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Original Research

# Laparoscopic left-sided hepatectomy for the treatment of hepatolithiasis: A comparative study with open approach

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## HIGHLIGHTS

- LLH is a safe and effective treatment for hepatolithiasis and exhibits advantages over OLH in some fields.
- The conversion rate was 5.6% for LLH.
- No obvious differences showed in operative time, initial/final stone clearance rate and stone recurrence rate in both groups.

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## ABSTRACT

*Background:* Hepatolithiasis is a prevalent disease in some regions of China. Left-sided hepatectomy is an effective treatment for left intrahepatic bile duct stones with irreversible disease, such as biliary strictures, severe parenchymal fibrosis or atrophy. However, the advantages of laparoscopic left-sided hepatectomy (LLH) over open approach (OLH) are still controversial. The aim of this study was to compare the clinical outcomes of LLH to those of OLH in the treatment of hepatolithiasis.

*Methods:* Between January 2013 and October 2016, 75 consecutive patients with hepatolithiasis undergoing left-sided hepatectomy were enrolled in this study. The demographic, intraoperative, and postoperative data were retrospectively analyzed.

*Results:* Among these 75 patients, 36 underwent LLH (LLH group) and 39 underwent OLH (OLH group). The LLH group exhibited a lower intraoperative blood loss (215.8 ± 75.8 *vs* 298.7 ± 158.9 mL, $p = 0.005$), intraoperative transfusion (5.6% *vs* 23.1%, $p = 0.032$), overall complication rate (13.9% *vs* 35.9%, $p = 0.029$), and shorter recovery of bowel movement (2.3 ± 0.8 *vs* 3.0 ± 1.0 d, $p = 0.004$), time of off-bed activities (3.2 ± 1.1 *vs* 5.8 ± 1.4 d, $p < 0.001$) and postoperative hospital stay (7.7 ± 2.2 *vs* 10.9 ± 3.3 d, $p < 0.001$) compared to the OLH group. Similar results were also observed in left lateral sectionectomy and hemihepatectomy subgroups. There was no significant difference in the operative time, initial stone clearance rate, final stone clearance rate, stone recurrence rate and overall cost (All $p > 0.05$). No perioperative mortality was observed. The conversion rate was 5.6%.

*Conclusion:* LLH is a safe and effective treatment for selected patients with hepatolithiasis, with an advantage over OLH in the field of intraoperative blood loss, intraoperative transfusion, overall complication and postoperative recovery.



## 1. Introduction

Hepatolithiasis is defined as a gallstone disorder in the intrahepatic bile ducts, which is prevalent primarily in Southeast Asia [1]. It may occur alone or with extrahepatic bile duct stones. Long-term of hepatolithiasis may cause secondary biliary stricture, liver cirrhosis and even cholangiocarcinoma [2]. Hepatectomy is a definite and effective treatment option for hepatolithiasis, because it can remove the stones and the ductal strictures simultaneously [3,4]. Regarding the hepatectomy for hepatolithiasis, left-sided hepatectomy including left lateral sectionectomy and left hemihepatectomy are the main procedure performed due to most patients with hepatolithiasis have stones in the left-sided liver.

With the development of laparoscopic approaches, laparoscopic hepatectomy (LH) has been utilized for the treatment of various

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liver diseases including benign or malignant liver tumors [5,6]. The international position of laparoscopic liver surgery has been widely recognized since Louisville statement in 2008 [7]. However, LH may be more difficult than open hepatectomy for hepatolithiasis due to the fact that patients with hepatolithiasis usually have alterations of normal anatomical structures and perihepatic adhesions caused by chronic recurrent inflammation. To date, only few studies involved comparison of the outcomes of laparoscopic left-sided hepatectomy (LLH) with open left-sided hepatectomy (OLH) for hepatolithiasis, and the feasibility and efficacy of LLH have not been fully evaluated. Therefore, this retrospective study was performed to evaluate the safety and effectiveness of LLH for hepatolithiasis through comparing its clinical outcomes with that of OLH.

## 2. Patients and methods

### 2.1. Inclusion criteria

Left-sided hepatectomy in this study refers in particular to left lateral sectionectomy and left hemihepatectomy. The inclusion criteria of this study were: (1) unilateral, left intrahepatic bile duct stones with or without extrahepatic bile duct stones, and with irreversible disease, such as biliary strictures, severe parenchymal fibrosis or atrophy requiring hepatectomy; (2) without acute suppurative cholangitis; (3) Child-Pugh class A or B; (4) no need for bilioplasty or bilioenteric anastomosis; (5) without previous upper abdominal surgery except for open or laparoscopic cholecystectomy.

