Laparoscopic approach of surgical treatment for primary hepatolithiasis: a cohort study


Abstract

BACKGROUND: The aim of the current study was to evaluate the perioperative and long-term outcome of a laparoscopic approach for management of primary hepatolithiasis.

METHODS: From January 1995 to June 2008, 55 consecutive patients with primary hepatolithiasis who underwent laparoscopic partial hepatectomy and laparoscopic bile duct exploration were analyzed. Immediate outcomes included stone clearance rate, operative morbidity, and mortality. Long-term outcomes included stone recurrence rate and hepatolithiasis-related mortality.

RESULTS: Nineteen patients underwent laparoscopic left lateral sectionectomy and 36 patients underwent laparoscopic bile duct exploration. Twenty-five patients also underwent concomitant laparoscopic choledochoduodenostomy bypass. The operative morbidity and mortality rates were 25.5% and 1.8%, respectively. Four procedures needed open conversion. The immediate stone clearance rate was 90.9%, and the final stone clearance rate was 94.5% after subsequent choledochoscopic treatment. With a mean follow-up of 59 ± 30 months, recurrent stones developed in 3 patients. One patient died of advanced cholangiocarcinoma.

CONCLUSIONS: In selected patients with primary hepatolithiasis, a laparoscopic approach of definitive treatment is safe and effective with good immediate and long-term outcomes.

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KEYWORDS: Hepatolithiasis; Recurrent pyogenic cholangitis; Hepatectomy; Exploration of bile duct; Laparoscopy

Primary hepatolithiasis is formed de novo in the intrahepatic ducts (IHD) and is a distinct disease entity characterized by repeated primary bacterial infection of the biliary system with subsequent formation of multiple stones and strictures in any part of the biliary tract. The disease was first described in Hong Kong in 1930 by Digby and it came to be known as recurrent pyogenic cholangitis (RPC). It is a prevalent disease in Southeast Asia but rare in Western countries. The definitive management of primary hepatolithiasis is to use a multidisciplinary approach, aiming to remove all biliary stones, to establish adequate drainage to the biliary system, and to resect nonfunctioning liver segments that harbor bacteria and serve as foci of infection. Theoretically, partial hepatectomy is the most definitive approach for hepatolithiasis as it can remove IHD stones and strictured bile duct simultaneously, thus reducing the risk of recurrent stones and development of cholangiocarcinoma. However, partial hepatectomy in patients with hepatolithiasis is particularly difficult because of the presence of dense perihepatic inflammatory adhesions resulting from previous infections, multiple previous abdominal operations, and cholangitic liver abscesses rupturing into the perihepatic space.

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The development of minimally invasive surgery over the last 2 decades has had a great impact on surgical practice worldwide. With the wide application of laparoscopic surgery in biliary diseases, laparoscopic common bile duct (CBD) exploration has been one of the main treatment methods for CBD stones. The technique for stone removal in the CBD could be applied to IHD stones. However, reports of laparoscopic surgery for IHD stones have been rare. Laparoscopic liver resection also becomes possible with the availability of new instruments that allow a relatively bloodless liver transection. Currently, the laparoscopy approach is employed mainly for minor hepatic resections, wedge resections, segmentectomy, and bisegmentectomy. The potential advantages of a laparoscopic approach are those of minimally invasive surgery, such as early recovery, shorter hospital stay, and better cosmetic outcome.

The aim of the present study was to study the feasibility, safety, and long-term results of a laparoscopic approach for definitive treatment of primary hepatolithiasis.

Methods

The study population was a consecutive series of patients with primary hepatolithiasis who underwent a laparoscopic surgical approach for definitive treatment in a tertiary referral center from January 1995 to June 2008. Informed consent for all surgical procedures was obtained from each patient. All operations were performed by consultant surgeons. Data were collected prospectively and analyzed retrospectively.

Acute and definitive management

The basic principle of management of primary hepatolithiasis is to control infection during an acute attack of cholangitis, and to eradicate all stones, strictures, and destroyed liver segments by elective definitive surgery when the disease is quiescent.

