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Technique and Results of Biliary Reconstruction Using Side-to-Side Choledochocholedochostomy in 300 Orthotopic Liver Transplants

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Objective

The authors evaluated the complication rate and outcome of side-to-side common bile duct anastomosis after human orthotopic liver transplantation.

Summary Background Data

Early and late biliary tract complications after orthotopic liver transplantation remain a serious problem, leading to increased morbidity and mortality. Commonly performed techniques are the end-to-end choledochocholedochostomy and the choledochojejunostomy. Both techniques are known to coincide with a high incidence of leakage and stenosis of the bile duct anastomosis. The side-to-side bile duct anastomosis has been shown experimentally to be superior to the end-to-end anastomosis. The authors present the results of 316 human liver transplants, in which a side-to-side choledochocholedochostomy was performed.

Methods

Biliary tract complications of 370 transplants in 340 patients were evaluated. Three hundred patients received primary liver transplants with side-to-side anastomosis of donor and recipient common bile duct. Thirty-two patients with biliary tract pathology received a bilioenteric anastomosis, and in eight patients, side-to-side anastomosis was not performed for various reasons. Clinical and laboratory investigations were carried out at prospectively fixed time points. X-ray cholangiography was performed routinely in all patients on postoperative days (PODs) 5 and 42. In patients with suspected papillary stenosis, endoscopic retrograde cholangioscopy and papillotomy were performed.

Results

One biliary leakage (0.3%) was observed within the early postoperative period (PODs 0 through 30) after liver transplantation. No stenosis of the common bile duct anastomosis was observed during this time. Late biliary stenosis occurred in two patients (0.6%). T tube-related complications were observed in 4 of 300 primary transplants (1.3%). Complications unrelated to the surgical technique, including papillary stenosis (5.7%) and ischemic-type biliary lesion (3.0%), which must be considered more serious in nature than complications of the anastomosis or T tube-related complications, were observed. Papillary stenosis led to frequent endoscopic interventions and retransplantations in 1.3%.

Conclusions

Side-to-side common bile duct anastomosis represents a safe technique of bile duct reconstruction and leads to a low technical complication rate after human orthotopic liver transplantation. Ischemic-type biliary lesion evoked by preservation injury, arterial ischemia, cholestasis, and cholangitis may represent a new entity of biliary complication, which markedly increases the morbidity after human liver transplantation. Therefore, this complication should be the subject of further research.

Before the introduction of cyclosporin A, survival after orthotopic liver transplantation (OLT) was low. Compromised outcome frequently was related to early postoperative biliary tract complications, i.e., leakage of the anastomosis, biliary peritonitis or sepsis.[1-5] Approximately 50% of these early liver transplants developed serious biliary tract complications after end-to-end choledochocholedochostomy or ROUX-en-Y-choledochojejunostomy. The anastomosis of the common bile duct was characterized as the Achilles heel of the whole procedure, and it has been suggested that the number of biliary tract complications may be even higher if more patients had survived the early postoperative period.[6]

Cholecystostomy and choledochoduodenostomy, alternative procedures of biliary reconstruction, have been performed experimentally and clinically, but these techniques often led to cholangitis and obstruction. For a time, the Roux-en-Y loop was preferred, but subsequently, the end-to-end bile duct anastomosis was used to preserve the natural sphincter mechanism. The gall bladder conduit technique was popular until the late 1980s, at least in England.[6] All other groups preferred the end-to-end anastomosis. Nevertheless, stenoses at the anastomotic site, biliary obstructions, and infections occurred several years after liver transplantation, and were frequently the cause of reoperation.

In 1982, we performed OLT with side-to-side common bile duct anastomosis in Rhesus monkeys, because this technique seemed to be more suitable in animals with very small bile ducts.[7] Because of the low complication rate, the side-to-side bile duct anastomosis was used in human liver transplantations at Hannover with great success.[3,4]

When the new liver transplant program was started at the Virchow Clinic Berlin in 1988, we decided to use the side-to-side choledochocholedochostomy whenever indicated. Clinical and laboratory evaluations were performed at prospectively fixed time points, including cholangiography at PODs 5 and 42 after transplantation to determine early and late biliary tract complications. In the present study, we report on the surgical method and the clinical outcome of side-to-side common bile duct anastomosis in human liver transplantations.

