



CLINICAL RESEARCH

Hepaticojejunostomy for hepatolithiasis: A critical appraisal

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Abstract

AIM: To evaluate the long-term outcome and surgical indications of hepaticojejunostomy (HJ) for the treatment of hepatolithiasis.

METHODS: Three hundred and fourteen elective cases with hepatolithiasis but without biliary stricture or cystic dilatation treated in the past 10 years were reviewed retrospectively. The patients were divided into HJ group and T tube drainage group according to biliary drainage procedure. Furthermore, four subgroups were subdivided by hepatectomy as a balance factor, group A₁: hepatectomy+HJ; group A₂: choledochotomy+HJ; group B₁: hepatectomy + choledochotomy T tube drainage; group B₂: choledochotomy + T tube drainage. The stone residual rate, surgical efficacy and long-term outcome were compared among different procedures.

RESULTS: There was no surgical mortality among all patients. The total hospital mortality was 1.6%. The overall stone residual rate after surgical clearance was 25.9%. There was no statistical difference between HJ group and T tube drainage group in terms of stone residual rate after surgical clearance, however, after postoperative choledochoscopic lithotripsy, the total stone residual rate of T tube drainage group was significantly lower than that of HJ group (0.5% vs 16.7%, $P < 0.01$). Hepatectomy + choledochotomy tube drainage achieved the optimal therapeutic effect, only 8.2% patients suffered from an attack of cholangitis postoperatively, which was significantly lower than that of hepatectomy + HJ (8.2% vs 22.0%, $P = 0.034$). The major reason for postoperative cholangitis was stone residual in the HJ group (16/23, 70.0%), and stone recurrence in the T tube drainage group (34/35, 97.1%). The operative times were significantly prolonged in those undergoing HJ, and the operative morbidity of HJ was higher than those of T tube drainage.

CONCLUSION: The treatment result of HJ for hepatolithiasis is not satisfactory in this retrospective study due to high rate of stone residual and postoperative cholangitis. HJ could not drain residual stone effectively. HJ may hinder post-operative choledochoscopic lithotripsy, which is the optimal management for postoperative residual stone. The indications of HJ for hepatolithiasis should be strictly selected.

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Key words: Hepatolithiasis; Hepaticojejunostomy; Outcome

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INTRODUCTION

Hepatolithiasis is a common disease in Southeast Asia and is especially prevalent in China^[1,2]. This disease features a high stone residual and recurrence and its long-term outcome is far from satisfactory. The principles for the treatment of hepatolithiasis are complete clearance of stones, eradication of the diseased bile duct (stricture) and atrophic liver tissue and reconstruction of satisfactory bile drainage. Biliary-enteric anastomosis which mostly includes choledochoduodenostomy (CD) and Roux-en-Y hepaticojejunostomy(HJ), is one of the most common procedures used for hepatolithiasis. Due to the sump syndrome and high risk of stasis following CD^[3,4], many authors prefer HJ to CD as the standard procedure for benign biliary diseases^[4-6]. In fact, we have used HJ instead of CD to reconstruct enteric biliary drainage for hepatolithiasis or bile duct stricture in our department since 1990.

In the cases of hepatolithiasis simultaneously with extrahepatic bile duct stricture or congenital cyst dilatation, because the diseased bile duct should be resected, HJ is the treatment of choice to reconstruct bile drainage. However, in the cases without bile duct stricture or cystic dilatation, whether HJ is suitable remains controversial^[7-9].

In the current study, we reviewed the cases with hepatolithiasis treated surgically in our department in the past 10 years retrospectively, and evaluated the outcome and surgical indications of HJ for the treatment of hepatolithiasis.

