

Simple resection of the lesion bile duct branch for treatment of regional hepatic bile duct stones

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Abstract

To evaluate the effectiveness and safety of simple resections of bile duct branch lesions for the treatment of regional hepatic bile duct stones.

A retrospective analysis of the clinical data from patients in our hospital from November 2008 to November 2015, who only underwent a simple resection of the lesion bile duct branch. The patients' clinical characteristics, surgical features, postoperative complications, stone clear rate, residual stone rate, and recurrence stone rate were analyzed.

This study of 32 patients included 13 males and 19 females with intrahepatic bile duct stones confined to the right hepatic bile duct branch. The intraoperative blood loss, operation time, and postoperative hospital stay were 478.0 ± 86.5 , 210.7 ± 6.6 , and 10.8 ± 3.5 , respectively. Postoperative complications occurred in 6 patients (18.8%), all of whom recovered with conservative management. There were no deaths during hospitalization. The intraoperative stone clearance rate was 95.8%. Three patients had a recurrence of stones at a mean of 22 months of follow-up (range, 4–36 months).

Simple resection of bile duct branch lesions is safe and feasible for patients who have regional hepatic bile duct stones limited to the right hepatic bile duct branches.

Abbreviations: 3D = 3-dimensional, 3DVS = 3-dimensional visualization system, CT = computed tomography, ICG-R15 = 15-minute retention rate of indocyanine green, MRCP = magnetic resonance cholangiopancreatography, MRI = magnetic resonance imaging.

Keywords: bile duct, hepatectomy, hepatolithiasis, surgical procedures

1. Introduction

Hepatolithiasis is common in East Asia, including Japan and especially prevalent in China, but it occurs much less frequently in Western countries.^[1] According to our department's statistics, 3568 patients presented with hepatolithiasis from November 2008 to November 2015, accounting for 20.65% of all patients. Because of the unique anatomy of the intrahepatic bile ducts, the treatment of bile duct stones also has obvious individual differences, and selecting the appropriate surgical approach is

very important.^[2] Hepatectomy is the most effective treatment for most patients with intrahepatic bile duct stones.^[3] In general, regional intrahepatic bile duct stones should be strictly resected in accordance with the liver's blood supply and bile duct drainage area.^[4] Therefore, simple resection of bile duct branch lesions for the treatment of regional right hepatic bile duct branch stones appears to be a reasonable and feasible approach. The purpose of this study was to evaluate the effectiveness and safety of this operation for selected patients.

2. Materials and methods

2.1. General information

The group of 32 patients had bile duct stones limited to right hepatic bile duct branches; it included 13 males and 19 females, aged from 35 to 79 years old, with a median age of 57 years. The patients' primary symptoms were upper abdominal pain and fever. Twelve of the 32 patients had undergone previous biliary tract surgery, including 3 who had undergone surgery twice previously. The preoperative evaluation included ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), or magnetic resonance cholangiopancreatography (MRCP). Biochemical markers and indocyanine green (ICG-R15) were used in tests to assess the patients' liver function. The distribution of the intrahepatic stones is shown in Table 1. This study was approved by the Second Affiliated Hospital of Nanchang University Ethics Committee.

2.2. Surgical procedures

By accessing the right margin of the incision, the hepatic ligament was freed, which fully revealed the liver, and a blocking zone was

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Table 1**Distribution of intrahepatic stones.**

Hepatic bile duct branches	No. of patients (n)
B5b	2
B5c	2
B6a	8
B6b	7
B6c	3
B6a + B6b	9

Couinaud 5 bile duct: dorsal branch (B5b), lateral branch (B5c).