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MATERIAL AND METHODS

Patients

Between October 1988 and April 1993, 370 orthotopic liver transplantations were performed in 340 patients at the Virchow Clinic Berlin; 340 were primary transplants, 28 were first retransplants, and 2 were second retransplants. Fifteen of thirty retransplantations were performed early after primary OLT because of initial nonfunction or irreversible rejection. The remaining retransplantations were performed more than 3 months after primary OLT. One hundred ninety-eight patients were men and 142 were women. Patient age ranged from 3 to 65 years, with 3 patients under 18 years old.

The spectrum of preoperative diagnoses emphasized benign end-stage liver diseases, especially postnecrotic cirrhosis, as outlined in Table 1. Three hundred eight of 340 patients had liver disease without affection of the extrahepatic biliary tract, and were candidates for side-to-side anastomosis of donor and recipient common bile duct. These 308 patients received 300 primary transplants with side-to-side anastomosis of the common bile duct and 8 transplants with other biliary anastomoses, including end-to-end (n = 3), end-to-side (n = 2) and choledochojejunostomy (n = 3). Thirty-five bilioenteric anastomoses were performed in primary transplantations because of affections of the extrahepatic biliary tract. Of 30 patients who underwent retransplantations, 21 had side-to-side anastomosis and 5 had bilioenteric anastomosis, as in their previous transplant; in 4 patients with side-to-side anastomosis, choledochojejunostomy was performed in the second transplant.

Donor Hepatectomy and Liver Preservation

Two hundred ninety-one livers were harvested by our team; 79 livers were shipped. Donor age ranged from 13 to 60 years (median 26.5 years). Liver function parameters were within the normal range in 70% of all donors;

Table 1. INDICATIONS FOR LIVER TRANSPLANTATION*

Postnecrotic cirrhosis	226
Hepatitis B (Delta virus positive n = 11)	79
Hepatitis NANB/C	72
Alcoholic	58
Autoimmune	8
Cryptogenic	9
Acute liver failure	27
Hepatitis B	7
Hepatitis NANB/C	13
Budd-Chiari syndrome	6
M. Wilson	1
Cholestatic disease	53
Primary biliary cirrhosis (PBC)	30
Primary sclerosing cholangitis (PSC)	20
Secondary biliary cirrhosis/cholangitis	2
Biliary atresia	1
Metabolic disorders	13
Alpha-1-antitrypsin deficiency	2
Porphyria	3
Wilson's disease	5
Hemochromatosis	3
Liver tumors	21
Hepatocellular carcinoma	6
Bile duct carcinoma	9
Carcinoid metastasis	1
Cystic liver disease	5
Retransplantations	30
Initial non-function (INF)	9
Irreversible rejection	6
Ischemic type biliary lesion (ITBL)	5
Recurrence of primary disease	8
HBV (6)	
Budd-Chiari (2)	
Vascular Thrombosis	2

* 370 transplantations in 340 patients (September 1988–April 1993).

in 20% of the donors, liver function parameters were slightly elevated, and in 10% of the donors, they were markedly elevated. Three hundred sixty-five livers were preserved with University of Wisconsin (UW)-solution (Viaspan, Du Pont Pharma, Bad Homburg, Germany), five livers with Histidine-Tryptophan-α-Ketoglutarate (HTK-Brettschneider; Custodiol, Köhler Chemie, Alsbach, Germany) solution and one with Euro Collins solution. The biliary system usually was flushed with 40 to 50 mL of cold UW-solution. Preservation time ranged from 2 to 26.5 hours, with a median of 10.3 hours.