MATERIALS AND METHODS

Patients

A total of 425 consecutive patients with hepatolithiasis treated surgically at the Department of Hepaticobiliary Surgery, the First Affiliated Hospital, Sun Yet-san University from June 1992 to June 2002 were reviewed retrospectively. According to our study purpose, the following cases were excluded because of no alternative surgical procedures for their conditions at that time, respectively, (1) 21 cases of hepatolithiasis complicated with acute obstructive suppurative cholangitis, who underwent choledochotomy, stone extraction and T tube drainage emergently once the diagnosis was confirmed; (2) 21 cases of hepatolithiasis with congenital choledochal cyst or Caroli's disease, who underwent stone removal, cyst resection or hepatectomy and HJ; (3) 23 cases of hepatolithiasis with left or right hepatic ducts or their second branches stricture, who received diseased bile duct resection and (or) bile duct stricturoplasty and HJ; (4) 46 cases of hepatolithiasis complicated with cholangiocarcinoma were also excluded. The remaining 314 elective cases were enrolled in this study, including 122 men, and 192 women. The mean age of whole group was 48 years (range: 15-88).

Grouping

According to the different procedures of bile drainage, 314 patients were divided into HJ group ($n = 123$) and T tube drainage group ($n = 191$). Because some cases in these two groups underwent hepatectomy simultaneously, we used hepatectomy as a balance factor to subdivide these two groups into four subgroups, Group A₁: Hepatectomy + HJ ($n = 76$); group A₂: choledochotomy + HJ ($n = 47$); group B₁: hepatectomy + choledochotomy T tube drainage ($n = 85$); group B₂: choledochotomy + T tube drainage ($n = 106$). The rate of residual stone, operative complications and therapeutic outcomes were compared among these groups.

Procedure of HJ

The standard procedure of HJ was an end-to-side, mucosa-to-mucosa anastomosis of the intra- and (or) extra-hepatic duct with a Roux-en-Y jejunal loop measuring 40 to 60 cm in length. The anastomosis was sutured with absorbable material (Viracyl, 4-0, Johnson Ltd, USA) interruptedly. A rubber tube measuring 3.5-5 mm in diameter was placed through biliary-enteric anastomosis retrogradely for later cholangiography or choledochoscopic manipulation. This drainage tube was removed when no stone resided within the biliary tract proofed by a cholangiogram at postoperative d 14. If there was residual stone proofed by cholangiography, the drainage tube tract was left for 6 wk to allow subsequent choledochoscopic manipulation. The indications of HJ we used previously were (1) the diameter of the common bile duct was larger than 2 cm; (2) intrahepatic stone located bilaterally; (3) peripheral bile duct stone that could not be cleared during surgery.

Measurement of residual stone

The diagnosis of postoperative stone residual was based on the cholangiogram performed through the T tube and

transanastomotic drainage tube at postoperative d 14 or ultrasound findings. Once residual stone was found, choledochoscopic stone extraction or lithotripsy (four-direction fiber choledochoscopy, 3.5 mm in diameter, Olympus Co., Japan) was done 6 wk after operation. This was repeated at 1 wk interval until the residual stone was completely cleared, or as clear as possible.

Postoperative follow-up

Follow-up was performed by reviewing medical records and patient interviews or telephone interview. At the end of this study, totally 241 out of 309 completed the follow-up (period: 2-12 years, median 7.6), the other patients were lost. Cholangitis was considered when patient presented with right upper quadrant pain, chill, fever or jaundice.

Statistical analysis

Patients' database was established by SPSS 11.0 software. *t*-test, rank test (continuous data) and Fisher's exact test, Chi-square test (categorical data) were used. $P < 0.05$ was considered statistical difference.

RESULTS

Operative mortality and hospital death

There was no surgical mortality in this study. Five cases (1.6%) died of hepatic failure postoperatively during their hospital stay, including 1 case in subgroup A₁, 2 cases in subgroup A₂, and 2 cases in subgroup B₂.

Patients' clinical characteristics

Patients' demographic and clinical data are shown in Table 1. The number of patients who had previous bile surgery of subgroups A₁ and A₂ was greater than those of subgroups B₁ and B₂, respectively ($P < 0.05$). The history and operating times of patients in the subgroups A₁ and A₂ were longer than those in subgroups B₁ and B₂, respectively ($P < 0.05$); the amount of blood loss in subgroups A₁ and A₂ was larger than those in the subgroups B₁ and B₂ respectively ($P < 0.05$).

