (16.8-29.7) kg/m<sup>2</sup>. The mean preoperative American Society of Anesthesiologists (ASA) score was 1.6 points. Sixteen patients (64%) were concurrent with acute cholangitis, 7 (28%) with common bile duct (CBD) stone and 7 (28%) with biliary pancreatitis. Four patients (16%) had percutaneous transhepatic biliary



**Fig. 1.** A 54-year old female with multiple IHD stones with RPC. (A) On preoperative abdominal CT, there were severe atrophic change of the left lobe of the liver (white arrow head). (B) She underwent a totally laparoscopic left hepatectomy. In a postoperative abdominal CT, there were no postoperative complications.

**Table 1.** Comparison of the demographics and preoperative status between the laparoscopy-assisted left hepatectomy (LAH) group and the totally laparoscopic left hepatectomy (TLH) group

	Total (n=25)	LAH (n=10)	TLH (n=15)	p-value
Demographics				
Age (years)	62.4 (39-85)	62.3 (49-76)	64.4 (44-85)	0.355
Sex (male)	7 (28%)	1 (10%)	6 (40%)	0.179
BMI (kg/m <sup>2</sup> )	23.0 (16.8-29.7)	24.4	22.1	0.082
ASA score	1.6	1.5	1.6	0.639
Comorbidities				
Acute cholangitis	16 (64%)	6 (60%)	10 (67%)	0.747
CBD stone	7 (28%)	3 (30%)	4 (27%)	0.863
Biliary pancreatitis	7 (28%)	3 (30%)	4 (27%)	0.863
Preoperative PTBD insertion	4 (16%)	1 (10%)	3 (20%)	0.626
Preoperative Lab				
WBC (/mm <sup>3</sup> )	7,807.6 (3,540-15,150)	7,821 (3,540-15,150)	7,865.3 (3,900-14,960)	0.668
Hb (g/dl)	12.7 (10.2-15.9)	12.6 (10.9-14.4)	12.82 (10.2-15.9)	0.651
Albumin (g/dl)	3.83 (2.8-4.6)	3.96 (3.2-4.6)	3.81 (2.8-4.6)	0.470
Total bilirubin (mg/dl)	1.11 (0.26-5.09)	0.713 (0.26-1.16)	1.37 (0.5-5.09)	0.090
AST (IU/L)	48.3 (10-288)	52.9 (15-288)	45.2 (10-174)	0.681
ALT (IU/L)	50.69 (5-211)	83.6 (14-197)	48.7 (5-211)	0.651

**Table 2.** Comparison of the perioperative and postoperative outcomes between the laparoscopy-assisted left hepatectomy (LAH) group and the total laparoscopic left hepatectomy (TLH) group

	Total (n=25)	LAH (n=10)	TLH (n=15)	p-value
Postoperative outcomes				
Duration of surgery (min)	360.6 (210-470)	319	298	0.387
Transfusion performed (n)	4 (16%)	2 (20%)	2 (13%)	0.672
Incision length (cm)	9.2 (5-12)	11.2	7.8	<0.001
Remnant stone (n)	0	0	0	
Postoperative outcomes				
Patients with complications (n)	2 (8%)	1 (10%)	1 (6.6%)	0.775
Length of hospital stay (days)	11.2 (5-32)	12.7 (8-32)	10.3 (5-20)	0.288

drainage (PTBD) preoperatively (Table 1).

