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Original Article

Hepatectomy for hepatolithiasis among patients with a history of biliary surgery

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Abstract: Background: Hepatolithiasis is characterized by its intractable nature and frequent recurrence, requiring multiple operative interventions. It is very important to diagnose the complex pathology of hepatolithiasis and choose proper surgical procedures. In this study, outcomes of hepatectomy for hepatolithiasis were evaluated in patients who had previously undergone biliary surgery. Methods: This retrospective study includes 81 consecutive patients who underwent partial hepatectomy between 2008 and 2015 with hepatolithiasis. All patients had undergone biliary surgery one or more times previously. Clinical characteristics, perioperative complications, and long-term outcomes of patients were studied. Results: Among total 81 patients, 56 patients (69.1%) had undergone one previous biliary operation, 21 patients (25.9%) had undergone two, 3 patients (3.7%) had undergone four, and one patient (1.2%) had undergone five. The residual stone rate after hepatectomy was 8.6% (7/81). There was no perioperative mortality. The postoperative complication rate was 12.3% (10/81). Histopathology showed concomitant cholangiocarcinoma in 8 patients (9.9%). The median follow-up period was 45.1 months (range 6-71 months). Recurrent stones developed in 5 of 78 (6.4%) patients who had no residual stones. Six patients died due to recurrence and metastasis of concomitant cholangiocarcinoma during follow-up. Conclusion: Hepatic resection is a safe and effective procedure in the management of hepatolithiasis for patients with a history of biliary surgery. Proper preoperative evaluation is critical to the success of surgery.

Keywords: Hepatectomy, hepatolithiasis, biliary surgery

Introduction

Hepatolithiasis is a common disease in southeast Asia, but it is rare in Western countries [1]. It may occur alone or with extrahepatic stones. The etiology of hepatolithiasis is not fully uncovered and may be governed by multiple factors, such as ethnics, environments, bacterial and parasitic infections, cholangitis, and bile stasis. The clinical presentation of hepatolithiasis is characterized by recurrent attacks of cholangitis, which leads to more stones and bile duct strictures. Although hepatolithiasis is a benign disease, improper treatment can result in liver cirrhosis and even cholangiocarcinoma [2, 3].

The management of hepatolithiasis is complex, requiring a multidisciplinary approach, such as surgery, percutaneous cholangioscopic lithotripsy, or endoscopic therapy. The goal is complete removal of stones and elimination of bile stasis.

Among various treatment modalities, surgery is considered a first approach. However, postoperative residual and recurrent stones occurred in 20% of patients treated by hepatectomy, or other surgical methods [4, 5]. Multiple operative interventions are required due to frequent recurrence. The operation is particularly difficult and challenging in patients with a history of biliary surgery due to adhesions. It is therefore very important to diagnose the complex pathology of hepatolithiasis and choose proper surgical procedures before every operation. In this study, the outcomes of hepatectomy for hepatolithiasis were evaluated in 81 patients with a history of biliary surgery.

Material and methods

Study population

Here, 81 patients with hepatolithiasis who had undergone partial hepatic resection in the

Table 1. Number and types of previous operations

Times of operations	Types of operations	Number of patients
1	Cholecystectomy	21
	Cholecystectomy+ECBD	30
	Cholecystectomy+BEA	5
2	Cholecystectomy; ECBD	10
	Cholecystectomy; BEA	5
	Cholecystectomy+ECBD; ECBD	4
	Cholecystectomy+ECBD; BEA	2
4	Cholecystectomy; ECBD; ECBD; BEA	1
	Cholecystectomy; ECBD; BEA; BEA	1
	Cholecystectomy+ECBD; ECBD; ECBD; BEA	1
5	Cholecystectomy; ECBD; ECBD; BEA; BEA	1

ECBD-Exploration of common bile duct; BEA-bilioenteric anastomosis.

Table 2. Clinical characteristic of patients

Variables	n (%)
Gender	
Male	29 (35.8%)
Female	52 (64.2%)
Age, y [median (range)]	54 (21-82)
Presentation	
Acute cholangitis	64 (79.0%)
Liver abscess	6 (7.4%)
Acute pancreatitis	3 (3.7%)
Cholangiocarcinoma	8 (9.9%)
Child-Pugh classification	
A	65 (80.2%)
B	16 (19.8%)

same department between January 2008 and January 2015 were analyzed. All participating patients had undergone one or more biliary surgeries in the past.