Postoperative stone residual

The diagnosis of postoperative stone residual was based on the cholangiogram and ultrasound findings postoperatively. The most common site of stone residual was the intrahepatic duct. The overall stone residual rate after surgical clearance in our series was 25.9% (Table 2). There was no significant difference of stone residual between the HJ group and the T tube drainage group (20.3% *vs* 28.3%, $P > 0.05$). The cases who underwent hepatectomy [group (A₁ + B₁)] had less stone residual than those who did not, [group (A₂ + B₂)] ($P < 0.05$).

Postoperative complications

The common postoperative complications are listed in Table 3. The complications in subgroup A₁ was more than that in subgroup A₂ ($\chi^2 = 4.324$, $P < 0.05$).

Management of residual stone

The treatment of choice for postoperative residual stone

Table 1 Patients' demographic and clinical data

Groups	n	PS ¹ n (%)	Age (yr)	Hospital stay (d)	Operative time (min)	History ² (yr)	Bleeding ² (mL)
HJ group	123	90 (73.17)					
+hepatectomy (A1)	76	55 (72.37) ^a	45.4 ± 13.8	32.1 ± 12.0	282.9 ± 99.3 ^a	8.5 ^a (0.1-40)	500.0 ^a (150-27 000)
left lateral segmentectomy	52						
left hepatectomy	15						
right hepatectomy	3						
segmentectomy	6						
+CBD exploration (A2)	47	35 (74.47) ^c	51.8 ± 13.5	27.0 ± 8.5	226.1 ± 80.4	8.0 ^c (0.1-35)	300.0 (100-3000)
T tube drainage group	191	102 (53.40)					
+hepatectomy (B1)	85	46 (54.12)	46.6 ± 12.6	29.2 ± 10.6	189.4 ± 54.1 ^c	3.5 (0.1-40)	300.0 ^c (100-5000)
left lateral segmentectomy	57						
left hepatectomy	13						
right hepatectomy	4						
segmentectomy	11						
+ CBD exploration (B2)	106	56 (52.83)	49.8 ± 15.7	28.3 ± 16.6	166.4 ± 97.7	3.0 (0.1-40)	150.0 (30-18 000)

^a*P* < 0.05 vs group B1, ^c*P* < 0.05 vs group B2. ¹ps: previous bile surgery, ²expressed as median (range). Age, hospital stay and operative time were expressed as mean ± SD. CBD: common bile duct; HJ: hepaticojejunostomy.

Table 2 Sites and rates of residual stone

Groups	n	Site of stone residual					Rate Total (%)
		Left liver	Right liver	CBD	Left liver	Right liver	
HJ group	123	8	14	1	2	25	20.3 ^a
+hepatectomy (A1)	76	3	10	1	0	14	18.4
+CBD exploration (A2)	47	5	4	0	2	11	23.4
T tube drainage group	191	17	22	3	12	54	28.3
+ hepatectomy (B1)	85	5	10	1	2	18	21.2
+ CBD exploration (B2)	106	12	12	2	10	36	34.0

HJ, hepaticojejunostomy; CBD, common bile duct. ^a*P* > 0.05 vs T tube drainage group.

was choledochoscopic lithotripsy through the T tube or the transanastomotic drainage tube route 6 wk after operation. Totally 54 cases had residual stones in the T tube drainage group, and 53 had their stones completely cleared by choledochoscopic lithotripsy after 1 to 6 sessions. Only 1 case was failed because his T tube withdrew simultaneously after discharge. However, only 5 cases whose residual stones could be successfully eliminated in HJ group, the other 20 cases failed because their fistula were unsuitable or difficult for the entry of choledochoscope, or the long Roux-en-Y loop hindered the technical manipulation. The overall stone residual rate of the T tube drainage group was significantly lower than the HJ group after choledochoscopic lithotripsy [0.5% (1/189) vs 16.7% (20/120), *P* < 0.01].