Couinaud 6 bile duct: ventral branch (B6a), dorsal branch (B6b), lateral branch (B6c).

placed in the first hepatic portal. The combined use of the preoperative imaging data and intraoperative ultrasound allowed the position of the stones' site in the bile duct and the location of the bile duct root of the lesion to be ascertained. Simultaneously, using repeated intraoperative ultrasound imaging and real-time examinations, the right hepatic duct branch was located. According to the location of the stone, the diseased bile duct and hepatic resection margin were marked 2 cm from the bile duct lesion on the liver's surface (Fig. 1). Then, the resection of the hepatic bile duct branch lesion was performed and revealed the diseased biliary branch roots (Fig. 2). Choledochoscopic exploration of the common bile duct and the contralateral hepatic duct, by sectioning the bile duct stump (Fig. 3). Further, lithotomy forceps or a stone basket was used to remove as many of the common bile duct and other bile duct stones as possible and

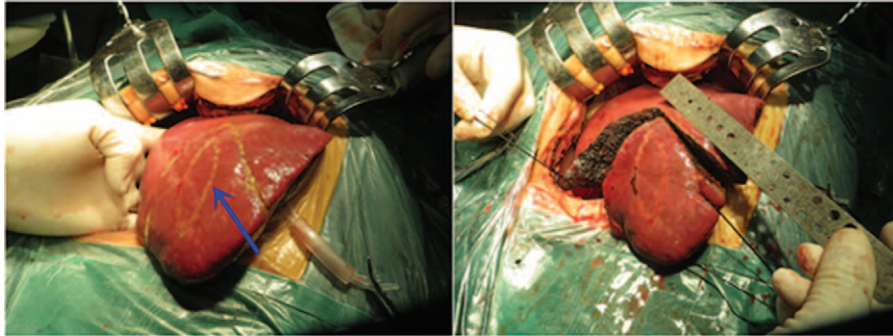


Figure 1. Marking the affected biliary branch (blue arrow) and measuring the distance between the affected biliary tree branch and the resection of liver tissue.

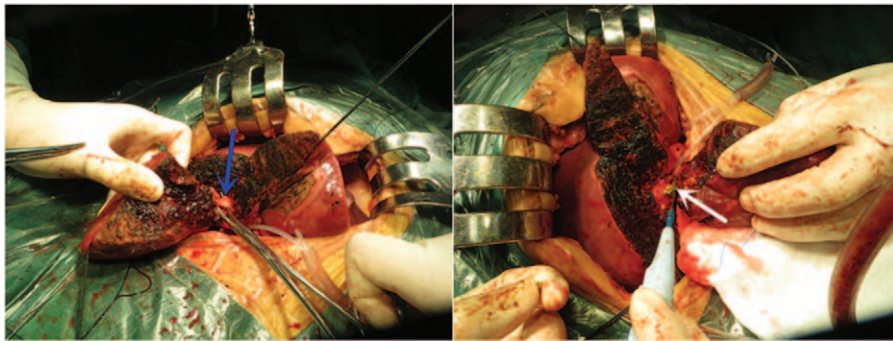


Figure 2. Treatment of the blood vessels and dilated bile ducts (blue arrow); complete removal of the stones and exposure of the root of the affected bile ducts (white arrow).

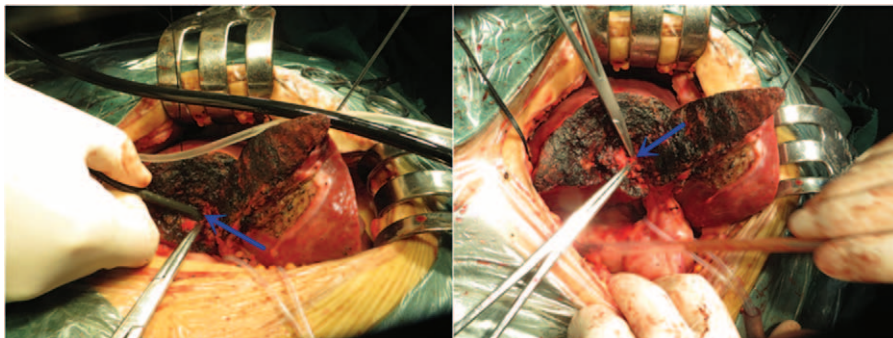


Figure 3. Combination use of choledochoscope exploration of the contralateral bile duct and common bile duct (blue arrow).