Among 81 patients, 56 (69.1%) had undergone one previous biliary operation, 21 patients (25.9%) had undergone two, 3 patients (3.7%) had undergone four, and one patient (1.2%) had undergone five. The types of procedures performed are listed in **Table 1**. Here, 29 patients were male and 52 patients were female. The patients ranged in age from 21 to 82 years. The distribution of calculi, the anatomy of biliary tract and liver atrophy were carefully assessed using multiple diagnostic techniques: ultrasonography (US), computed tomography (CT), endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangioscopy (PTC), and magnetic resonance cholangiopancreatography (MRCP) Preoperative liver function was assessed according to Child-Pugh classification. Clinical characteristics are shown in **Table 2**. The intraoperative and postoperative variables included operation time, blood loss, residual stone rate, hospital stay, and perioperative complications. Long-term outcomes were retrieved from follow-up visit information, which included the stone recurrence rate and survival.

Surgical procedure

Hepatectomy was indicated when the patient had either localized intrahepatic calculi or an atrophic liver segment or lobe. The type of resection performed depended on the distribution of pathological location of hepatolithiasis. Hepatectomy was performed using the clamp crushing method. The Pringle maneuver was used to control blood loss during liver parenchyma transaction when necessary. Common bile duct exploration was performed if extrahepatic stones were found or suspected. A T-tube was placed in the common bile duct for postoperative cholangiography and choledochoscopy. Choledochoscopy was carried out through bile duct opening to determine whether the duct stricture had been resected and whether all the stones in the rest of the biliary system had been cleared. In the presence of residual stones, choledochoscopy was performed through the T-tube tract for stone extraction 10 weeks after the operation. A hepaticojejunostomy was performed for biliary drainage in patients with stricture of the common bile duct. The hepaticojejunostomy was performed through end-to-side, mucosa-to-mucosa anastomosis of the hepatic duct with a Roux-en-Y jejunal loop 50 cm in length. Drains were placed routinely in the subphrenic space or the Winslow's foramen for draining peritoneal fluid in all patients.

Results

The clinical presentation of patients was cholangitis (64/81), liver abscess (6/81), acute pancreatitis (3/81), and suspected cholangio-

Table 3. Stone locations and operative procedures

Stone location	Operative procedures	Number of patients
Left lobe (n=54)	Left lateral sectionectomy	3
	Left lateral sectionectomy with ECBD	33
	Left lateral sectionectomy with hepaticojejunostomy	2
	Left medial sectionectomy with ECBD	1
	Left hepatectomy	2
	Left hepatectomy with ECBD	12
	Left hepatectomy with hepaticojejunostomy	1
Right lobe (n=2)	Right hepatectomy with ECBD	1
	Right segmentectomy (V) with ECBD	1
Bilateral lobes (n=25)	Left lateral sectionectomy with ECBD	9
	Left lateral sectionectomy with hepaticojejunostomy	9
	Left hepatectomy with ECBD	4
	Left hepatectomy with hepaticojejunostomy	2
	Left lateral and right posterior sectionectomy with ECBD	1

ECBD-Exploration of common bile duct.

Table 4. Postoperative complications

Complications	Number of patients
Bile leakage	3
Anastomotic leakage	2
Wound infection	2
Pleural effusion	1
Colon perforation and leakage	1

carcinoma (8/81). Ultrasonography was performed in 49 patients (60.5%); CT was performed in 24 patients (29.6%); MRCP was performed in 53 patients (65.4%); one patient (1.2%) underwent PTC; and one patient (1.2%) underwent ERCP. Of the 81 patients, 33 patients (40.7%) had intrahepatic biliary stones; and 48 patients (59.3%) had intrahepatic and extrahepatic bile duct stones at the same time. Here, 54 patients (66.7%) had left-sided hepatolithiasis, 2 patients (2.5%) had right-sided hepatolithiasis, and 25 patients (30.8%) had hepatolithiasis in both left and right lobes of the liver.