Recipient Operation

Veno-venous bypass was used in all but two cases. Hepatic arteries and portal veins were anastomosed before reperfusion, and 500 to 800 mL (median 600 mL) perfusate and blood were discharged via the inferior vena cava, i.e., no (kristalloid) rinse solution was used before reperfusion. Side-to-side common bile duct anastomosis was performed after mobilization of the distal common bile duct preserving the connective tissue. All but the first ten patients received aprotinin intraoperatively and postoperatively to prevent fibrinolysis. Warm ischemic time ranged from 32 to 145 minutes (median 64 minutes).

Immunosuppression

Standard immunosuppressive management consisted of quadruple immunosuppression — antithymocyte globulin and intravenous cyclosporin A (1 mg/kg body weight) — twice a day for 5 days, prednisolone, and azathioprine (197 patients). Seventy-two patients received a new monoclonal anti-IL-2 receptor antibody instead of antithymocyte globulin for the first 12 postoperative days. One hundred one patients received FK506 and prednisolone as part of two prospective randomized multicenter studies.

Methylprednisolone was used for treatment of acute rejection (3 × 500 mg) and monoclonal antibody (OKT3, Cilag GmbH, Sulzbach, Germany) for steroid-resistant or severe repeated rejection. Prednisolone and azathioprine medications were reduced and (ideally) withdrawn within the first 12 months after transplantation. Cyclosporin and FK506 dosages were reduced according to blood levels and patient course.

Prophylaxis, Monitoring, and Treatment of Infections

All patients received selective bowel decontamination (SBD) before and up to 3 weeks after OLT. Perioperative antibiotic prophylaxis was performed with cefotaxime, metronidazole, and tobramycin. Bacterial monitoring, including bile fluid collected from the T tube, was performed twice a week and in all cases with suspected infection. Since 1990, viral studies have been performed before and after OLT, with special attention to cytomegalovirus status using polymerase chain reaction techniques. Acyclovir was used routinely as prophylaxis against herpes virus infection. Treatment with ganciclovir was initiated when clinical signs of cytomegalovirus disease were observed. During the last 2 years, all patients received ciprofloxacin against legionellosis and trimethoprim/sulfamethoxazole, as prophylaxis of pneumocystis carinii infection.

Technique of Bile Duct Anastomosis

A small grooved probe (otherwise used in anal fistula surgery) was inserted into the donor and recipient com-

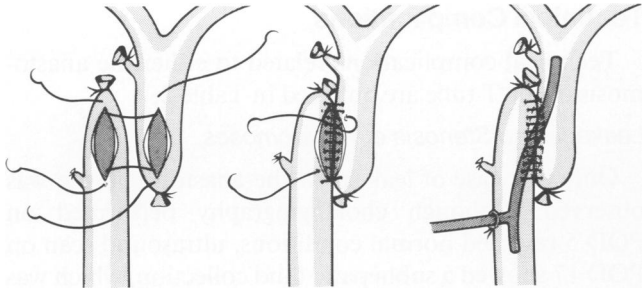

Figure 1. Operative steps of the side-to-side choledochocholedochostomy.

mon bile ducts, and a 12- to 15-mm incision was performed in the corresponding posterior and anterior aspects of the donor and recipient common bile ducts (Fig. 1). Then the ends of both common bile ducts were closed by suture-ligation using 4-0 polyglactin 910 (Vicryl, Ethicon, Somerville, NJ). Both ducts were approximated with 5-0 polydioxanon (PDS, Ethicon, Hamburg, Germany) by two corner stitches. The upper needle was used for an inside running suture of the posterior wall of the anastomosis and knotted with the suture of the lower corner stitch outside of the bile duct. A small rubber T tube (2.5 mm) was tailored and fit on a special bile duct probe (Waldemar Link, Hamburg, Germany) (Fig. 2). The probe was brought out through a small hole (electrocautery) of the recipient's common bile duct. The anterior wall of the anastomosis was then closed with a running suture commencing on both corners toward the middle of the anastomosis. Patency of the anastomosis was tested with saline after fixing the T tube with two fine stitches.[7] The T tube was brought through the abdominal wall and connected with a collecting bag for 5 days. X-ray cholangiography was performed 5 days after transplantation and the T tube was closed subsequently, if no abnormalities were detected (Fig. 3). After 6 weeks, a second x-ray cholangiography was performed routinely, and the T tube was removed, if no pathological findings were observed. All patients received ursodeoxycholic acid (250 mg) twice a day for at least 6 weeks after transplantation to increase bile secretion and reduce bile viscosity.