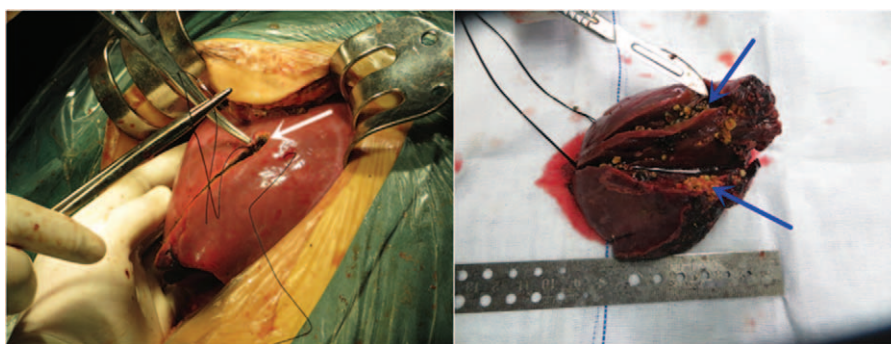


Figure 4. Sutured lesions of the bile duct root and liver parenchyma (white arrow). Resection of the diseased bile duct branch specimens and stones.

to remove the stricture between the bile duct lesions and the hilar bile duct. After confirming the bile duct's patency, the bile duct was washed repeatedly with saline to remove the residual biliary stones. A Prolene line continuous suture was used to suture the bile duct lesion's root ends, and a full-thickness interrupted suture was used for the liver parenchyma after confirmation that there were no biliary fistula (Fig. 4). All operations were performed by the same hepatobiliary surgical team.

2.3. Statistical methods

The database of the patients' clinical data was established using SPSS 13.0 software.

All values are presented as the mean \pm the standard deviation.

3. Results

During the study period, a total of 32 patients underwent simple resections of bile duct branch lesions. The intraoperative blood loss, operation time, and postoperative hospital stay were 478.0 ± 86.5 , 210.7 ± 6.6 , and 10.8 ± 3.5 , respectively. Six patients had postoperative complications (18.8%), 3 cases had bile leakage, 2 cases had surgical wound infections, and 1 case had intra-abdominal fluid collection; all patients were discharged uneventfully after conservative treatment. There were no deaths during hospitalization. The intraoperative stone clearance rate was 95.8%. Three of the patients were considered to have recurrences of stones at a mean of 22 months of follow-up.

4. Discussion

In recent years, the incidence of hepatolithiasis has increased not only in Asia but also in Western countries.^[5] Hepatolithiasis seriously affects liver function, and with the increasing rate of recurrence, clinical treatment proves very difficult.^[3]

With the development of medical imaging, determining the accurate location and providing surgical simulation of the lesions of the liver and bile duct stones can provide a strong foundation for treatment. MRI not only can clearly define the site of the stones in a noninvasive manner but also aids in the more effective evaluation of the degree of biliary system stenosis and hepatic atrophy.^[6] For patients who have bile duct stones above grade 3 and more distally located intrahepatic bile duct stones, a 3-dimensional visualization system (3DVS) on CT images for 3D reconstruction can be used in sparsely populated and narrow bile ducts. This 3D visualization allows the construction of a model of the stones and the intrahepatic and extrahepatic biliary tree, on

which the location of stones and bile duct lesions are much clearer,^[7] which can avoid the artifacts of sham lesions that often appear on MRCP.

In recent years, many methods have been contrived to surgically treat hepatolithiasis, including hepatectomy, intrahepatic bile duct lithotomy, resection of the bile duct stricture and reconstruction, and liver transplantation. The specific operation method should be selected according to the number and distribution of the intrahepatic bile duct stones, the location and extent of the hepatic duct stenosis, the function of the liver and the clinical status of the patient.^[8] Regional intrahepatic bile duct stones should be distributed in the intrahepatic bile duct area, and a liver resection should be performed to remove the hepatic lesion and stones depending on the basis of the liver's blood supply and bile duct drainage area.^[4] Hepatectomy can eliminate stones and bile duct stenosis while also removing irreversible changes in the liver parenchyma. In cases of left-sided hepatolithiasis, a laparoscopic left hemihepatectomy is more safely and effectively performed than is an open left hemihepatectomy.^[9] In cases of right intrahepatic bile duct stones, the anatomy causes difficulties with performing a hepatectomy, primarily because the right hepatic duct location is deep and difficult to access, and with right hepatic duct stones, liver atrophy-hypertrophy complex syndrome is often found, resulting in liver rotation.^[10]

