ORIGINAL ARTICLE

Bilioenteric Reconstruction for Small Bile Ducts Without Mucosa-to-Mucosa Alignment

Long-term Results

Kiyoshi Hasegawa, MD, PhD; Norihiro Kokudo, MD, PhD; Hiroshi Imamura, MD, PhD; Keiji Sano, MD, PhD; Taku Aoki, MD; Kenji Miki, MD, PhD; Takuya Hashimoto, MD; Yasuhiko Sugawara, MD, PhD; Masatoshi Makuuchi, MD, PhD

Hypothesis: Biliary reconstruction of the small bile duct is difficult, and bilioenteric reconstruction without mucosa-to-mucosa alignment would be a simple and useful maneuver in this situation; however, the long-term results of this surgical technique remain to be evaluated.

Objective: To evaluate the usefulness of bilioenteric reconstruction without mucosa-to-mucosa alignment from the standpoint of the long-term results.

Design: Retrospective review.

Setting: University hospital.

Patients: Bilioenteric reconstruction without mucosa-to-mucosa alignment was performed in 17 patients at our institution. Six patients had malignancy, and 11 were liver transplant recipients from a living donor.

Main Outcome Measures: Clinical records, blood chemistry data, and findings from dynamic computed tomography.

Results: Among the 17 patients, 4 died of recurrent malignant disease, and 3 died of thrombosis, brain hemorrhage, and pneumonia, respectively. During the follow-up (median, 41.2 months) of the remaining 10 patients, cholangitis occurred in 2 (1 episode in each), and anastomotic leakage from the hepaticojejunostomy performed by the standard method for other thicker ducts developed in 1. There were no other anastomosis-related complications. Dynamic computed tomography performed 2.4 to 62.7 months (median, 34.4 months) after the operation showed no bile duct dilatation in any of the 10 cases.

Conclusions: Long-term patency of the small bile ducts after bilioenteric reconstruction without mucosa-to-mucosa alignment was demonstrated. Thus, this technique is useful for the reconstruction of small bile ducts, especially in patients with poor liver function in whom even minimal additional reduction in the volume of functioning liver due to occlusion of a small bile duct would be acceptable.

Arch Surg. 2004;139:1050-1054

BILIOENTERIC RECONSTRUCTION of small bile ducts poses a technical challenge because of the increased risks of anastomotic stricture and/or cholangitis. It is common practice among hepatobiliary surgeons to anastomose the mucosal layers of the bile duct and the intestine during bilioenteric reconstruction.[1,2] However, in the reconstruction of a small and fragile bile duct, this standard mucosa-to-mucosa alignment may become difficult or even impossible. For such a situation, we previously introduced a simple and useful technique of bilioenteric reconstruction without mucosa-to-mucosa alignment.[3] We then applied this technique to the reconstruction of the small bile duct of the left caudate lobe (the Spiegel lobe) in living donor liver transplant recipients of a left hemiliver graft.[4] The median follow-up period in these studies was rather short, namely, 363 days (range, 300-657 days) for transplant recipients and 25 months (range, 8-35 months) for the other patients. These preliminary reports showed that the short-term results of our technique were satisfactory, although the long-term results were yet to be tested. We then extended our study to evaluate the patency of the small bile ducts and the complications after bilioenteric reconstruction without mucosa-to-mucosa alignment performed on a larger number of cases from the standpoint of the long-term results.

From the Division of Hepato-Biliary-Pancreatic Surgery, Department of Surgery, Graduate School of Medicine, University of Tokyo, Tokyo, Japan.

