BILIARY RECONSTRUCTIVE TECHNIQUES AND ASSOCIATED ANATOMIC VARIANTS IN ADULT LIVING DONOR LIVER TRANSPLANTS: THE A2ALL EXPERIENCE

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Abbreviations

A2ALL, Adult to Adult Living Donor Liver Transplantation Cohort Study

BC, biliary complication

ESLD, end-stage liver disease

HAT, hepatic artery thrombosis

HCC, hepatocellular carcinoma

LDLT, Living donor liver transplantation

SRTR, Scientific Registry of Transplant Recipients

PVT, portal vein thrombosis

VC, vascular complication

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Abstract

Introduction: Living donor liver transplantation (LDLT) is a technically demanding endeavor, requiring command of the complex anatomy of partial liver grafts. We examined the influence of anatomic variation and reconstruction technique on surgical outcomes and graft survival in the nine-center A2ALL Study.

Methods: Data from 272 adult LDLT recipients (2011-2015) included details on anatomic characteristics and types of intraoperative biliary reconstruction. Associations were tested between reconstruction technique and complications, which included first biliary complication ([BC]; leak, stricture, or biloma) and first vascular complication (hepatic artery thrombosis [HAT] or portal vein thrombosis [PVT]). Time to patient death, graft failure, and complications were estimated using Kaplan-Meier curves and tested with log-rank tests.

Results: Median post-transplant follow-up was 1.2 years. Associations were found between the type of biliary reconstruction and the incidence of vascular complication ($p=0.034$) and BC ($p=0.053$). Recipients with Roux-en-Y hepatico-jejunostomy had the highest probability of vascular complication. Recipients with biliary reconstruction involving the use of high biliary radicals on the recipient duct had the highest likelihood of developing BC (56% by one year) compared to duct-to-duct (42% by one year).

Conclusion: The varied surgical approaches in the A2ALL centers offer a novel opportunity to compare disparate LDLT approaches. The choice to use higher biliary radicals on the recipient duct for reconstruction was associated with more BC, possibly secondary to devascularization and ischemia. The use of Roux-en-Y biliary

reconstruction was associated with vascular complications (HAT and PVT). These results can be used to guide biliary reconstruction decisions in the setting of anatomic variants and inform further improvements in LDLT reconstructions. Ultimately, this information may contribute to a lower incidence of technical complications after LDLT.

Introduction

Although liver transplantation (LT) has become the standard for care for end-stage liver disease (ESLD) and unresectable hepatocellular carcinoma (HCC), at least 14,771 patients await liver transplantation in the US (1). With a critical shortage of donated organs, patient waiting list mortality has increased and patients are often critically ill at the time of transplant (2-3). Living donor liver transplantation (LDLT) has become widely accepted in the US as a potential alternative to address this imbalance in organ supply. Several important factors, however, have limited center-specific adoption and growth of LDLT programs. Most significantly, LDLT is an extremely technically challenging procedure that requires sophisticated training as well as institutional and programmatic commitment (4). Furthermore, there are risks associated with the donor operation, including liver failure and death, which call the ethics of LDLT into question (5-11). For these reasons, among others, there are a limited number of transplant centers in the US routinely performing this procedure.

To properly study optimal outcomes and utilization of LDLT in the US, the US National Institutes of Health organized a consortium of nine leading transplant centers, and established the Adult to Adult Living Donor Liver Transplantation Cohort Study (A2ALL) in 2002 (12). The participating centers dedicated themselves to reporting and investigating short- and long-term outcomes for both recipients and donors. Starting in February 2011, extensive intraoperative and anatomic data were collected for both recipients and donors. Data were recorded chronicling the details of anatomic reconstructive techniques used in the transplant procedures. While many have described arterial (4,13-21), portal venous (22-25), and biliary (26-30) variants and their

potential impact on the living donor procedure (31-39), this is the first multi-institutional investigation with disparate, non-prescribed approaches to biliary reconstructive techniques to study the overall implications of biliary reconstructions and associated anatomic variations on outcomes after living donor liver transplant. The aim of this study, in addition to describing the anatomic and surgical variation, was to critically evaluate this unique study cohort to examine the influence of anatomic variations and multiple biliary reconstructive techniques on surgical outcomes and overall graft and patient survival.