Postoperative cholangitis

Postoperative cholangitis presented by right upper quadrant pain, chill, fever and jaundice occurred at least once in 58 cases (Table 4). Five cases in the HJ group suffered from 4-6 episodes of cholangitis till the second operations were done. The main causes of cholangitis observed in our series were stricture of the biliary-enteric anastomosis (*n* = 3), stone residual (*n* = 16) or reflux of intestinal fluid (*n* = 1) in the HJ group, and stone recurrence (*n* = 34) or later

Table 3 Postoperative complications

Complications	Group A1 (<i>n</i> = 76)	Group A2 (<i>n</i> = 47)	Group B1 (<i>n</i> = 85)	Group B2 (<i>n</i> = 106)
Wound infection	6	3	5	7
Subphrenic collection/infection	7	0	3	0
Pleural infusion	3	0	2	0
Bile leakage	2	0	3	1
Biliary hemorrhage	1	0	0	2
Liver abscess	1	0	0	0
Liver failure	1	2	0	6
Pulmonary infection	0	1	1	1
Septicemia	1	0	0	0
Total	22	6	14	17
%	28.95 ^a	12.77	16.47	16.04

^a*P* < 0.05 vs group A2.

Table 4 Follow-up and postoperative cholangitis

Groups	n	Follow-up patients (<i>n</i> , %)	Postoperative cholangitis (<i>n</i> , %)	Causes of cholangitis			
				ST	SR	SRE	RC
HJ group	123	96 (78.0)	23 (24.0)	3	16	(3) ⁴	1
+ hepatectomy (A1)	76	59 (77.6)	13 (22.0)	1	9	3	0
+ CBD exploration (A2)	47	37 (78.7)	10 (27.0)	2	7	(2) ³	1
T tube drainage group	191	145 (76.0)	35 (24.1)	0	1	34	0
+ hepatectomy (B1)	85	61 (71.8)	5 (8.2) ¹	0	0	5	0
+ CBD exploration (B2)	106	84 (79.2)	30 (35.7) ²	0	1	29	0

¹*P* = 0.034 vs group A1. ²*P* = 0.349 vs group A2. ^{3,4}these two (or three patients) patients who had stone recurrence also had stricture of anastomosis. HJ: hepaticojejunostomy, ST: stricture of anastomosis or intrahepatic bile duct, SR: stone residual; SRE: stone recurrence; RC: reflux cholangitis.

development of bile stricture for chronic inflammation of bile duct in the T tube drainage group (Table 4).

DISCUSSION

Postoperative stone residual and recurrence still remain a

challenge in the treatment of hepatolithiasis. Though the systemic approaches have been used, the stone residual rate was over 30% in a nationwide survey of 4197 surgical hepatolithiasis cases in China^[2]. The overall stone residual rate after surgical clearance in our series was 25.9%. There was no significant difference between the HJ group and the T tube drainage group after surgical clearance. However, when hepatectomy as one of the treatments of choice was considered as a balance factor, we found that among patients who received hepatectomy the stone residual rate was significantly lower than those who did not. This finding is consistent with our previous report^[10] and other reports^[11-13].

Hepatolithiasis will cause bile duct stricture, liver parenchyma atrophy and chronic fibrosis due to repeated pyogenic cholangitis. These pathologic changes, especially bile duct stricture, may hinder stone extraction during surgery, even though the choledochoscopy was used. Hepatectomy provided the best therapeutic effect for completely removing the stone, the diseased bile duct (stricture ring) and atrophic liver parenchyma as well.

Postoperative choledochoscopic lithotripsy through the T tube or the bile duct drainage tube route is a potential remedial treatment for residual stone, as indicated by the T tube drainage group in this study. However, only 5 cases whose residual stone could be successfully removed by this method in the HJ group. Other cases with residual stone could not be removed due to the difficulty for choledochoscopy to access the bile duct through a long (40-60 cm) Roux-Y loop or because the tunnel was too small to enter for the choledochoscopy. After postoperative choledochoscopic lithotripsy, the overall stone residual in the T tube drainage group was markedly lower than that in the HJ group (0.5% *vs* 16.7%, $P < 0.01$). This indicates that HJ hinders postoperative choledochoscopic manipulation. For easy access to the biliary tract, hepaticocutaneous jejunostomy with a stoma after biliary surgery is recommended for the convenience of long-term treatment of stone residual or recurrence^[14]. However, hepaticocutaneous jejunostomy is not advocated for its possible complications related to fistula, infection, parastomal hernia, early stoma closure, and prolonged surgical procedure or hospitalization^[15].