### 2.2. Patients

From January 2013 to September 2016, 313 patients with hepatolithiasis underwent elective hepatectomy in our institution. 75 of these patients met the above inclusion criteria, including 36 LLHs and 39 OLHs. The patients' characteristics, surgical features, intraoperative and postoperative outcomes were retrospectively reviewed.

### 2.3. Surgical techniques

#### 2.3.1. Laparoscopic left-sided hepatectomy

Under general anesthesia, the patient was placed in a supine position with both legs separating. Pneumoperitoneum was established through the subumbilical incision access, and the pressure was maintained at 12–14 mmHg. Then, a 10 mm trocar for telescope was inserted through the subumbilical incision. The main manipulation 12 mm trocar was placed in the left subcostal midclavicular line and the auxiliary 12 mm trocar was inserted just 2 cm below the xiphoid. Another one or two 5 mm trocar was located in the right midabdomen for the assistant.

For patients with cholecyslithiasis, laparoscopic cholecystectomy preceded laparoscopic hepatectomy. In patients for left lateral sectionectomy (LLS), the round ligament, falciform ligament, left triangular ligament, left coronary ligament, and gastrohepatic ligament were sequentially divided. Then, liver parenchyma was directly transected using ultrasonic shears (Harmonic Scalpel, Ethicon, Cincinnati, OH, USA) though the line about 1 cm left of the falciform ligament with low central venous pressure (<5 mmHg). The left intrahepatic bile duct was interrupted, and the visible stones were removed (Fig. 1A). The vessels larger than 2 mm in diameter were ligated with absorbable clips or titanium. In proximity to the second hepatic hilum, the left hepatic vein and the surrounding parenchymal tissues were transected using an Endo-GIA device (Fig. 1B). To compensate for the loss of tactile sensation, laparoscopic intraoperative ultrasonography was repeatedly used to locate stones.

While patients undergoing laparoscopic left hemihepatectomy, perihepatic ligaments were also firstly transected to mobilize the left liver. Then, dissection of the porta hepatis was performed. The left hepatic artery and portal vein were isolated and ligated respectively (Fig. 1C and D), and the left hepatic bile duct (LHD) was interrupted and labeled. The hepatic transection line was marked 0.5–1 cm away from the ischemic line, and the hepatic parenchyma and the left hepatic vein were transected using the same protocol of LLS.

After hepatic transection, choledochoscopic exploration was performed through the labeled LHD orifices (Fig. 1E). Remnant extrahepatic bile duct stones were removed using a retrieval basket as possible. If the remnant stones were too difficult to remove through the LHD orifices, choledochotomy with choledochoscopic exploration was performed, and T-tube drainage was routinely performed. Then, LHD orifice was closed with a continuous suture (3-0 or 4-0 Stratafix Spiral PDO; Ethicon Endo-Surgery, Inc; Fig. 1F). The transected surface was rinsed and confirmed to be free of bile leakage or bleeding. The specimen was placed in a plastic bag and removed through a small incision of 4–6 cm. Routine silastic drain for intraabdominal drainage was inserted.

#### 2.3.2. Open left-sided hepatectomy

An inverted L-shaped or vertical rectus muscle-splitting incision was performed, according to the condition of hepatolithiasis. The operative procedures of hepatectomy and choledochoscopic exploration were similar to those of laparoscopic group, while the liver ductal system usually ligated by silk suture in place of clips.

### 2.4. Postoperative care and follow-up

All patients received routine care and postoperative monitoring, which included liver function tests and blood routine examinations. The peritoneal drain was removed in the absence of bile leakage or peritonitis. In the patients with T-tube, T-tube cholangiography was performed on the 5–7th postoperative day and removed about one month after surgery. All patients received every 3–6 months follow-up at outpatient clinics. Routine physical examinations, liver laboratory tests, abdominal ultrasound, and/or magnetic resonance cholangiopancreatography (MRCP) were performed for the patients during the follow-up.

### 2.5. Statistical analysis

All data were analyzed by the SPSS 17.0 software program (IMB Inc., Chicago, IL, USA). Student's t-test was used to compare continuous variables among groups, which were expressed as mean ± standard deviation (SD). $\chi^2$ test or Fisher's exact test was used to compare categorical variables. $p$-Value less than 0.05 was considered as statistically significant.

## 3. Results

### 3.1. Patients' characteristics

75 patients were enrolled into this study, consisting of 26 men and 49 women with mean age of 51.5 years. Among these patients, 36 underwent LLH (LLH group) and 39 OLH (OLH group). The patients' characteristics were listed in Table 1. The two groups had comparable demographic characteristics, including gender, age, Child-Pugh classification, parenchymal atrophy, operative procedure and previous cholecystectomy and extrahepatic bile duct stones.