METHODS

PATIENTS

Between February 18, 1997, and January 16, 2000, bilioenteric reconstruction without mu-

Table 1. Clinical Characteristics of the Patients

Patient No./ Sex/Age, y	Disease	Operative Procedure	Weight of Graft, g (%)*
1/M/58	ICC	Extended left hepatectomy with resection of Spiegel lobe and CBD	. . .
2/M/63	Hilar bile duct carcinoma	Extended left hepatectomy with resection of Spiegel lobe and CBD	. . .
3/M/56	HCC with invasion to CBD	Resection of segments 3, 4, 5, and 8 and CBD	. . .
4/F/46	Metastatic liver carcinoma	Resection of caudate lobe and CBD	. . .
5/F/66	GB Ca with invasion to CBD	Extended right hepatectomy with pancreaticoduodenectomy	. . .
6/M/43	GB Ca with invasion to CBD	Extended right hepatectomy with resection of CBD	. . .
7/F/45	PBC	LDLT (left hemiliver graft with Spiegel lobe)	375 (35)
8/F/49	PBC	LDLT (left hemiliver graft with Spiegel lobe)	393 (40)
9/M/21	Wilson disease	LDLT (left hemiliver graft with Spiegel lobe)	431 (38)
10/M/45	Hereditary hypercitrullinemia	LDLT (left hemiliver graft with Spiegel lobe)	388 (37)
11/F/55	PBC	LDLT (left hemiliver graft with Spiegel lobe)	374 (38)
12/M/54	PBC	LDLT (left hemiliver graft with Spiegel lobe)	445 (40)
13/F/37	PBC	LDLT (left hemiliver graft with Spiegel lobe)	434 (41)
14/F/13	Wilson disease	LDLT (right hemiliver graft)	707 (69)
15/M/33	Fulminant hepatitis	LDLT (right hemiliver graft)	543 (45)
16/M/49	Liver cirrhosis, hepatitis C	LDLT (right lateral sector graft)	468 (45)
17/M/54	Liver cirrhosis, HCC	LDLT (right hemiliver graft)	703 (54)

Abbreviations: CBD, common bile duct; GB Ca, gallbladder carcinoma; HCC, hepatocellular carcinoma; ICC, intrahepatic cholangiocarcinoma; LDLT, living donor liver transplantation; PBC, primary biliary cirrhosis.

*Ratio of the volume of the liver graft to the estimated standard liver volume of the recipient is expressed in parentheses.

cosa-to-mucosa alignment was performed in 17 patients at the Division of Hepato-Biliary-Pancreatic Surgery and Division of Artificial Organ and Transplantation, Tokyo University Hospital, Tokyo, Japan. The patients included 10 male and 7 female patients between the ages of 13 and 66 years (median age, 49 years). Hepatic resection with removal of the extrahepatic bile duct was performed for a hilar bile duct carcinoma in 2 patients, for a gallbladder carcinoma with invasion into the common bile duct in 2 patients, for hepatocellular carcinoma with a tumor thrombus in the common bile duct in 1 patient, and for a recurrent metastatic liver carcinoma with intraoperative injury of the bile ducts in the remnant left liver in 1 patient. In the remaining 11 patients, living donor liver transplantation that required bilioenteric reconstruction of the small ducts was performed for the following diseases: primary biliary cirrhosis in 5 patients, Wilson disease in 2 patients, liver cirrhosis caused by hepatitis C in 1 patient, liver cirrhosis with a hepatocellular carcinoma in 1 patient, hereditary hypercitrullinemia in 1 patient, and fulminant hepatitis in 1 patient. The patient background data, including the procedural details of the operation and the graft weight data in the transplant recipients, are summarized in **Table 1**.

SURGICAL TECHNIQUE

We perform bilioenteric reconstruction without mucosa-to-mucosa alignment for a small (<2 mm in diameter) and/or fragile bile duct, especially if the patient's liver function is too poor to allow further sacrifice of the duct-confining area. We have described our surgical procedure in detail in previous reports.[3,4] Briefly, a vinyl chloride tube, which closely fits in the bile duct orifice, is inserted into the duct and fixed to the duct wall by simple ligation; a purse-string suture is placed to fix the tube to the intestine at the insertion site. Sutures are then passed through the connective tissue of the duct wall and the surrounding liver parenchyma, using a 3-0 or 4-0 braided absorbable suture material. The tube is then led extracorporeally through a Roux-en-Y jejunal loop as an external hepaticostomy and fixed to the loop at the insertion site by a purse-string suture. Several interrupted sutures are placed between the bile duct and the intestinal loop. In these procedures, suturing should not be made through the full thickness of the ductal and intestinal walls but through the connective tissue and/or liver parenchyma around the duct orifice and the seromuscular layer of the intestinal wall (**Figure 1**). The sutures are then tied to complete the bilioenteric reconstruction. The diameter of the bile duct orifices of a liver graft in living donor liver transplantation is routinely measured by inside calipers. In hepatic resection for hepatobiliary malignant diseases, we substitute the size of the drainage tubes (expressed by French size) for the diameter of the bile ducts.

