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Novel Biliary Reconstruction Techniques During Liver Transplantation

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Background: Biliary complications remain a significant problem following liver transplantation. Several surgical options can be used to deal with a significant size mismatch between the donor and recipient bile ducts during the biliary anastomosis. We compared biliary transposition to recipient biliary ductoplasty in cadaveric liver transplant.

Methods: A total of 33 reconstructions were performed from January 1, 2005 to December 31, 2013. In the biliary transposition group (n=23), 5 reconstructions were performed using an internal stent (5 or 8 French pediatric feeding tube), and 18 were performed without. Of the 10 biliary ductoplasties, 2 were performed with a stent. All patients were managed with standard immunosuppression and ursodiol. Follow-up ranged from 2 months to 5 years.

Results: No patients in the biliary transposition group required reoperation; 1 patient had an internal stent removed for recurrent unexplained leukocytosis, and 2 patients required endoscopic retrograde cholangiography and stent placement for evidence of stricture. Three anastomotic leaks occurred in the biliary ductoplasty group, and 2 patients in the biliary ductoplasty group required reoperation for biliary complications.

Conclusion: Our results indicate that biliary reconstruction can be performed with either biliary transposition or biliary ductoplasty. These techniques are particularly useful when a significant mismatch in diameter exists between the donor and recipient bile ducts.

Keywords: *Anastomosis–surgical, bile ducts–extrahepatic, biliary tract surgical procedures, liver transplantation*

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INTRODUCTION

Historically, the biliary anastomosis has been termed the *Achilles heel* of orthotopic liver transplantation.[1] Complications such as leak, structure, fistula, infection, and cast formation led to the evolution of new technical methods. Early biliary reconstructions were performed using loop choledochojejunostomy and Roux-en-Y choledochojejunostomy (RYCJ), as well as using the gallbladder as a conduit. In the 1980s, duct-to-duct drainage over a T-tube became the most popular technique. During the past 2 decades, duct-to-duct anastomosis without a T-tube has become the primary method of reconstruction.

In cases of a significant size mismatch between donor and recipient bile ducts, several surgical options are available. Most commonly, RYCJ was performed prior to 1990. With the advent of living donor liver transplantation in the 1990s, reconstruction without enteric anastomosis has been perfected. Biliary ductoplasty is usually performed by either partially closing a patulous recipient common duct, spatulating the donor common duct, creating a common orifice between the cystic and common ducts, joining via a side-to-side anastomosis, or performing a choledochoduodenostomy. These techniques may be performed with or without the use of internal stents. The use of an internal stent, although theoretically eliminating the possible complications associated with T-tubes, has not shown uniformly reproducible results.

The evolution of the field of liver transplantation has resulted in improved patient outcomes.[2] In an effort to encourage this improvement, we have adapted a technique of biliary drainage. Although use of the cystic duct for duct-to-duct biliary reconstruction has been previously reported in living donor liver transplantation,[3] to our knowledge, it has never been described for cadaveric liver transplantation.

The objective of this study was to compare the outcomes of biliary ductoplasty and biliary transposition in cadaveric liver transplantation. A paucity of data exists for the outcomes of these 2 techniques. To our knowledge, ours

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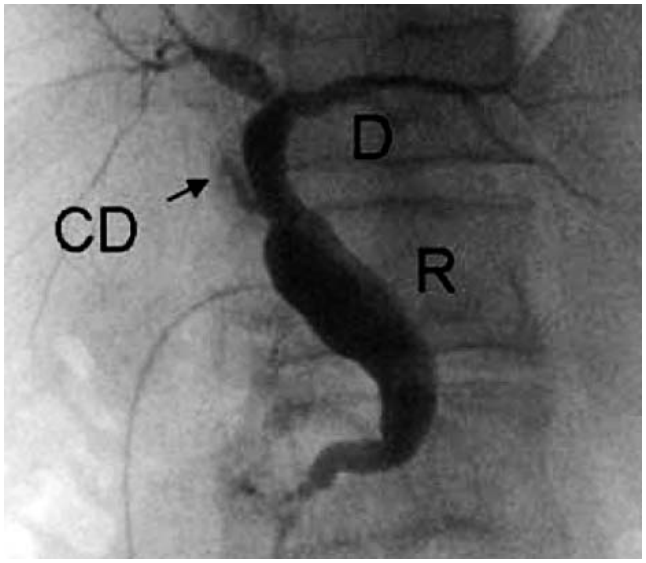

Figure 1. Biliary ductoplasty. CD, cystic duct; D, donor bile duct; R, recipient.

is the largest series describing the use of recipient cystic duct biliary drainage for reconstruction.