Methods

Patient population: Subjects in this study, a subset of those enrolled in A2ALL, included those transplanted between April 2011 and January 2014. The A2ALL consortium is a multi-center observational cohort study designed to investigate outcomes in donors and recipients of adult-to-adult LDLT. All subjects were enrolled prospectively at one of nine North American transplant centers (eight in the United States and one in Canada) at the time their living donor was accepted for donation. Baseline demographic and clinical data were collected at the time of enrollment. Detailed clinical data were collected prior to transplant, peri-operatively, and post-operatively, with prospective follow-up continuing through August 1, 2014. We excluded from analysis one adult recipient of a left lateral segment graft.

This study used data from the Scientific Registry of Transplant Recipients (SRTR) to supplement data on graft failure and mortality for subjects transplanted at centers located in the United States. The SRTR data system includes data on all

donors, wait-listed candidates, and transplant recipients in the United States, submitted by members of the Organ Procurement and Transplantation Network (OPTN), and has been described elsewhere (40). The Health Resources and Services Administration (HRSA), U.S. Department of Health and Human Services, provides oversight to the activities of the OPTN and SRTR contractors.

Intraoperative data collection: Information on donor anatomy was collected for donors that enrolled in A2ALL. Details on the types of reconstruction used in the transplant procedure were collected intraoperatively. Our primary focus in this study was on the type of biliary reconstruction performed. Reconstruction was categorized into five main groups as characterized previously in the literature (32,33): **1AD**: single duct-to-duct ; **2CD**: ductoplasty to single duct ; **AJ**: all Roux-en-Y anastomoses; **ADAJ**: a mix of Roux-en-Y and duct-to-duct; and **AY**: reconstruction using high biliary radicals (i.e., cystic duct or right/left hepatic duct radicals). Details on the types of hepatic vein, hepatic artery, and portal vein reconstructions were also collected.

Outcome measures: The primary outcomes of interest were biliary (leak, stricture) and vascular (hepatic artery thrombosis, portal vein thrombosis) complications. As this was a multi-institutional observational study, complications were defined and reported by center-specific criteria without standardization. Graft failure, defined as death or retransplant, and mortality were also examined.

Statistical Methods: Study subjects were followed from the time of transplant to death or last available follow-up. Descriptive statistics are given as means and standard deviations for continuous variables or as proportions for categorical variables.

Demographic, clinical, and reconstruction information is shown separately for left and right lobe transplants.

To examine the association between biliary reconstruction and complications, the time to first biliary complication and time to first vascular complication (both censored at graft failure or death) were examined using Kaplan-Meier curves stratified by type of biliary reconstruction. Differences among reconstruction types were tested using log-rank tests. Graft and patient survival by reconstruction type were also evaluated using Kaplan-Meier survival curves and log-rank tests. Statistical analyses were carried out using SAS version 9.4 (SAS Institute; Cary, NC). Results with a two-sided p-value ≤ 0.05 were considered statistically significant.

Results

Study population and demographics.

Both recipient and donor characteristics are given in Table 1 by right and left lobe. The mean recipient age was approximately 52, and 37% were female. Recipients of left lobe grafts had significantly lower MELD scores than recipients of right lobe grafts (13.4 vs. 16.2; p = 0.003). Few recipients in this cohort were on a ventilator (n = 3) or on dialysis (n = 3) at the time of transplant, and all were right lobe recipients. No significant differences, by lobe transplanted, were found for recipient age, BMI, sex, diagnosis, on dialysis or a ventilator at transplant, and cold or warm ischemia time. Among donors, the mean age was approximately 35 and mean BMI was nearly 27. Most donors were blood relatives of the recipient (63%), with the most common relationship being adult-

child (35%). No significant differences were found between donors of right and left lobes for donor age, BMI, sex, and relationship to recipient.