When the bile duct wall is thick and sufficiently firm, we perform standard hepaticojejunostomy by suturing the ductal and intestinal walls through their full thickness. Our preferred procedure is as follows: the anastomosis is performed with interrupted 4-0 braided absorbable sutures, and a short internal stent, in the form of a vinyl chloride tube with the same caliber as the bile duct opening, is placed at the anastomotic site. Using a 16F tube, an external jejunostomy is constructed by the Witzel maneuver to decompress the Roux-en-Y loop.

ASSESSMENT

After discharge, the patients were followed up every month at the outpatient clinic. Blood chemistry tests were performed once every month, and dynamic computed tomography (CT) was conducted at least once every year. In this study, we regarded the following signs as indicative of a poorly functioning bilioenteric anastomosis: abnormal blood chemistry values (increase of serum alanine aminotransferase, serum total bilirubin, and serum alkaline phosphatase levels and decrease of the serum albumin level), abnormal findings on dynamic CT (dilated bile duct, segmental atrophy, and/or segmental early enhancement of the relevant part of the liver), and abnormal physical findings (occurrence of cholangitis, obstructive jaundice, or choledocholithiasis). The diagnosis of cholangitis was made based on the presence of a combination of fever and elevated serum alanine aminotransferase, serum total bilirubin, and/or serum alkaline phosphatase levels. In the 4 recipients who received a left hemiliver graft with the Spiegel lobe, the volume of the Spiegel lobe, in which the bile duct was reconstructed by our technique, was calculated by the Heymsfield method[5]

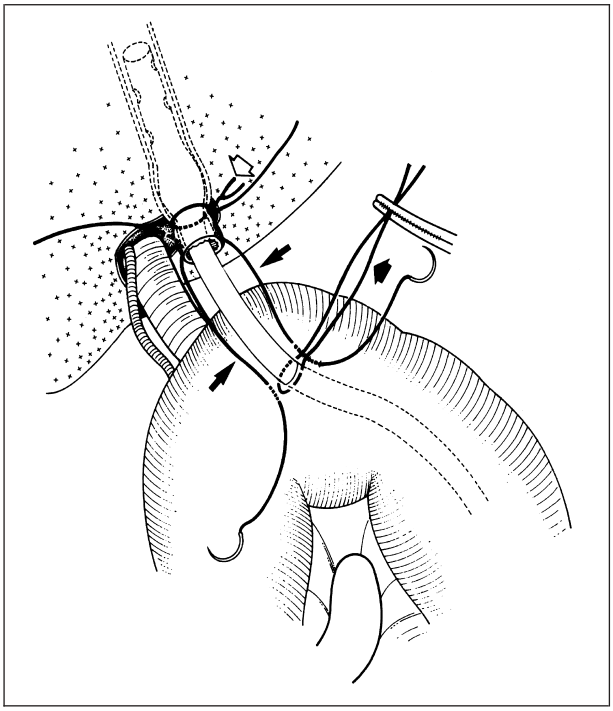

Figure 1. The procedural details of the bilioenteric reconstruction without mucosa-to-mucosa alignment are described. The tube was fixed to the duct by a simple technique (white arrow). A purse-string suture was placed to fix the tube to the intestine at the insertion site and secured (thick arrow). Sutures were then placed between the periductal connective tissue and the seromuscular layer of the intestine and also secured (thin arrows). After moving the duct adjacent to the loop, the purse-string suture was tied followed by the other sutures (thin arrows). Reprinted with permission from Hasegawa et al.[3]

from dynamic CT scans obtained 1 month after the operation and at the end of the follow-up period. The pretransplantation volume of the Spiegel lobe was also measured from the dynamic CT scans of the corresponding donor.