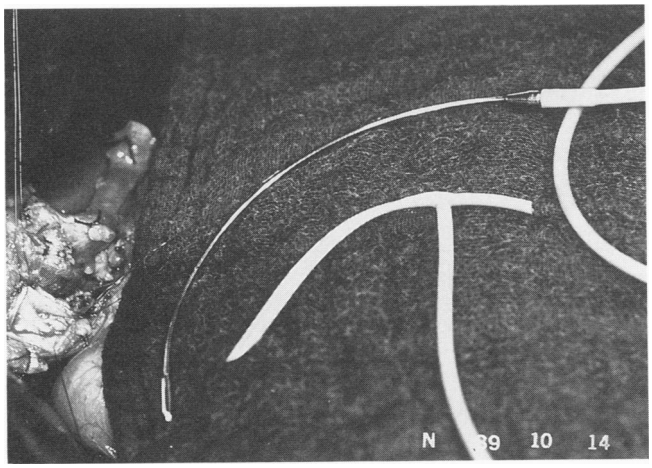

Figure 2. T tube with a long proximal limb attached to a curved bile duct probe.

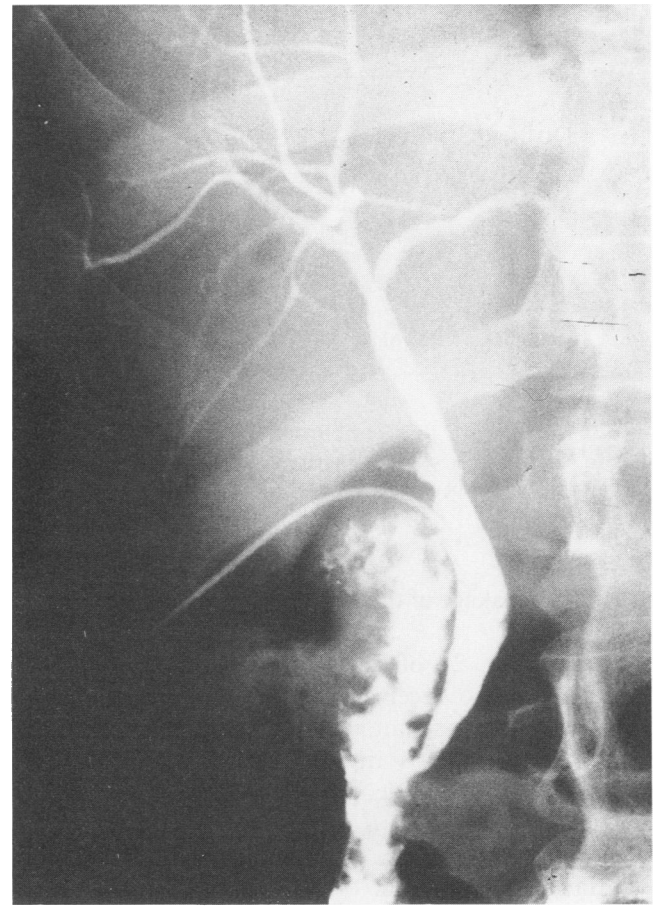

Figure 3. Normal T-tube cholangiogram 5 days after liver transplantation with side-to-side biliary anastomosis (note the long donor cystic duct).