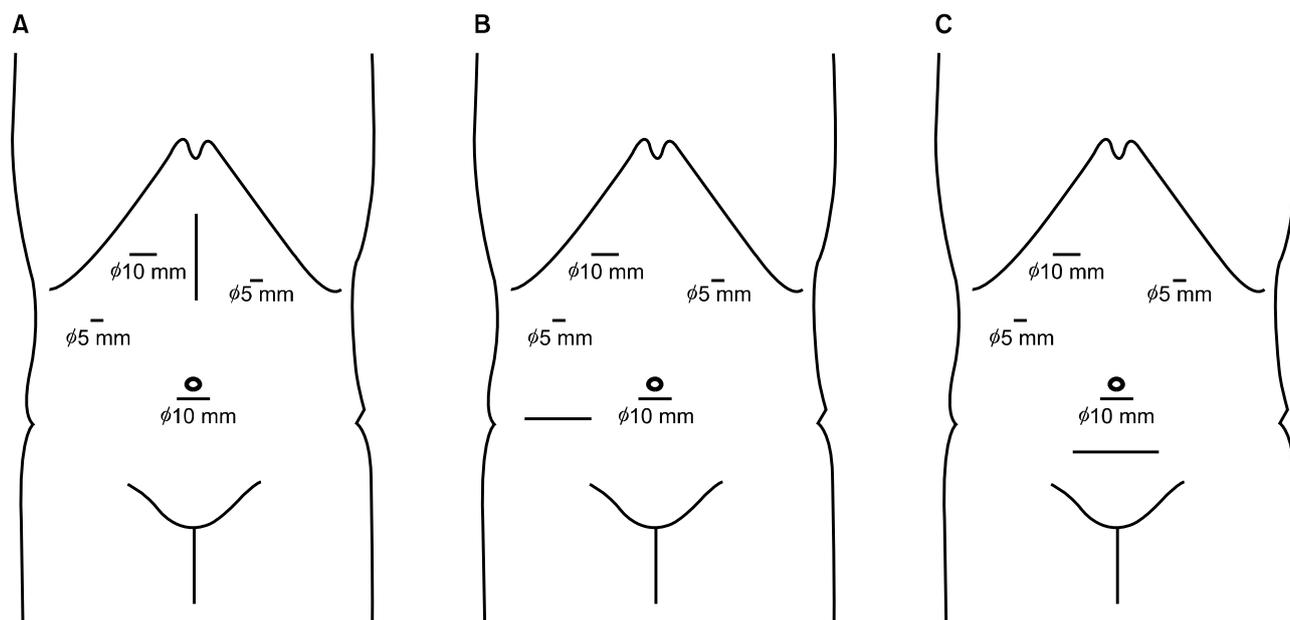
The mean operation time was 360.6 (range: 210-470) minutes and intraoperative transfusions were given in 4 cases (16%). The conversion to open procedure was done in 1 case because of a stapler malfunction. Postoperative biliary leakage occurred in 2 cases (8%) and they were well treated with conservative management. The mean postoperative hospital stay was 11.2 (range: 5-32) days (Table 2).

Patients were divided into two groups depending on the type of hepatic parenchymal dissection: the laparoscopy-assisted left hepatectomy (LAH) group and the total laparoscopy left hepatectomy (TLH) group. The mean BMI was 24.4 kg/m<sup>2</sup> in LAH and 22.1 kg/m<sup>2</sup> in TLH. The ASA score was 1.5 in LAH and 1.6 in TLH. Patients with acute cholangitis were: 6 cases in LAH (60%) and 10 cases in TLH (67%). Biliary pancreatitis cases were

3 in LAH (30%) and 4 in TLH (27%). A combined CBD tone was in 3 cases of LAH (30%), 4 cases of TLH (27%). There was one case of preoperative PTBD insertion in LAH (10%) and 3 in TLH (20%).

The preoperative laboratory data were also analyzed. The mean leucocyte count was 7,821/mm<sup>3</sup> in LAH and 7,865.3/mm<sup>3</sup> in TLH. The mean hemoglobin was 12.6 g/dl in LAH and 12.82 g/dl in TLH and the mean albumin was 3.96 g/dl in LAH and 3.81 g/dl in TLH. The mean total bilirubin was 0.71 mg/dl in LAH, 1.37 mg/dl in TLH, and the mean aspartate aminotransferase (AST) / alanine aminotransferase (ALT) were 52.9/45.2 IU/L in LAH and 83.6/48.7 IU/L in TLH. All of these demographics and preoperative clinical conditions had not different statistically between the two groups (Table 1).

The mean operation time was longer in the laparoscopy assisted group, but there was no statistically significant



**Fig. 2.** The incisions to retrieve the specimen. (A) An upper midline incision was made in the laparoscopy-assisted left hepatectomy. (B) A right lower transverse incision was made in the totally laparoscopic left hepatectomy. (C) A Pfannenstiel incision was made in the totally laparoscopic surgery.

difference (319 vs. 298 minutes,  $p=0.387$ ). Intraoperative transfusion was given to 2 cases with LAH (20%, each was 1 pint and 2 pints) and 2 cases of TLH (13%, each 1 pint) and showed no statistical significance ( $p=0.672$ ). The mean incision length was 11.2 cm in LAH and 7.8 cm in TLH. Postoperative complications occurred in each one patient from both groups. There were no remnant stones in all cases. The mean postoperative hospital stay was not different statistically (12.7 vs. 10.3,  $p=0.288$ ) (Table 2).