The clinical records, blood chemistry data, and findings of dynamic CT were analyzed retrospectively. At the time of drafting this report, of the 6 patients with malignant disease, 4 had died of recurrence of cancer. Among the 11 transplant recipients, 3 had died of simultaneous hepatic artery and portal vein thrombosis on the 10th postoperative day (POD), uncontrollable pneumonia on the 52nd POD, and brain hemorrhage on the 26th POD, respectively. The data for these 7 patients were excluded from the analyses of the long-term results. We compared the volumetric data in each patient and evaluated the statistical significance of differences using the paired *t* test, with the help of the computer software StatView 5.0 (SAS Institute Inc, Cary, NC).

RESULTS

In the 17 patients, a total of 47 bile ducts were reconstructed, among which bilioenteric reconstruction without mucosa-to-mucosa alignment was performed for 27 ducts (including 11 ducts in bile duct segment 1 [B1], 2 ducts in B2, 2 ducts in B3, 1 duct in B4, 2 ducts in B5, 3 ducts in B6, 3 ducts in B7, and 3 ducts in B8). For the remaining 20 ducts, we performed standard hepaticojejunostomy. The median internal diameter of the ducts reconstructed without mucosa-to-mucosa alignment was 1.7 mm (range, 1-3 mm). The procedural details of the bile duct reconstruction in the 17 patients are summarized in **Table 2**.

Table 2. Procedural Details of the Bile Duct Reconstruction

Patient No.	No. of Ducts	Reconstructed Ducts Without Mucosa-to-Mucosa Anastomosis*	Reconstructed Ducts by the Standard Method
1	4	B7 (2.5)	B5, B6, B8
2	5	B5 (3), B5 (2.5), B6 (3), B8 (2.5), B8 (3)	. . .
3	4	B2 (2), B3 (2), B6 (1.7), B7 (1.7)	. . .
4	3	B2 (2), B3 (2.5), B4 (1.7)	. . .
5	2	B1 (1.7)	Left hepatic duct
6	3	B1 (1.3)	B2 + 3, B4
7	2	B1 (1)	Left hepatic duct
8	2	B1 (1.3)	Left hepatic duct
9	2	B1 (1)	Left hepatic duct
10	4	B1 (1), B1 (1)	B2, B3 + 4
11	3	B1 (1.3)	B2, B3 + 4
12	2	B1 (1)	Left hepatic duct
13	2	B1 (1)	Left hepatic duct
14	2	B7 (1.7)	B5 + 6 + 8
15	2	B8 dorsal (1.3)	Right hepatic duct
16	2	B6 (1)	B7
17	3	B1 (1.3)	B5 + 8, B6 + 7
Median	2	1.7	. . .
Range	2-5	1-3	. . .

Abbreviation: B, bile duct segment.
*The diameter of the external tubes used for anastomosis is expressed in parentheses (in millimeters).

In the 6 patients who underwent surgery for hepatobiliary malignant disease, the median length of hospital stay was 42 days (range, 22-107 days), whereas in the 8 transplant recipients, it was 70 days (range, 38-104 days). The median interval between the operation and removal of the external biliary tubes was 99 days (range, 30-181 days). During this interval, leakage after guidewire manipulation of a hepaticojejunostomy performed by the standard method occurred in 1 patient (patient 17), and reanastomosis was performed in this patient on the 21st POD.

The median follow-up period of the 14 patients, excluding the 3 transplant recipients who died within 2 months of the operation, was 35.7 months (range, 7.7-70.9 months). In 4 patients who had undergone liver resection for malignant disease, the follow-up was cut short by death due to recurrence of cancer at 7.7, 22.5, 22.8, and 33.1 months after the operation, respectively. The median follow-up duration of the 10 patients who remain alive was 41.2 months (range, 18.7-70.9 months). **Table 3** gives the long-term results of our surgical technique, including a summary of the adverse events, in the 14 patients.