RESULTS

Three hundred of 340 patients with primary liver transplants received a side-to-side choledochocholedochostomy. Thirty-two patients did not receive a direct bile duct anastomosis because of primary disease affecting the extrahepatic bile duct system of the recipient; in 8 patients, the donor bile duct was unsuitably short, necessitating hepatojejunostomy for 3 patients, end-to-side anastomosis for 2 patients, and end-to-end anastomosis for 3 patients for their first liver transplant. The complication rate of bilioenteric anastomoses was 6% (2 of 35)

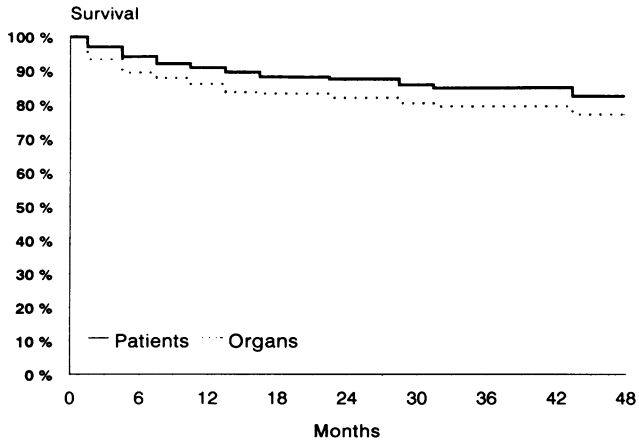

Figure 4. Actuarial survival of 340 patients with 370 grafts in the Berlin Virchow liver transplant program.

because of leakage of the anastomosis requiring reoperation.

In addition, 21 of 30 patients undergoing retransplantations also received side-to-side anastomosis in their second transplant. Five patients underwent bilioenteric anastomosis in the first transplant, and in four cases, side-to-side anastomosis was switched to choledochojejunostomy. After retransplantation, not a single complication was observed, regardless of the biliary tract reconstruction.

Survival

Survival rates of 340 patients with 370 grafts are presented in Figure 4. One-month patient survival was 98%. Three, six and twelve-month survival rates were estimated at 97%, 94%, and 91%, respectively.

Early Biliary Tract Findings

When x-ray cholangiography via the T tube was performed on POD 5, normal conditions were observed in more than 95% of the patients, and the T tube was closed. The intrahepatic and extrahepatic bile duct system appeared regularly contrasted, and the contrast fluid passed the anastomosis without leakage. No stenoses were diagnosed at that time (Fig. 3). T-tube cholangiography on POD 42 showed normal conditions in more than 97% of the cases, and the T tube was removed thereafter. Leakage or stenosis was not observed. In three patients, mild changes of the intrahepatic or extrahepatic bile duct system were observed, which progressed over time and will be presented, summarized as the entity of ischemic-type biliary lesions (ITBL).

Technical Complications

Technical complications related to either the anastomosis or the T tube are outlined in Table 2.

Leakage and Stenosis of Anastomoses

Only one case of leakage at the anastomotic site was observed. Although cholangiography performed on POD 5 revealed normal conditions, ultrasound scan on POD 17 showed a subhepatic fluid collection, which was identified by fine needle aspiration as bile fluid. After endoscopic papillotomy and introduction of a stent into the common bile duct, clinical signs of peritonitis resolved. The stent was left in place for 5 weeks, but after removal, the leakage persisted, and the patient required reoperation. The leak was sewn over intraoperatively, but it remained unclear whether it originated from the anastomosis or the ligated end of the recipient common bile duct. Early stenoses of the anastomosis were not observed, but in two cases, late stenoses developed at the anastomotic site more than 3 months and 1 year after transplantation. The first patient experienced signs of cholestasis and cholangitis. Stenosis of the papilla Vateri was diagnosed, followed by endoscopic sphincterotomy. After a year, the same patient showed a short stricture below the bifurcation of the bile duct, which was resected surgically and reconstructed by an end-to-end anastomosis. Almost the same results were seen in a second patient, with a subtotal stricture at the level of the bifurcation. Both anastomoses were treated initially with balloon dilatation and intraluminal stent for 6 weeks, and the patients remained asymptomatic afterward.