The initial conservative measures for acute cholangitis consist of broad-spectrum antibiotics, commencement of intravenous fluids infusion, adequate analgesics, and careful monitoring of abdominal and vital signs. Emergency therapeutic intervention for decompression of the biliary tract is necessary in some patients when the acute attack fails to resolve, as evidenced by septicemia shock, persistent fever, and worsening of peritoneal signs.

The definitive procedure is planned according to the results of all imaging studies. Preoperative evaluation of the hepatobiliary system includes use of ultrasonography (USG), computed tomography (CT) scan, hepatobiliary iminodiacetic acid (HIDA) scintigraphy, magnetic resonance cholangiopancreatography (MRCP), endoscopic retrograde cholangiopancreatography (ERCP), or percutaneous transhepatic cholangiography (PTC). These investigations provide information about the location of stones, and any biliary stricture or liver atrophy, which in turn provide guidance on the type of operation. Our indications for partial heptectomy include biliary stricture, atrophy of the affected liver segments or hemi-liver, presence of liver abscess, suspected cholangiocarcinoma, and stones filled in the peripheral bile duct branches inaccessible to exploration from an extrhepatic bile duct incision.

The surgical procedures include CBD/common hepatic duct (CHD)/enterobiliary anastomosis exploration with extraction of stones, or partial heptectomy. All cases of partial heptectomy include a bile duct exploration via choledochoscopy through the main intrahepatic duct over the resection plane to check for any residual stones or strictures. Cholecystectomy is routinely performed. Laparoscopic choledochochudodenostomy biliary bypass operation is also performed in selected patients to eliminate bile stasis and prevent stone recurrence.

Selection criteria for the laparoscopic approach

Only patients with IHD stones, associated with ductal strictures or atrophic parenchyma located over the left lateral section (segments II and III) of liver, are considered for laparoscopic partial heptectomy. For those patients without ductal strictures, if the IHD stones are located over the proximal portion of the IHD, they will be considered for laparoscopic bile duct exploration.

Surgical procedure—laparoscopic bile duct exploration

The site of ports and setup are similar to those in the usual laparoscopic cholecystectomy, but an additional 5-mm port is inserted into the left iliac fossa; this is used for the insertion of a needle holder during intracorporeal suturing for choledochoduodenostomy Anastomosis. This port is also very useful for continuous irrigation and can be used for the passage of a retractor to press down the duodenum during exploration of the bile duct. An intraoperative cholangiogram is not mandatory unless a preoperative cholangiogram is suboptimal. The length and site of the choledochotomy used is governed by the stone size and location of the stone, which is at least 15 mm. During the operation, intraoperative flexible choledochoscopy is performed through a choledochotomy to find and remove the stones, and to detect any biliary stricture. Once the bile duct is opened, stones are removed by forceps, basket, or saline flushing under choledochoscopic guidance. Large impacted stones are removed after electrohydraulic lithotripsy. A side-to-side choledochoduodenostomy bypass is performed at the end of procedure in selected patients.

In selected patients with muddy stones or suspected residual stones, a T-tube is inserted for postoperative cholangiography. Postoperative cholangiography is performed via the T-tube about 1 week after the operation to detect residual stones. In the case of residual stones found in T-tube cholangiogram, the T-tube tract is left to mature for 10 to 12 weeks to allow a choledochoscopy through the tract for stone extraction.
Surgical procedure—laparoscopic partial hepatectomy