In this study, most of the patients had a history of long-term recurrent cholangitis, obstructive jaundice, and lesions from liver atrophy and hypertrophy, resulting in liver function with varying degrees of damage. A patient's liver function depends largely on the amount of hypertrophy of the hepatic segments.^[11] If an anatomical hepatectomy is performed, it can be difficult for the remnant liver to maintain the normal function of the liver.^[12]

The simple resection of a bile duct branch lesion refers to an operation that does not require first directly dissecting the hepatic portal, performed without a routine cholecystectomy (except for cases of gallstones), combined with intraoperative ultrasonography to define the bile duct root lesion, with the precise location of the bile duct lesion and the range of stones. In simple resections, liver tissue can be removed from the bile duct lesions around 2 cm from their position, and the bile duct lesions and bile duct stricture can be resected. In addition, with the help of a choledochoscope, the common bile duct and the contralateral hepatic duct through the bile duct stump can be repeatedly explored, and a stone basket can be used to remove residual stones. This surgical method can completely and accurately resect the bile duct lesion, remove the stones and reduce the residual stones.

Our results demonstrated that the stone clearance rate and postoperative complications were 95.8% and 18.8%, respectively. Our results were similar to those of most studies that have reported hepatic resections or bilateral resections.^[13–15] These results indicate that a simple resection of the bile duct branch lesion is safe and effective, with outcomes that are satisfactory.

We obtained the following experience when we performed the simple resection of the lesion bile duct branch for treating regional hepatic bile duct stones.

1. Accurately locate both the bile duct root lesion and the range of the bile duct stones. The vast majority of the patients who require biliary reoperation do so because the accurate location of the lesion was not determined or preoperative preparation was insufficient, and residual stones or bile duct lesions were not completely removed.^[16] Simple resection of the bile duct branch lesion is based on complete preoperative imaging, especially the clear imaging of the biliary tree to determine the location of the bile duct lesions and the range of stones, used in combination with repeated intraoperative ultrasound examination, to locate the bile duct root lesions to resect them completely and remove all of the stones.
2. The subsegmental resection of liver tissue needs to be performed approximately 2 cm from the bile duct. Hepatolithiasis is often accompanied by the liver's compensatory hyperplasia or atrophy around the bile duct lesions; hyperplasia primarily occurs with cell hypertrophy, accompanied by bile duct cholestasis and biliary secretion of serotonin, limiting the growth of the bile duct. Therefore, bile duct lesions of approximately 2 cm of hyperplasia in the liver tissue generally do not contain normal bile duct and branch.^[17] The goal of a simple resection is the thorough resection of the bile duct lesion, leaving approximately 2 cm around the hyperplasia and hypertrophy of the liver tissue, which is accomplished without leaving residual bile duct lesions; performing a successful resection will not damage other normal bile duct and liver tissue and will leave sufficient postoperative surplus to ensure residual liver volume.
3. The variations in individual patient's blood vessels and bile ducts during simple resections of bile duct branch lesions require attention. Studies have shown that 95% of these cases have a right posterior lobe bile duct trunk^[18] and that approximately 10% of cases have varying locations between the right posterior lobe bile duct and the portal vein.^[19] Therefore, the surgeon should pay special attention to these variations to avoid damaging the right branch of the portal vein.

5. Conclusions

The treatment options for hepatolithiasis vary with the individual differences of the disease. Because of the pathological and anatomical characteristics of right hepatic regional stones, it is necessary to be cautious in the treatment. Simple resection of the lesion bile duct branch has as its goal the thorough resection of the diseased of bile duct branch, by resecting 2 cm around the

disease bile duct branch centre with hyperplasia and hypertrophy of the subsegmental tissue, without leaving the lesions bile duct. Subsegmental resection can avoid removing more normal liver tissue and can reduce the damage to normal blood vessels and bile ducts in liver (including ischemic damage). It is also safe and feasible for patients who have regional hepatic bile duct stones limited to right hepatic bile duct branches. However, the study involved a small number of patients relatively, so our conclusions may need be further confirmation.

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