T-Tube Complications (n = 4)

Biliary leakage occurred in one patient after early removal of the T tube 4 weeks after OLT. Because of this

Table 2. SURGICAL COMPLICATIONS AFTER BILIARY RECONSTRUCTION WITH SIDE-TO-SIDE CHOLEDOCHOCHOLEDOCHOSTOMY IN 300 PRIMARY LIVER TRANSPLANTATIONS

		Treatment	
		Endoscopy	Surgery
Anastomotic complications	3 (1%)		
Biliary leakage	1 (0.3%)	—	1
Early biliary stenosis	0	—	—
Late biliary stenosis	2 (0.6%)	—	2*
T-tube complications	4 (1.3%)		
Leakage after removal	3 (1.0%)	1	2
T-tube torn off	1 (0.3%)	1	—

* Both patients may represent ITBL instead of anastomosis stenosis.

Table 3. COMPLICATIONS UNRELATED TO SURGERY IN 340 PATIENTS WITH 370 ORTHOTOPIC LIVER TRANSPLANTS

		Treatment		
	28 (9.3%)	Endoscopy	Surgery	Retransplantation
Hemobilia (biopsy)*	2 (0.6%)	—	—	2
Papillary stenosis	17 (5.7%)	13	—	—
Ischemic type biliary lesions†	9 (3.0%)	2	—	4

* One patient with ITBL also.
† One patient with diffuse alterations of the intrahepatic and extrahepatic biliary system is awaiting retransplantation and two are being treated expectantly.

experience, all T tubes were left in place for 6 weeks. A second complication occurred when the T tube was dislocated accidentally on POD 3, which required operative replacement. In the third patient, an external biliary fistula along the T-tube track was apparent after removal of the T tube because of primarily undiagnosed papillary stenosis. Sphincterotomy was performed endoscopically. In the last patient, the T tube was torn off during removal and the remnant extracted endoscopically. None of these T tube-related complications were associated with serious side-effects, such as cholangiosepsis, bacterial peritonitis, or complicated surgery.

Biliary Complications Unrelated to Anastomotic Site (Table 3).

Hemobilia after liver transplantation was seen in two patients and was related to percutaneous liver biopsy. The primary course was uneventful, but severe bleeding occurred after liver biopsy, which was followed by complete thrombosis of the biliary tract, requiring endoscopic intervention. Within the following months, intermittent episodes of septic cholangitis and abscesses in the right lobe of the liver developed. Six months later, the patient, who was diagnosed cholangiographically, required retransplantation because of severe destruction of the biliary tract. The patient recovered completely. The second patient required repeated biopsies because of recurrent episodes of cholangitis associated with minor signs of bile duct destructions (ITBL), predominantly in the left lobe of the liver. The patient experienced severe hemobilia with two episodes of hemorrhagic shock, and required massive blood transfusion. Urgent retransplantation was performed, but the patient died 40 days later with intact graft function caused by cardiac failure.

Stenosis of the Papilla Vateri

Stenosis or dysfunction of the papilla vateri was observed in 17 patients between PODs 42 and 180 after transplantation. This diagnosis was based on elevations of cholestatic enzymes (alkaline phosphatase, Γ-glutamate transferase), bilirubin, or ultrasound findings, and was confirmed by endoscopic retrograde cholangioscopy. All patients were treated successfully by endoscopic sphincterotomy.

Ischemic-Type Biliary Lesions

Ischemic-type biliary lesions within the intrahepatic or extrahepatic biliary system of the graft have been diagnosed in nine patients. Two patients were treated initially with balloon dilatation and intraluminal stent; one patient recovered and remained asymptomatic, but the other patient died after urgent retransplantation after hemobilia caused by liver biopsy, as mentioned previously. Seven patients showed diffuse extrahepatic and intrahepatic strictures and lesions. Four of these patients have had successful retransplantations, one patient is awaiting retransplantation, and the remaining two do not appear to need retransplantation at the present time.