The patient is placed in the Lloyd–Davis position. The chief surgeon operates between the patient’s legs with assistants on each side. Preoperative laparoscopy with intraoperative USG is performed first before liver resection. After preoperative assessment of the extent of IHD stones and liver functional reserve, the plane of transection is determined. The planned transection plane is marked on the liver surface by diathermy. Total laparoscopic liver resection or hand-assisted laparoscopic liver resection is adopted according to the surgeon’s preference. Four to 6 working ports are used. The position of the laparoscopic system (GelPort; Applied Medical Resources Corp., Rancho Santa Margarita, CA) is governed by the position of the patient and the type of liver resection. A 7-cm transverse incision (based on the palm size of the operating surgeon) is made at the right side of the abdomen, slightly above the level of the umbilicus. For patients with good liver functional reserve, the Pringle maneuver is used to apply intermittent vascular control to reduce blood loss. After mobilization of liver, and provided the central venous pressure (CVP) is optimal (<5 cm H₂O), parenchymal resection is performed with an ultrasonically activated cutting and coagulating instrument (UltraCision Harmonic Scalpel; Ethicon, Cincinnati, OH) and an ultrasonic surgical aspirator (Sonopet UST2000; M&M Co, Ltd., Tokyo, Japan). Application of either a titanium clip or an endostapler (2.5/60, Autosuture; United States Surgical Corp., Norwalk, CT) is used for the main vascular branches and bile ducts. After the completion of the parenchymal transection, the raw surface is inspected for any bile leak or oozing, and such areas are plicated with 2/0 polypropylene. An argon beam is also used to achieve hemostasis from any raw and oozing surface. Bile duct exploration via cholecdochoscopy through the main IHD over the resection plane is performed to check for any residual stones or strictures. Tissue glue (Tisseel Kit; Immuno AG, Vienna, Austria) is also sprayed over the raw resection surface to improve hemostasis and prevent bile leak at the end. All specimens are delivered inside a protective bag.

Postoperative management

All patients receive the same postoperative care by the same team of surgeons. Patients who undergo partial hepatectomy are monitored in the intensive care unit during the early postoperative period. Subsequent need for stay in the intensive care unit is determined by the patient’s condition.

Follow-up

All patients have postoperative follow-up by the same team of surgeons. USG or CT scan follow-up is conducted annually, or whenever the patients present with symptoms suggestive of cholangitis. MRCP, ERCP, or PTC is performed if USG or CT scan has features of stone recurrence or ductal strictures.

Statistical analysis

Demographic, operative data and follow-up progress of these patients were collected prospectively. Data were analyzed retrospectively. The perioperative/short-term outcomes included stone clearance rate, operative morbidity, and mortality. The long-term outcomes included stones recurrence rate, and hepatolithiasis-related mortality. Residual stone was defined as those biliary stone persisted within 6 months after definitive surgery. Continuous data were expressed as mean ± SD.

Results

Between January 1995 and June 2008, 58 consecutive patients with primary hepatolithiasis underwent laparoscopic surgical treatment in our hospital. Three patients (5.2%) with pathologic diagnosis of cholangiocarcinoma were excluded from analysis. There were 37 women (67.2%) and 18 men (32.7%). The mean age was 67 years (range 39–92 years). Nineteen patients underwent laparoscopic left lateral sectionectomy and 36 patients underwent laparoscopic bile duct exploration. Twenty-five patients also underwent concomitant laparoscopic choledochoduodenostomy bypass. The characteristics of patients are listed in Table 1. The operative procedures are given in Table 2.

Perioperative and short-term outcomes

The operative morbidity and hospital mortality rates were 25.5% and 1.8%, respectively. The perioperative outcome of each group is shown in Table 2. Two patients...
needed re-laparotomy due to sepsis with bile leakage and intra-abdominal collection. One of these patients died of multi-organ failure.

There were 4 open conversions (7.3%). The first was performed because of injury to the left hepatic vein that ended up with significant bleeding. The second conversion was because of difficult dissection due to perihepatic and periporal dense inflammatory adhesions. The third conversion was carried out because of a mishap—the tip of the ultrasonic dissector was broken, and the broken tip could not be found on careful searching; therefore, the operation was converted. The last conversion was due to significant bleeding during choledochotomy, which could not be satisfactorily controlled laparoscopically.

The immediate stone clearance rate was 90.9%. The final stone clearance rate was 94.5% (Table 3).