## DISCUSSION

The types of laparoscopic hepatectomy are variable, such as a total laparoscopic hepatectomy, a laparoscopy-assisted hepatectomy,<sup>6</sup> a hand-assisted laparoscopic hepatectomy<sup>7</sup> and a gasless laparoscopic hepatectomy.<sup>8</sup> From these procedures, we performed laparoscopy-assisted hepatectomy for early cases. As our experiences expanded, the totally laparoscopic hepatectomy was mainly performed. The most important difference of the two procedures is the method of hepatic parenchymal dissection. Performance of a laparoscopy-assisted hepatectomy required the parenchymal dissection to be done in the same manner as open surgery. But in total laparoscopic hepatec-

tomies, all procedures, including a parenchymal dissection, were performed using laparoscopic instruments. We used the Harmonic Scalpel<sup>®</sup> for the superficial layer, and the CUSA<sup>®</sup> for the deep layer of the hepatic parenchyma. But, there have been some problems with the laparoscopic parenchymal dissection with bleeding control in the visual field. The abdominal cavity is a closed and limited space. Moreover, as we set the intra-abdominal CO<sub>2</sub> gas pressure under 14 mmHg to prevent the formation of postoperative air embolism, the field can be narrower. To resolve these problems, we used a 30-degree angled laparoscope, so that the operative field was shown slightly downward for a better view. Vapor from laparoscopic instruments can also make the field hazy, so we set a gas filter to remove vapor and applied an anti-fog solution to make the field clear. Even a little bleeding can make the field unclear, so we were very careful to prevent bleeding. When a vessel was injured, we applied laparoscopic metal clips to ligate it. If bleeding was not controlled with this manner, we packed the area with some gauze or sutured the bleeding site.

After we adapted the laparoscopic procedures for hepatectomies, the incision length greatly decreased and recovery took less time. We used 4 or 5 ports for the laparoscopic hepatectomy. The location of the ports was im-

portant for traction of the liver to secure an adequate field and for control of the surgical instruments without interrupting each other. First, the laparoscopist stands between the patient's legs so he can show display a stable surgical field over the course of the operation.<sup>9</sup> The first assistant handles the instruments via 2 ports, so he can reposition and move the liver similar to an open surgery procedure.

There are many ways of retrieving the specimen. For example, through the extension of a port site, or an incision at another site.<sup>10</sup> We mostly used a Pfannenstiel incision or a right lower transverse incision in a left total laparoscopic hepatectomy, and upper midline incision in a laparoscopy-assisted left hepatectomy (Fig. 2).

There are not many cases of totally laparoscopic hepatectomy for IHD stone. In 2003 Min et al.<sup>11</sup> reported 6 cases of totally laparoscopic left hepatectomy and a left lateral sectionectomy. The mean operation time was 469.2 minutes and the hospital stay was 11.7 days. There was no complication or mortality. In 2007, Kim et al.<sup>12</sup> reported 25 cases of IHD stones. Their mean operation time was 263.3 minutes for left lateral sectionectomy, and 419.4 minutes for a left hepatectomy. The mean hospital stay was 11 days. In the same year, Cai et al.<sup>13</sup> performed laparoscopic hepatectomies for 29 patients, and open hepatectomies for 22 patients. They reported a shorter time of fasting and hospital stay after a laparoscopic surgery with similar results in recurrence, operation time and blood loss between the two groups.

In our institution, patients who underwent a total laparoscopic hepatectomy showed similar results to the laparoscopy-assisted hepatectomy or open hepatectomy group in the remnant stone or complication rate. And the duration of fasting and hospital stay were superior to the latter. We expect that the operation time and blood loss will become better in the future with more experiences.

In this study, we concluded that a total laparoscopic left hepatectomy can be adapted for patients with left IHD stone with RPC. Because a laparoscopic parenchymal dissection of the liver is safe and is not inferior to an open hepatectomy, it can be a possible substitute for the open procedure for other benign or malignant liver diseases requiring a hepatectomy. More careful approaches, adequate patient selection and laparoscopic hepatobiliary surgical experiences are required.

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