DISCUSSION

Liver transplantation has reached a high technical standard, but biliary reconstruction remains a surgical challenge (Table 4). Early experiences were characterized by high reoperation and mortality rates for biliary complications. Preservation injury, arterial thrombosis, and severe acute or chronic rejection, which contributed considerably to biliary complications before 1988, have been observed less frequently within the last years. Early leakage of the anastomosis, T tube-related biliary complications, and early or late stenosis followed by cholangitis and sepsis remain serious problems.

Cholecystoduodenostomy, cholecystojejunostomy, or the gall bladder conduit technique were used in the early experience of liver transplantation.[1,6] Septic complications were observed in up to 70% of patients, and many defunctionalized gall bladders had to be removed be-

Table 4. OVERALL INCIDENCE OF TECHNICAL COMPLICATIONS RELATED TO ESTABLISHED BILIARY ANASTOMOSIS TECHNIQUES AFTER LIVER TRANSPLANTATION

Author	Center	Year	End/End + T-Tube	Roux-Y Chol.Jej.	Gall Bladder Conduit-Technique
Iwatsuki[9]	Pittsburgh	1983	12/51 (24%)	2/24 (8%)	—
Krom[10]	Groningen	1984	5/29 (17%)	—	—
Bismuth[8]	Paris	1987	—	2/55 (4%)	—
Hiatt[11]	Los Angeles	1987	13/55 (28%)	8/27 (30%)	—
Lerut[12]	Pittsburgh	1987	20/159 (12.6%)	9/175 (5.2%)	—
		"with stent"	14/32 (43.8%)	—	—
Rolles[2]	Cambridge	1987	12/24 (50%)	—	23/196 (12%)
Vicente[13]	Mayo	1987	12/31 (38.7%)	5/19 (26.3%)	—
Ringe[4]	Hannover	1989	14/41 (36%)	18/121 (14.9%)	—
Stratta[14]	Omaha	1989	23/118 (19.5%)	27/144 (18.8%)	—
Anselmi[15]	Birmingham	1990	27/60 (45%)	—	29/60 (48.3%)
Decurtins[16]	Zürich	1990	2/14 (14%)	—	—
Rouch[17]	Chicago	1990	9/25 (35%)	15/72 (21%)	—
		"without T-tube"	7/38 (18%)	—	—
Lopez[18]	Nashville	1992	14/52 (27%)	3/10 (30%)	—
Totals			184/729 (25%)	89/647 (14%)	52/256 (20%)

cause of obstruction of the cystic duct. Therefore, choledochojejunostomies with Roux-en-Y loop were used subsequently.[8] An intact sphincter Oddi is thought to be most important in preventing septic cholangitis by ascending infections, which evolved into the preferred strategy of end-to-end anastomosis of donor and recipient common bile ducts drained by a T tube. This technique can be difficult, especially in children with very small bile ducts. Complication rates of up to 25% were observed, including leakage, stenosis, and T tube problems (Table 4).

A physiologic reconstruction preserving the sphincter function also can be achieved using the side-to-side anastomosis. Initially, we used this technique in Rhesus monkeys and had great success.[7] These experimental findings prompted us to perform the side-to-side choledochocholedochostomy in human liver transplants. In the present study, we report our results with side-to-side choledochocholedochostomy in 370 liver transplants within the last 5 years. Although first described more than 10 years ago, side-to-side anastomosis of the common bile duct has not been accepted widely.

The blood supply of the common bile duct has been discussed controversially and was considered to be the critical factor in the transplant situation.[19] The blood supply of the common bile duct is very rich, and thus, can be destroyed only by severe trauma.[20] Because the biliary system of transplanted livers is vascularized mainly by the hepatic artery of the donor, the transplant situation may be more critical to the anastomotic site, and a well-preserved hepatic artery of the graft seems to be very important.