During the follow-up period of the 14 patients, 1 episode of anastomosis-related cholangitis occurred in 1 patient (patient 10). In another patient (patient 2), ischemic cholangitis occurred, presumably induced by transarterial embolization for recurrent hepatocellular carcinoma (details of the clinical course of this patient are described in a previous report[6]). Three other patients developed fever with no signs of cholangitis: 1 of them had

Table 3. Long-term Results of Hepaticojejunostomy Without Mucosa-to-Mucosa Anastomosis

Patient No.	Follow-up, mo	Laboratory Data				Findings on the Latest CT	Timing of CT, mo	Adverse Events
		ALB, g/dL	ALT, U/dL	TB, mg/dL	ALP, U/dL			
1	7.7‡	. . .	. . .	. . .	. . .	. . .	. . .	None
2	70.9	4.2	29	0.9	230	NP	62.7	None
3	22.5‡	. . .	. . .	. . .	. . .	. . .	. . .	Recurrence of cancer, ischemic cholangitis caused by TAE
4	33.1‡	. . .	. . .	. . .	. . .	. . .	. . .	Recurrence of cancer
5	22.8‡	. . .	. . .	. . .	. . .	. . .	. . .	Fever (3 times, abscess), recurrence of cancer
6	28.2	4	19	0.4	213	NP	26	Fever (once, viral infection)
7	54.9	3.9	26	0.9	291	NP	51	Fever (twice, viral infection)
8	54.7	4.6	14	0.9	194	NP	38	Esophageal varices
9*	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
10	43.8	4.8	19	1	109	NP	37.3	Fever (once, cholangitis)
11*	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
12*	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
13	42.7	3.7	25	0.5	436	NP	36.9	Rejection, depression due to steroid pulse therapy
14	39.6	4.6	35	1	335	Slight dilatation of B6§	27.4	None
15	38.3	4.3	20	0.7	228	NP	31.8	None
16	16.3	4.2	219	0.6	346	NP	2.4	Recurrence of hepatitis C
17	18.7	3.7	60	2	321	Slight dilatation of B4§	12.3	Rejection, recurrence of cancer, pneumocystosis
Median†	41.2	4.2	26	0.9	261	. . .	34.4	. . .
Range†	18.7-70.9	3.7-4.8	13-219	0.4-2	109-436	. . .	2.4-62.7	. . .
Reference range	. . .	3.7-4.9	4-36	0.3-1.3	60-201	. . .	. . .	. . .

Abbreviations: ALB, albumin; ALP, alkaline phosphatase; ALT, alanine aminotransferase; B, bile duct segment; CT, computed tomography; NP, nothing in particular; TAE, transcatheter arterial embolization; TB, total bilirubin.

SI conversion factor: To convert bilirubin to micromoles per liter, multiply by 17.1.

*Three patients (Nos. 9, 11, and 12) who died within 2 months after operation were excluded from this long-term analysis.

†Four dead patients (Nos. 1, 3, 4, and 5) were excluded when the median and range of the follow-up periods were calculated.

‡Died of recurrence of cancer.

§Computed tomography showed slight dilatation of the bile ducts, which were reconstructed by the standard procedure.

intra-abdominal abscess and the other 2 had viral infection. Six patients developed some adverse events that required medical care: short-term rejection of the liver graft occurred in 2 patients (1 of these developed depression due to steroid pulse therapy for short-term rejection), esophageal varices in 1, recurrence of hepatitis C in 1, and recurrence of malignant disease in 4.

In the 10 patients who remained alive, the blood biochemical examination conducted at the end of the follow-up period showed almost normal liver function, except for slight elevation of the serum alkaline phosphatase level. Dynamic CT, performed 2.4 to 62.7 months after the operation, demonstrated neither early enhancement nor local atrophy, as shown in **Figure 2** (patient 10). No bile duct dilatation was detected by dynamic CT, except for a slight dilatation of the ducts reconstructed by the standard method in 2 patients. The volume of the Spiegel lobe was almost similar before and after the transplantation in the 4 recipients of a left hemiliver graft (**Table 4**).