METHODS

In this single-center, retrospective study, all patients ≥18 years who received a cadaveric liver transplant from January 1, 2005 to December 31, 2013, were enrolled. Follow-up ranged from 2 months to 5 years. All patients were managed with standard immunosuppression and ursodiol.

Our standard liver transplant procedure is the performance of hepatectomy with bicaval reconstruction without the use of bypass. Once vascular reconstruction is completed, the graft is reperfused, and hemostasis is completed, the donor gallbladder is removed using a top-down technique. The donor cystic duct and cystic artery are individually ligated. Blood supply and connective tissue surrounding the donor duct are preserved. The size match between the donor and recipient common bile ducts is assessed. The operative surgeon makes the decision to perform biliary transposition or biliary ductoplasty.

Biliary Ductoplasty Technique

Biliary ductoplasty is performed by closing a portion of the lateral recipient common bile duct with a running 6-0 PDS (polydioxanone) suture (Ethicon US, LLC). Anastomosis then proceeds in a similar manner as with an unaltered donor bile duct, with the surgeon taking special care to place needle bites on each side of the ductoplasty suture line to avoid bile leakage (Figure 1).

Biliary Transposition Technique

In biliary transposition, the recipient cystic duct remnant is transected and flushed with saline via bubble needle syringe. Special care is taken to assess the ease of flow through the spiral valves of Heister. The biliary transposition is performed using loupe magnification. The common hepatic duct to cystic duct anastomosis is performed using a running 6-0 PDS suture (Figure 2). Jackson-Pratt drainage is used routinely.

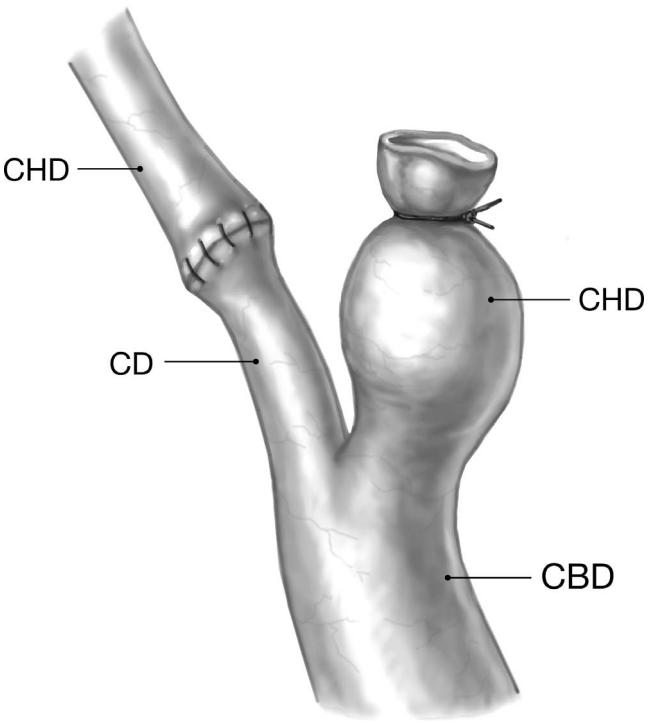

Figure 2. Biliary transposition. CHD, common hepatic duct; CD, cystic duct of recipient, CBD, common bile duct of recipient.

Immunosuppression Management

Immediately prior to the transplant, patients received induction therapy either with a steroid (methylprednisolone) protocol or thymoglobulin. Thymoglobulin induction was used in patients with hepatitis C virus (HCV) and a Model for End-Stage Liver Disease (MELD) score <25 in an effort to minimize HCV recurrence posttransplantation. All patients were initiated on a tacrolimus-based maintenance immunosuppression regimen in combination with mycophenolate and a prednisone taper. Patients who underwent steroid induction were targeted to be on tacrolimus monotherapy at 6 weeks. The thymoglobulin protocol is steroid-free by postoperative day 2, and patients are targeted to be on tacrolimus monotherapy.

Data Collection

The electronic medical record was used to collect patient characteristics including age, medical history, details of transplant surgery, and postoperative hospital course. Postoperative information collected included patient and graft survival.