Hepatic and biliary reconstructive patterns in the A2ALL cohort

Overall, 85% of grafts in the cohort were right lobes (232 versus 40 left lobes) (Table 2). The majority of right lobe grafts (90%) did not include the middle hepatic vein; most left lobe grafts did (85%). For right lobe recipients, hepatic venous reconstruction was performed from the right hepatic vein to the vena cava (including all segments) in 54%. For left lobe recipients, a common orifice, including the left and middle hepatic vein, was anastomosed to the vena cava in 55% and the common orifice of the left and middle hepatic vein in 45% of recipients. Eighteen right lobe recipients required portal venous interposition grafts, and 10 right and 10 left lobe recipients underwent reconstruction of two hepatic arteries at implantation.

All but one (right lobe) recipient had data on biliary reconstruction. Of right lobe recipients, 151 (65%) underwent a single biliary anastomosis versus 37 (93%) of left lobe recipients. Eighty (34%) right lobe recipients and 3 (8%) left lobe recipients underwent more than one biliary anastomosis, with 27 right lobe (and no left lobe) recipients having an accessory duct oversewn.

Table 3 contains biliary reconstruction information on 271 recipients, with detailed biliary anatomy for 250 corresponding donors. Biliary anatomy and reconstructive techniques were recorded and classified as previously reported in the literature.[32,33] Overall, of the 212 right lobe grafts with known donor biliary anatomy, 86 (41%) contained single right hepatic duct anatomy and most were reconstructed via

duct-to-duct (1AD; n = 44) or Roux-en-Y (1AJ, 2AJAJ, 3AJCJ; n = 35) fashion. For 38 left lobe grafts with known donor anatomy, 36 (95%) contained single left hepatic duct anatomy. Of these, 21 underwent duct-to-duct reconstruction and 10 used Roux-en-Y. Interestingly, multiple hepatic ducts originating from the right lobe were not universally reconstructed using a roux limb. Thirty right lobe recipients underwent ductoplasty (2CD) prior to implantation in duct-to-duct fashion.

Surgical methods, numbers of procedures, and the usage of right vs. left lobes varied among the nine A2ALL transplant centers (Figure 1). Six of the nine centers performed at least one LDLT using the left lobe, with only three centers performing more than two left lobe transplants. The majority of left lobes were performed by Center A (n = 15) and Center E (n = 15). Most of the left lobe recipients at those two centers underwent duct-to-duct reconstruction +/- ductoplasty (n =21/30). For right lobe recipients, most centers reconstructed the bile duct by duct-to-duct or Roux-en-Y limb, or a combination of the two. Use of higher biliary radicals for the anastomosis was rare at most centers, and was used at least once in five of the nine centers.

Association between biliary reconstructive techniques and graft and patient survival

Estimates of overall post-transplant survival at 3 months, 1 year, and 2.5 years, respectively, were 90%, 85%, and 83% for graft survival, and 94%, 88%, and 87% for patient survival. When presented by ductal reconstruction type (Figure 2), differences are visually apparent, although they do not reach significance for either graft or patient survival (p=0.073 and 0.056, respectively). The most common methods, duct-to-duct

and Roux-en-Y, had similar graft survival (86% and 81% at 2.5 years, respectively) and patient survival (89% and 85% at 2.5 years, respectively). Both graft and patient survival were lower when higher biliary radicals (Group 5) were used (70% and 73% at 2.5 years), with most events occurring shortly after transplant. The 32 patients undergoing duct-to-duct with ductoplasty had 94% graft survival at 2.5 years.

Association between biliary reconstructive techniques and vascular and biliary complications

Overall, fewer recipients had vascular complications (n=27) than biliary complications (n=101), ranging among reconstructive technique groups from 4% to 19% (p=0.034) for vascular complications and 34% to 76% (p=0.053) for biliary complications (Figure 3). For vascular complications, the highest rates were among recipients with a Roux-en-Y or a combination of Roux-en-Y and duct-to-duct reconstruction (Groups 3 and 4). Vascular complications for those without a bowel anastomosis (Groups 1, 2, and 5) appear to be limited to the early post-transplant period, and have a much lower probability of developing overall.