The technical advantage of side-to-side anastomosis is broad adaptation of small bile ducts, without the danger of developing stenosis. The incidence of strictures approached 54% and 78% in patients receiving end-to-end biliary anastomosis after biliary tract injury during cholecystectomy.[21,22] Mechanical trauma to the edges and traction on the suture are more likely to cause necrosis and leakage in an end-to-end than in a side-to-side situation. Proximal and distal blind pouches can be kept very small, and therefore, are unlikely to cause stone formation — i.e., we did not observe any stone formation in 316 bile duct anastomosis.

After 300 choledochocholedochostomies, we observed 7 surgical complications (2.3%), which compared well with other reports published on biliary complications after liver transplantation (Table 4). The overall incidence of biliary complications for end-to-end choledochocholedochostomy varied between 10% and 50%, for Roux-en-Y choledochojejunostomy, it varied between 4% and 30%, and for the gall bladder interposition, it varied between 12% and 48%. Using the gall bladder conduit technique, biliary tract abnormalities were observed in 80%.[15] Next to our center, Hannover successfully used the side-to-side choledochocholedochostomy with an incidence of complications of 4.9% between 1982 and 1987.[4] Excellent results also were reported using a modified technique of duct-to-duct reconstruction with a cobra-head technique known from vascular surgery.[23] The incidence of complications was 4% in 100 liver transplantations.

The most striking argument for using the side-to-side technique is the virtual absence of early biliary leakage (1/300, 0.3%). The incidence of biliary leakage after end-to-end anastomosis was as high as 22%, often requiring

surgical intervention. The incidence of either early or late stenosis may be even higher than reported in the literature because of the variable aggressiveness of diagnostic procedures.

Placement of the T tube has been identified as the main source of complications — i.e., early dislocation with leakage, obstruction by the T tube, or leakage after removal of the T tube. T tube-related complications varied between 10% and 28%.[4,11,12,14] The incidence of biliary complications in patients with end-to-end choledochocholedochostomies and T tubes was considerably higher (35%) than patients who did not receive T tubes (18%).[17] In our series, T tube-related complications occurred in 1.3%, which is similar to the results reported from Hannover.[4] Regardless of the kind of anastomosis, the use of rubber T tubes, instead of tubes of silicon or other materials, may be one of the keys for low T-tube complications.

In addition to surgical technique, preservation injury, impaired blood supply, adverse side-effects of immunosuppression, and rejection may contribute to the complications of the biliary tract anastomosis.[24] Biliary complications unrelated to surgery have been encountered more frequently within recent years.[25] This is especially true of ITBL, which has been diagnosed in nine of our patients (3%); four patients required retransplantations because of this. In two other patients, pathologic findings were circumscript and could be managed endoscopically. We believe that ITBL represents the most serious complication of the bile duct system, which is associated highly with stenosis or dysfunction of the papilla Vateri. Seventeen cases (5.7%) of papillary stenosis have been diagnosed and treated with endoscopic papillotomy. The incidence of papillary stenosis, in previously asymptomatic patients, seems to be surprisingly high. A possible explanation may be the denervation of the proximal bile duct segment during resection of the liver. This can lead to dysfunction in a critical (not identified yet) papillary situation. It has not been shown if a combination of papillary stenosis (stasis), bile composition (acid), cholangitis, and preservation injury, in conjunction with a Compromised arterial blood supply of the bile duct epithelium, has an impact on the development of ITBL. Further investigations must elucidate whether ITBL is just a syndrome evoked by the factors mentioned above, or if immunologic events contribute to it. Decreased arterial blood supply may be the result of chronic rejection, because onset of ITBL is late for an event related to preservation injury.

CONCLUSION

Side-to-side choledochocholedochostomy is a safer and more reliable technique of biliary anastomosis after orthotopic liver transplantation compared to either end-to-end choledochocholedochostomy or end-to-side choledochojejunostomy. Early anastomotic complications are negligible, and T-tube complications are rare. The use of T tubes seems advantageous for diagnostic purposes. Complications unrelated to surgery, such as papillary stenosis and ITBL, have been observed increasingly. Both represent the most serious biliary complications, and should be the subjects of further research.

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