Postoperative cholangitis is a critical factor to evaluate the long-term surgical result of this disease. Hwang *et al*^[16] reported that high risk factors related to cholangitis after initial surgery was bile duct stricture, residual stones, recurrent stones, and patients who were treated with nonhepatic resection. Our long-term follow-up (2-12 years, median 7.6) data demonstrated that patients who underwent hepatectomy with CBD exploration and T tube drainage had less attack of cholangitis, and the occurrence of cholangitis was significantly lower than those who underwent hepatectomy with HJ. Though the residual stones were nearly cleared in the T tube drainage group, and the immediate outcome was good, the occurrence of cholangitis was high. This was due to high recurrence of intrahepatic stone secondary to the bile duct stricture which was not treated during the initial surgery. The major reasons for postoperative cholangitis observed in our study were stone residual in the HJ group (16/23, 70.0%), and stone recurrence in the

T tube drainage group (34/35, 97.1%).

It was believed that the intrahepatic residual stone located in the peripheral bile duct would drain to Roux-Y loop through a large biliary-enteric anastomotic mouth simultaneously after surgery, therefore, residual stone would be cleared, and furthermore, HJ could prevent biliary-enteric regurgitation^[14,17]. To drain a residual stone, HJ is a popular procedure for hepatolithiasis, especially for the case with bilateral stones. Our data showed that the numbers of patients who had previous biliary surgery for hepatolithiasis were higher in the HJ group than that in the T tube drainage group. It suggests that HJ would be the final and optimal procedure for recurred or residual hepatolithiasis at that time. However, many clinical evidences showed that the intrahepatic residual stone could not drain to the Roux-Y loop completely and easily, especially for the stones located at the right posterior lobe and left lateral lobe of the liver. Rather they would accumulate continuously within the bile ducts, which was the main reason for the postoperative cholangitis episodes. This was also evidenced by the long-term follow-up data of the HJ group in this series. Actually, HJ can not completely block biliary-enteric regurgitation. The reflux cholangitis occurring in HJ performed for benign biliary diseases was 10%-15%^[18]. Besides the stone residual and bile duct stricture, postoperative cholangitis was also related to the decrease of motility of Roux-en-Y loop itself. Jejunal transection would lead to abnormal motility of the distal part of jejunum^[19,20]. Ducrotte *et al*^[21] reported that low motility of the Roux-en-Y loop presented by near-absence of phase III's activity, and an absence of response to meal was observed in recurrent cholangitis patients, and subsequently, microbes might colonize and overgrow in the loop. Later on they documented a similar result in asymptomatic patients undergoing HJ^[22].

HJ permanently eliminates the physiological preventive function of regurgitation by the papilla of Vater, which is a barrier between biliary tract and gastrointestinal tract, and subsequently, enteric biliary reflux and bacterial colonization of the biliary tract may occur^[23,24]. Furthermore, in a long-term large series study, Tocchi *et al* found that biliary tract may tend to develop malignancy following biliary-enteric bypass procedures for the benign biliary disease due to chronic inflammation of the bile duct^[25]. This indicates that bile duct cancer may be a long-term complication of biliary-enteric drainage.

On the other hand, our data also demonstrated that HJ prolonged the operation time and increased the risk of intraoperative bleeding and blood transfusion.

In conclusion, the overall long-term outcome of HJ for intrahepatic lithiasis was not satisfactory because of its high rate of stone residual and postoperative cholangitis in our study. HJ could not drain the residual stone effectively. Considering the shortcomings of HJ mentioned above, it is of critical importance to consider the surgical indications of HJ for hepatolithiasis. We advocate that HJ is needed only in the following conditions. (1) Hepatolithiasis complicated with extrahepatic ducts or its second branches stricture, which needs stricturoplasty and HJ. (2) Hepatolithiasis with congenital bile duct dilatation in which the dilated bile duct should be resected. (3) Dysfunction of the papilla of Vater, especially in the case of fibrotic

stricture of the papilla of Vater. Our results indicate that if intrahepatic stone could not be cleared during surgery, a T tube placement within the CBD rather than HJ would facilitate postoperative choledochoscopic lithotripsy.

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