The primary outcomes were 1-, 3-, and 5-year graft and patient survival following liver transplantation. Secondary outcomes were postoperative complications, biliary complications, and HCV recurrence.

RESULTS

Statistical analysis was not performed because the sample sizes were small and heterogeneous. A total of 33 patients were enrolled in the study: 23 patients in the biliary transposition group and 10 in the biliary ductoplasty group.

Table 1. Demographics and Outcomes Comparison

	Biliary Ductoplasty Group n=10	Biliary Transposition Group n=23
Mean recipient age, years	58	54
Mean donor age, years	28	38
Diagnosis, n[a]		
Hepatitis C virus	6	10
Laennec cirrhosis	2	7
Hepatocellular carcinoma	4	6
Hepatitis B virus	1	0
Nonalcoholic steatohepatitis	0	2
Adenomatosis	0	1
Fulminant hepatic failure	0	1
Outcomes, n		
Death	1	0
Reoperation	2	0
Leak	3	1
Stricture	5	2
Endoscopic retrograde cholangiography	18	13
Operating room stent	2	5
Hepatitis C virus recurrence	7	13

[a]Some patients had more than one diagnosis.

Of the 10 biliary ductoplasties, 6 were performed with interrupted suture and 4 were performed with continuous suture. Two biliary ductoplasties were performed with a stent. By operative surgeon preference, internal stenting using a 5 or 8 French pediatric feeding tube was used in 5 of the 23 cases of biliary transposition. Demographic and outcome data are presented in Table 1.

Patient and graft survival data are presented in Table 2. Patient survival for biliary ductoplasty and biliary transposition was 100% in both groups at 1 year; 80% and 88%, respectively, at 3 years; and 75% and 86% respectively, at 5 years. Graft survival for biliary ductoplasty and biliary transposition was 100% in both groups at 1 year; 80% and 82%, respectively, at 3 years; and 75% and 86%, respectively, at 5 years.

Postoperative complication rates were 70% (7/10) in the biliary ductoplasty group and 61% (14/23) in the biliary transposition group. Fifty percent of the patients in the biliary ductoplasty group had a stricture compared to 9% of the patients in the biliary transposition group. Ten percent (1/10) of patients in the biliary ductoplasty group had an early stricture compared to 9% (2/23) in the biliary transposition group. HCV recurrence rates were 70% in the biliary ductoplasty group and 57% in the biliary transposition group.

DISCUSSION

Compared to RYCJ, biliary transposition and biliary ductoplasty have the theoretical advantages of no bowel manipulation, less biliary reflux because of the intact sphincter, decreased cholangiocarcinoma risk, and easier endoscopic access for examination or treatment of biliary complications.

Table 2. Patient and Graft Survival

	Biliary Ductoplasty Group n=10	Biliary Transposition Group n=23
Patient survival, %		
1 year	100	100
3 years	80	88
5 years	75	86
Graft survival, %		
1 year	100	100
3 years	80	82
5 years	75	86

Theoretical disadvantages include decreased bile flow because of the valves of Heister and risk of perforation of the recipient common hepatic duct stump at endoscopic retrograde cholangiography (ERC). It is important to communicate the operative biliary anatomy to the specialist performing the ERC. A high risk of significant bile duct mismatch would appear to occur in recipients who have previously undergone cholecystectomy, as well as those who have large gallstones and/or choledochalithiasis.

Our series was not without complications. No deaths occurred in the biliary transposition group. The most significant complication in the biliary transposition group was a bile leak. The most significant complication in the biliary ductoplasty group was death unrelated to biliary complication. Other significant complications included bile leak and strictures. The trend with all the outcomes in this study favors biliary transposition compared to biliary ductoplasty. However, this series is underpowered, so we cannot definitively conclude that one technique is superior to the other. Additionally, because of the sample size, we cannot conclusively evaluate the use of internal stenting at the time of reconstruction.

Our results do indicate that biliary reconstruction can be performed with either biliary transposition or biliary ductoplasty. These techniques are particularly useful when a significant mismatch in diameter exists between the donor and recipient bile duct. We will continue to follow these patients to describe the long-term outcomes of these techniques.

CONCLUSION

Our results indicate that biliary reconstruction in the face of significant bile duct size mismatch can be performed using either biliary transposition or biliary ductoplasty, but a trend appears to favor outcomes with biliary transposition. Future research directions include analyzing costs and length of stay compared to Roux-en-Y reconstruction.

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