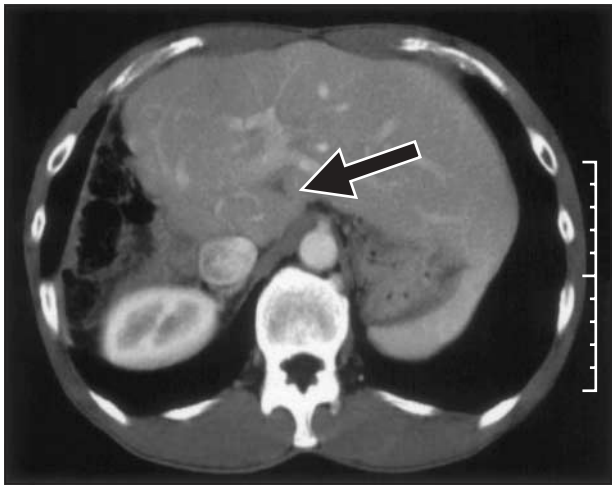

Figure 2. Dynamic computed tomography performed at 37.3 months after the surgery (patient 10). This dynamic computed tomographic scan shows the left hemiliver graft with the Spiegel lobe; 2 small bile ducts of the Spiegel lobe had been reconstructed by bilioenteric reconstruction without mucosa-to-mucosa alignment. Neither bile duct dilatation nor atrophy is seen in the Spiegel lobe (arrow).

COMMENT

In this study, we showed that bilioenteric reconstruction without mucosa-to-mucosa alignment was feasible and useful, with satisfactory long-term results.

The occurrence (or not) of cholangitis and jaundice and the need for subsequent intervention are important measures of the outcome of biliary reconstruction.[7] During the follow-up of the presented cases, none of the aforemen-

Table 4. Changes of Spiegel Lobe Volume in 4 Transplant Recipients Receiving a Left Hemiliver

Patient No.	Spiegel Lobe Volume, cm^3			
	Before LDLT*†	One Month After LDLT*	At the End of Follow-up†	Follow-up Period, mo
7	26	24	22	51
8	41	37	25	38
10	31	39	40	37.3
13	22	25	18	36.9

Abbreviation: LDLT, living donor liver transplantation.
*No difference ($P = .67$).
†No difference ($P = .52$).

tioned events occurred, except in 1 patient who developed anastomosis-related cholangitis, suggesting that our technique poses no problems clinically. To objectively evaluate the long-term results of the operation by our technique, we analyzed the findings of dynamic CT and the results of the blood chemistry tests. Dilated bile ducts associated with segmental liver atrophy after cholangiojejunostomy have been reported to be indicative of biliary retention due to anastomotic stenosis.[8,9] Early enhancement of a segment or a subsegment of the liver, suggestive of segmental liver atrophy, is also indicative of biliary retention.[10,11] Therefore, we selected bile duct dilatation, segmental atrophy, and early segmental enhancement of the liver as signs of anastomotic stenosis. Because dynamic CT revealed none of these signs in the patients in this study, we concluded that segmental or subsegmental areas, confined by the bile ducts reconstructed by our technique, were in fact functioning during the follow-up period. In addition, the results of the blood chemistry tests reflected almost normal liver function in the patients, except for transient abnormal values during short-term rejection in 2 patients. These imaging findings and the data were compatible with a good clinical course outcome.

The volume of the Spiegel lobe remained the same before and after transplantation in the 4 transplant recipients. This finding also supported our claim that the area of the liver confined by the duct reconstructed by our technique was actually functioning. We did not adopt this analytical approach in the other patients, because CT voltmetry is less reliable for other hepatic areas than the Spiegel lobe.

All the bile ducts reconstructed by our technique in this study were small (median internal diameter, 1.7 mm). Closure of the small ducts without reconstruction may be one possible option, especially when the function of the remnant liver or the liver graft is well preserved. Theoretically, the segmental or subsegmental area confined by the closed duct will be nonfunctioning after the surgery and become atrophic in the long run.[8,9] Because the 17 patients in this study consisted of transplant recipients of a small-for-size graft and the patients had undergone extended right hepatectomy or repeated liver resection, they had little redundant liver function. For such patients, loss of functioning liver volume, even if it were small, may cause fatal postoperative liver failure. Although the volume of the Spiegel lobe is only approximately 3% of the whole liver, it corresponds to 9% of the left hemiliver graft with a Spiegel lobe.[12] Preservation of function of the Spiegel lobe is therefore important in a small-for-size graft.