For biliary complications, recipients with reconstruction using high biliary radicals had the highest probability of developing a biliary complication (76%). For the common clinical scenario of a dual ductal system, we performed a subgroup analysis to compare outcomes between ductoplasty ((2CD) and Roux-en-Y (2AJAJ) and found that these reconstructive approaches did not have disparate complication rates. Ductoplasty (2CD) was associated with earlier biliary complications, but long-term outcomes were similar. With the exception of Group 4 (combination duct-to-duct and Roux-en-Y), the risk of

developing a biliary complication appeared to increase steadily in all groups over the first year post-transplant.

To further investigate vascular complications, we tested for associations between biliary reconstruction and either hepatic artery thrombosis (HAT) or portal vein thrombosis (PVT) (Figure 4). There were significantly different probabilities of HAT among biliary reconstruction groups (Figure 5A, p=0.019). The highest probability of HAT (15% at 2.5 years) was in the Roux-en-Y and duct-to-duct combination group, with approximately half that probability in the Roux-en-Y (8%) and the duct-to-duct with ductoplasty (6%) groups, and no HAT in the duct-to-duct and higher biliary radicals groups. To see if these results were explained by arterial anatomy, we examined the number of arteries reconstructed. Of the 21 recipients with more than one hepatic artery reconstructed, there was only one vascular complication noted, obviating the possibility of demonstrating an association. Furthermore, the number of hepatic arteries was not different for Roux-en-Y vs duct-to-duct reconstruction (p=0.23). For Roux-en-Y reconstruction, 3/106 (3%) had more than one artery reconstructed. For duct-to-duct reconstruction, 8/125 (6%) had more than one hepatic artery reconstructed.

For PVT, differences among reconstruction groups in anatomic variants of portal venous anatomy were not significant (Figure 5B, p=0.134). The highest probability of PVT, however, was again noted in the Roux-en-Y group. Most events in both HAT and PVT occurred during the first two months after transplant, although two HAT and two PVT events occurred beyond 2 months; all four were in the Roux-en-Y group.

Biliary complications included bile leak and biliary stricture. Most bile leaks from either the cut surface or anastomosis occurred in the first six months post-transplant

(Figure 5A). A comparison of reconstruction groups demonstrated significant differences (p=0.04), with the high biliary radical group (Group 5) having the highest risk of bile leak (probability at one year of 45% compared to 15%-25% among Groups 1-4). In contrast to bile leaks, which occurred shortly after transplant, biliary strictures occurred primarily during the first year but with some events continuing throughout the second year post-transplant (Figure 5b). A comparison of reconstruction groups demonstrated no significant differences (p=0.37).

Discussion

The critical shortage of donor organs in the United States has contributed to a growing interest in the adoption of living donor grafts as a reasonable source of donor organs. Living donor grafts offer equivalent or better outcomes than deceased donor grafts, even though living donor grafts are smaller (41,42,43,44). However, technical challenges associated with this procedure and risks to the donor (9,10,11) have contributed to limited adoption outside Asia (4,48,49,50). The A2ALL consortium was conceived to study and optimize donor and recipient outcomes in LDLT.

This longitudinal, multicenter North American experience reflected real-world experience with the full gamut of anatomic variants encountered in living donor liver transplantation and a wide variety of reconstructive surgical techniques. Neither donor selection criteria (including anatomical features) nor operative technique was prescribed. This created the opportunity for the consortium to amass a unique and novel database of anatomic variants in donors and recipients with reconstruction approaches driven by surgeon preference and experience.

The first major finding of the study was related to biliary complications. Simple duct-to-duct anastomosis was associated with a lower risk of biliary leaks or strictures than reconstruction using higher biliary radicals. Nonetheless, 42% of transplant recipients with duct-to-duct reconstructions had a biliary complication (leak or stricture) within a year, the majority of which ultimately resolved (30). Reconstruction with higher order biliary radicals was associated with the highest incidence of biliary complications, including early biliary leaks and development of late biliary strictures. This is likely secondary to ischemia associated with devascularization of the ducts as they are dissected into the higher radicals. We did not identify a strong association between biliary reconstructive techniques and ultimate graft and patient outcome.