### Long-term outcomes

With a follow-up of 59 ± 30 months, recurrent stones developed in 3 of the remaining 52 patients with no residual stones (5.8%). During follow-up, 1 patient died of hepatolithiasis-related complications. This patient developed advanced cholangiocarcinoma with metastases at 59 months after surgery.

### Comments

The treatment strategy for primary hepatolithiasis may vary according to the preference and expertise available at different institutions. However, the primary goals of definitive surgery remain to eliminate attacks of cholangitis and to stop the progression of the disease. In some patients, cure is possible. The aim of definitive treatment is to use a multidisciplinary approach, aiming to remove all biliary stones, to establish adequate drainage to the biliary system, and to resect nonfunctioning liver segments that harbor bacteria and serve as foci of infection. This encompasses stone extraction, strictureplasty or excision of strictures, resecting nonfunctioning liver segments, and even creating

### Table 2 Operative details and outcome

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Hepatic resection group (n = 19)</th>
<th>Bile duct exploration group (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total laparoscopic left lateral sectionectomy</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Hand-assisted laparoscopic left lateral sectionectomy</td>
<td>18</td>
<td>—</td>
</tr>
<tr>
<td>Laparoscopic bile duct exploration</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>Laparoscopic choledochoduodenostomy bypass</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>Operating time (min)</td>
<td>174.9 ± 61.4</td>
<td>145.5 ± 50.0</td>
</tr>
<tr>
<td>Blood loss (mL)</td>
<td>210.5 ± 178.4</td>
<td>66.0 ± 55.9</td>
</tr>
<tr>
<td>Pringle maneuver (n)</td>
<td>11 (57.9%)</td>
<td>—</td>
</tr>
<tr>
<td>Vascular control time (min)</td>
<td>22.9 ± 7.2</td>
<td>—</td>
</tr>
<tr>
<td>Open conversion</td>
<td>2 (10.5%)</td>
<td>2 (5.6%)</td>
</tr>
<tr>
<td>Postoperative hospital stay (d)</td>
<td>10.0 ± 8.0</td>
<td>9.7 ± 7.8</td>
</tr>
<tr>
<td>Perioperative mortality (n)</td>
<td>0 (0%)</td>
<td>1 (2.8%)</td>
</tr>
<tr>
<td>Overall complications (n)</td>
<td>4 (21.1%)</td>
<td>10 (27.8%)</td>
</tr>
<tr>
<td>Type of complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liver failure</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Biliary leakage</td>
<td>2 (10.5%)</td>
<td>6 (16.7%)</td>
</tr>
<tr>
<td>Acute cholangitis</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Acute pancreatitis</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Intra-abdominal collection</td>
<td>0 (0%)</td>
<td>2 (5.6%)</td>
</tr>
<tr>
<td>Intra-abdominal bleeding</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Wound dehiscence</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Re-laparotomy</td>
<td>0 (0%)</td>
<td>2 (5.6%)</td>
</tr>
</tbody>
</table>