The appropriate duration of follow-up after bilioenteric anastomosis to evaluate its long-term results remains controversial. Late complications after biliary reconstruction (such as cholangitis, anastomotic stricture, and hepatolithiasis) can occur at any time, even 10 years or more after the surgery.[13-15] The median follow-up duration of this study was 41.2 months; therefore, longer follow-up might be needed to evaluate the efficacy of our technique over the longer term.

In conclusion, bilioenteric reconstruction without mucosa-to-mucosa alignment allows liver function of a segmental or a subsegmental area confined by the reconstructed duct to be maintained and is not associated with any biliary complications. Our technique is simple and useful for small bile duct reconstruction, when even the slightest loss of functioning liver volume is not permissible.

Accepted for publication October 29, 2003.

This work was supported by a grant-in-aid for scientific research from the Ministry of Education, Science, Sports and Culture (grant 12470252) of Japan (Tokyo).

Correspondence: Masatoshi Makuuchi, MD, PhD, Division of Hepato-Biliary-Pancreatic Surgery, Department of Surgery, Graduate School of Medicine, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8655, Japan (makuuchi-tky@umin.ac.jp).

REFERENCES

1. Bismuth H, Corlette MB. Intrahepatic cholangioenteric anastomosis in carcinoma of the hilus of the liver. *Surg Gynecol Obstet.* 1975;140:170-178.
2. Blumgart LH. Hilar and intrahepatic biliary enteric anastomosis. *Surg Clin North Am.* 1994;74:845-863.
3. Hasegawa K, Makuuchi M, Kubota K, et al. Reconstruction of small and fragile bile ducts without mucosa-to-mucosa anastomosis. *Arch Surg.* 2000;135:596-599.
4. Kubota K, Takayama T, Sano K, et al. Small bile duct reconstruction of the caudated lobe in living-related liver transplantation. *Ann Surg.* 2002;235:174-177.
5. Heymsfield SB, Fulenwider T, Nordlinger B, et al. Accurate measurement of liver, kidney and spleen volume and mass by computerized axial tomography. *Ann Intern Med.* 1979;90:185-187.
6. Hasegawa K, Kubota K, Miyazawa M, et al. Ischemic cholangitis caused by transcatheter hepatic arterial embolization 10 months after resection of the extrahepatic bile duct. *Cardiovasc Intervent Radiol.* 2000;23:304-306.
7. Millis JM, Tompkins RK, Zinner MJ, et al. Management of bile duct strictures: an evolving strategy. *Arch Surg.* 1992;127:1077-1083.
8. Braasch JW, Whitcomb FF, Watkins E, et al. Segmental obstruction of the bile duct. *Surg Gynecol Obstet.* 1972;134:915-920.
9. Czerniak A, Soreido O, Gibson RN, et al. Liver atrophy complicating benign bile duct strictures: surgical and interventional radiologic approaches. *Am J Surg.* 1986;152:294-300.
10. Itai Y, Moss AA, Goldberg HI. Transient hepatic attenuation difference of lobar or segmental distribution detected by dynamic CT. *Radiology.* 1982;144:835-839.
11. Demaerel P, Marchal G, Van Steenbergen W, et al. CT demonstration of right hepatic lobe atrophy. *J Comput Assist Tomogr.* 1989;13:351-353.
12. Takayama T, Makuuchi M, Kubota K, et al. Living-related liver transplantation of left liver plus caudate lobe. *J Am Coll Surg.* 2000;190:635-638.
13. Pitt HA, Miyamoto T, Parapatis SK, et al. Factors influencing outcome in patients with postoperative biliary strictures. *Am J Surg.* 1982;144:14-21.
14. Muñoz R, Cardenas S. Thirty years' experience with biliary tract reconstruction by hepaticoenterostomy and transhepatic T tube. *Am J Surg.* 1990;159:405-410.
15. Röthlin MA, Löpfe M, Schlumpf R, et al. Long-term results of hepaticojejunostomy for benign lesions of the bile ducts. *Am J Surg.* 1998;175:22-26.