The surgical procedures are shown in **Table 3**. There were no surgical deaths among 81 patients. The mean duration of the operation was 251 ± 94 min. The mean volume of blood lost during surgery was 356.5 ± 98 mL. Here, 21 patients required blood transfusion during operation; the mean volume of blood transfused was 420.6 ± 104 mL. The mean postoperative hospital stay was 18 ± 9.1 days.

After surgery, 7 patients still had residual stones; the residual stone rate was 8.6% (7/81). The residual stones of 4 patients were removed by cholangioscopy through the T-tube tract. The other 3 patients presented with minor symptoms and received no specific treatment.

There was no perioperative mortality. The postoperative complication rate was 12.3% (10/81). Complications are listed in **Table 4**. The common complications were bile leakage, anastomotic leakage, and wound infection. One patient experienced a postoperative colon perforation and leakage due to operative injury. The case was successfully managed conservatively with drainage and antibiotics.

Pathological examination showed the resected liver showed atrophy in 27 patients (33.3%), fibrosis in 38 patients (46.9%), and cirrhosis in 21 patients (25.9%). Concomitant cholangiocarcinoma was observed in 8 patients (9.9%). Mean tumor size was 5.1 cm ± 2.2 cm and regional lymph node metastasis was observed in 2 of 8 patients. Surgical margins at the liver cut surfaces were negative in all eight patients with cholangiocarcinoma.

During the follow-up period (6-71 months), 5 patients got biliary stones again. The rate of recurrent stones was 6.4% (5/78). Three of the five patients presented with recurrent attacks of cholangitis and underwent the operation again. The other 2 patients presented with mild

symptoms and treated conservatively. Of 8 patients with cholangiocarcinoma, 6 patients died during follow-up, 2 patients were alive at 12 months and 17 months after operation.

Discussion

Hepatolithiasis is characterized by its intractable nature and frequent recurrence. It often requires multiple surgical interventions. Moreover, inappropriate management of hepatolithiasis can predispose patients to recurrent cholangitis, liver cirrhosis, and even cholangiocarcinoma, which also require additional surgical procedures. This makes it more difficult to treat patients with a history of biliary surgery due to the complexity of lesions and dense adhesions.

The principles of surgical management in hepatolithiasis are to remove calculi, to eliminate any strictures on the bile ducts, and to establish sufficient drainage of the biliary tract [6, 7]. Hepatectomy can remove stones, eliminate strictures and the consequent bile stasis that is responsible for stone formation, and eradicate the risk of cholangiocarcinoma. This has made it the preferred choice for select patients who have localized intrahepatic stones with irreversible biliary strictures, atrophied liver segments, multiple cholangitis abscesses, or cholangiocarcinoma [8-10]. Many favorable results have been reported in the literature with regard to hepatectomy in the management of hepatolithiasis. Chen et al. reported 103 patients who underwent hepatectomy due to hepatolithiasis and revealed an immediate stone clearance rate of 90%, which increased to 98% when combined with postoperative choledochoscopic lithotripsy [11]. Eight patients developed recurrent stones during the follow-up period. Jarufe et al. retrospectively reviewed 52 patients treated with hepatic resection for hepatolithiasis [12]. In their study, 75% of participating patients had previous biliary operations, the rate of postoperative clearance of the biliary tree was 90.4%, and postoperative morbidity was 30.8%. In the present study, hepatectomy was used to manage hepatolithiasis in 81 patients with a history of biliary surgery. These data showed that the stone clearance rate after liver resection to be about 91.4%. There were no perioperative deaths. The postoperative complication rate was 12.3%. The stone recurrence rate was about 6.3% during the follow-up period. This showed hepatic resection to be an effective procedure in the management of hepatolithiasis for patients with a history of biliary surgery.