### Table 3 Outcomes of surgery

<table>
<thead>
<tr>
<th>Postoperative outcome</th>
<th>Hepatic resection group (n = 19)</th>
<th>Bile duct exploration group (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative residual stones</td>
<td>0 (0%)</td>
<td>5 (13.9%)</td>
</tr>
<tr>
<td>Final stone clearance after subsequent choledochoscopic treatment</td>
<td>19 (100%)</td>
<td>33 (91.7%)</td>
</tr>
<tr>
<td>Long-term outcome during follow-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone recurrence</td>
<td>54 ± 33</td>
<td>61 ± 30</td>
</tr>
<tr>
<td>Development of cholangiocarcinoma</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hepatolithiasis-related death</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
a biliaryerc bypass with a permanent percutaneous access loop to biliary tract to allow subsequent access to the biliary system for stone extraction and dilatation of strictures. The type of definitive procedures for patients who settled on conservative measures depends on the frequency and severity of each attack, presence of biliary strictures, and the presence of any existing comorbid medical conditions. Nonoperative treatments offer attractive alternatives, particularly for patients with simple and mild forms of hepatolithiasis, elderly patients with prohibitive operative risk, and patients with multiple previous operations. Percutaneous cholecodochoscopy has become a well-established procedure for the removal of stones and dilatation of strictures.19–22 When compared to percutaneous cholecodochoscopy, laparoscopic bile duct exploration dispenses with the stress and pain caused by the creation of a fistula tract, the stone removal procedure, and the prolonged treatment period, and also the potential requirement of repeated attempts. However, the study of laparoscopic bile duct exploration for IHD stones is rare.17,18 The technical skill requirement is also very high. Primary hepatolithiasis can result in complex IHD strictures with multiple stones that can pose difficulties for its surgical management. Intrahepatic strictures have been reported to be associated with poor outcomes. The rate of restenosis is high despite successful dilation of the stricture.23 There is also the possibility of harboring malignancy. Of course, without these complications, straightforward endoscopic or surgical exploration with or without biliary bypass is an acceptable treatment option. With advances in hepatic surgery, partial hepatectomy has emerged as an option for removing IHD stones together with biliary strictures in patients with hepatolithiasis. Partial hepatectomy is only performed for those with recurrent, troublesome, and localized severe disease.3,6 There is a predilection of hepatolithiasis in the left liver, but the reason for this remains unclear. It is generally agreed that partial hepatectomy should be offered to patients with associated atrophy of the involved segments, mostly those in whom the left lobe is involved, because of the reduced operative risk. This has been shown to have good results in previous reports for traditional open partial hepatectomy.7–11 As with most laparoscopic operations, laparoscopic liver resection follows the same surgical principle as its open counterpart but with reduced access trauma. We have previously reported a nonrandomized comparative study (hand-assisted laparoscopic left lateral sectionectomy, n = 10, vs open left lateral sectionectomy, n = 7) in patients with RPC.14 Perioperative outcome was assessed. It showed that the laparoscopic approach had the benefit of less postoperative pain and shorter hospital stay (median 8 days vs 14 days) but with a longer operating time (median 232.5 minutes vs 150 minutes). There was no significant difference in postoperative morbidity and mortality. In the other nonrandomized comparative study of Cai et al (laparoscopic hepatectomy group, n = 29, vs open hepatectomy, n = 22), laparoscopic hepatec-

tomy group also had a shorter postoperative hospital stay (mean 8.8 days vs 9.2 days) and fasting time (mean 1.1 days vs 2 days).15 A lower postoperative serum aminotransferase level, and a higher postoperative serum albumin level were found also. Stone clearance rate (immediate rate 89.7% vs 86.4%; final rate 100% vs 96.5%), stone recurrence rate (0% vs 4.5%), operating time (mean 236 minutes vs 220 minutes), and intraoperative blood loss (mean 603 mL vs 655 mL) were similar in the 2 groups. There was no significant difference between the complications rate (6.8% vs 18.2%) and the perioperative mortality rate (0% vs 0%). Currently, we reported a good short-term and long-term outcome of a cohort series of patients who underwent a laparoscopic approach for definitive treatment of primary hepatolithiasis. Comparing the results of the laparoscopic bile duct exploration group and laparoscopic liver resection groups in our series was not appropriate, as they represented different groups of patients.

This study also highlights the problem of the concomitant occurrence of hepatolithiasis with cholangiocarcinoma. It has been reported that 4.5% to 12% of patients with IHD stones have concomitant cholangiocarcinoma.5,8–11,24-26 In our series, 5.2% of patients had concomitant cholangiocarcinoma diagnosed after laparoscopy. Although it is not necessary to perform partial hepatectomy for all hepatolithiasis to prevent the development of concomitant cholangiocarcinoma, hepatectomy may reduce the risk of cholangiocarcinoma.

In selected patients with primary hepatolithiasis, the laparoscopic approach offers an alternative option of safe and effective definitive treatment.

References