Accurate preoperative evaluation of distribution of stones and bile duct strictures is very important for patients with a history of biliary surgery. There are a variety of imaging modalities that afford preoperative assessment of intrahepatic stones. Abdominal ultrasound is the most economical, accessible, and useful method of detecting intrahepatic stones and bile duct dilatation. US is an operator-dependent method and cannot distinguish pneumobilia from intrahepatic stones. Computed tomography can detect duct dilatation and stones and provide additional information about liver topography (liver abscess, atrophy of the affected lobe, etc.). Examination of the entire biliary tree is necessary for clearly recognizing the precise pattern of the intrahepatic calculi and the biliary strictures. Percutaneous transhepatic cholangiography (PTC) and endoscopic retrograde cholangiopancreatography (ERCP) can offer more direct details about the biliary tract. Both ERCP and PTC are invasive modalities, which limits their use. Magnetic resonance cholangiopancreatography (MRCP) is currently the non-invasive investigation of choice for study of the biliary tree, and has substituted ERCP and PTC. MRCP has 97% sensitivity, 99% specificity, and 98% accuracy in detecting and locating intrahepatic stones [13]. In the current study, ultrasonography and MRCP were routinely performed for basic evaluation and to define the character and anatomy of the intrahepatic calculi. Computed tomography is a useful supplementary tool; it is used to establish why any of part of the duct or parenchymal anatomy could not be visualized. Experience indicates that MRCP is superior to other methods in determining the suitability of surgery for hepatolithiasis.

Liver function is another important parameter that has to be considered in patients with hepatolithiasis, particularly among patients with a history of biliary surgery. Proper preoperative assessment of liver function reserve is critical to the success of hepatectomy. Among tools suitable for assessing liver function, the Child-Pugh classification is a simple and useful, providing an initial clue to the extent of hepatic resection [14]. These results indicate that hep-

atectomy can be performed safely in patients with Child A or Child B patients with hepatolithiasis. It is here asserted that hepatectomy should be generally considered for Child A class patients with hepatolithiasis; only limited liver resection should be considered for Child B class patients; Child C class is here considered an absolute contraindication for hepatectomy.

The association between hepatolithiasis and cholangiocarcinoma is well established. Although the mechanism is not fully understood, there many factors are associated with carcinogenesis, such as cholangitis, and mechanical irritation of stones. Studies have shown that cholangiocarcinoma develops in 5% to 16% of patients with hepatolithiasis [15, 16]. In the current study, 8 (9.9%) patients had concomitant cholangiocarcinoma; no cholangiocarcinoma was noted postoperatively in patients who underwent hepatectomy within the follow-up period. It is very difficult to diagnose cholangiocarcinoma in patients with hepatolithiasis. Among the 8 patients with cholangiocarcinoma, only 4 were diagnosed preoperatively, 2 patients were diagnosed during surgery, and 2 patients were diagnosed by pathologic examination postoperatively. Moreover, 6 patients died within the follow-up period. Patients with cholangiocarcinoma had poor prognoses after hepatectomy [17]. Hepatic resection can remove the stones and the affected bile ducts and prevent the development of cholangiocarcinoma in patients with hepatolithiasis [18]. For these reasons, hepatic resection should be performed early for suitable patients with hepatolithiasis.

Unilateral localized hepatolithiasis can be managed by hepatic resection. The beset strategy for patients with bilateral localization is still unclear [19]. Recent study showed that hepatic resection combined with postoperative choledochoscopic lithotripsy might be an efficacious approach for patients with bilateral hepatolithiasis [20]. It has been reported that hepatectomy and hepaticojejunostomy is also effective [21]. With improvements in liver surgery, simultaneous resection of the few involved segments is another option when stones are distributed in limited segments of both lobes of the liver [22]. In the present study, only one patient underwent resection of the left and right segments simultaneously, and this patient had an uneventful recovery. Hepatectomy with operative and postoperative cholangioscopy was applied in 15 patients. The other 10 patients received partial hepatectomy with hepaticojejunostomy because the bile duct below hepatic portal was constricted. In this way, the treatment of complex bilateral hepatolithiasis is still full of challenges.

Limitations

The principal limitation of this study is the retrospective assessment of the patients who were treated at a single institution. Due to the complicated nature of the disease and differences between individual patients' conditions, the inherent differences within the patient group, although not statistically important, still weaken this work.

Conclusions

Hepatectomy is safe and effective in the management of hepatolithiasis in patients with previous histories of biliary surgery. Accurate preoperative evaluation of the distribution of stones, bile duct strictures, and liver function is extremely important for the success of surgery. For bilateral hepatolithiasis, the hepaticojejunostomy and postoperative cholangioscopy should also be considered. The presence of concomitant cholangiocarcinoma is associated with poor survival after hepatic resection.

Disclosure of conflict of interest

None.

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