The second major finding was an association between the type of biliary reconstruction and the development of vascular complications. This finding cannot be explained by the number of reconstructed arteries, which did not differ between Roux-en-Y reconstructed recipients and those with choledochocholedochostomy. Among the 21 recipients with more than one hepatic artery reconstructed, there was only one vascular complication recorded. The incidence of HAT was significantly higher with the use of a Roux-en-Y reconstruction compared to duct-to-duct anastomoses. This association is thought to be related to the conformation of the reconstructive approach with the Roux-en-Y limb potentially causing compression of the arterial anastomosis. In contrast, PVT incidence was not significantly associated with the type of biliary reconstruction.

The observational nature of the study without standardized criteria for acceptance of anatomic variants, surgical approach, or the use of uniform

reconstructive techniques precludes inference of causal relationships for the associations we observed. The consortium relied on the participation of transplant surgeons with expertise in living donation and center-specific practices of evaluation and acceptance of potential living donors based on anatomic considerations, as well as surgeon-specific operative approaches to reconstruction. Furthermore, the small number of some less common anatomic variants included in the study limit the universal applicability of the findings. Nonetheless, the results represent a real-world experience. The novel findings relating biliary reconstruction to the risk of hepatic artery thrombosis add an important nuance to the well-recognized place held by the bile duct as the Achilles' heel of liver transplantation.

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Figure Legends

Figure 1. Recipient biliary reconstruction by transplant center and graft type (left and right lobe). Bar heights show percents, and counts are given above each bar. Reconstruction types are duct-to-duct (1AD), ductoplasty (2CD), roux-en-y (1AJ, 2AJAJ, 3AJCJ), a combination of duct-to-duct and roux-en-y limb (2ADAJ, 3ADAAJ), and use of higher biliary radicals (1AY, 2AYAY, 3AYAYAY).

Figure 2. Graft (panel A) and patient (panel B) survival after living donor liver transplantation, by type of surgical reconstruction. Reconstruction types are duct-to-duct (1AD), ductoplasty (2CD), roux-en-y (1AJ, 2AJAJ, 3AJCJ), a combination of duct-to-duct and roux-en-y limb (2ADAJ, 3ADAAJ), and use of higher biliary radicals (1AY, 2AYAY, 3AYAYAY). Numbers of events by group [1-5] were [13,2,17,3,8] for graft failure and [11,1,13,1,7] for death.

Figure 3. Probability of vascular (panel A) and biliary (panel B) complications after living donor liver transplantation. Numbers of events by group [1-5, see Figure 2 legend] were [4,2,18,2,1] for vascular and [35,12,36,4,14] for biliary complications.

Figure 4. Probability of Hepatic Artery Thrombosis (HAT) (panel A) and Portal Vein Thrombosis (PVT) (panel B) vascular complications after living donor liver transplantation. Numbers of events by group [1-5, see Figure 2 legend] were [0,2,8,2,0] for HAT and [4,0,11,0,1] for PVT complications.

Figure 5. Probability of bile leak (panel A) and biliary stricture (panel B) complications after living donor liver transplantation. Numbers of events by group [1-5, see Figure 2 legend] were [18,5,17,3,10] for leaks and [27,10,22,3,8] for strictures.

Table 1. Characteristics of study population (n=272)

Characteristic	Right lobe grafts (n=232)	Left lobe grafts (n=40)	p-value*
	n (%) or mean (std.)	n (%) or mean (std.)	
Recipient age	51.8 (11.5)	52.4 (14.7)	0.80
Recipient BMI	27.0 (5.6)	25.6 (4.1)	0.06
Recipient Female	81 (34.9%)	19 (47.5%)	0.13
Recipient diagnosis HCC	56 (24.1%)	6 (15.0%)	0.20
Recipient diagnosis HCV	67 (28.8%)	16 (40.0%)	0.16
MELD score at transplant	16.2 (6.2)	13.4 (4.9)	0.003
Recipient on dialysis at transplant	3 (1.2%)	0 (.)	0.47
Recipient on ventilator at transplant	3 (1.2%)	0 (.)	0.47
Cold ischemia time (minutes)	81.8 (101.2)	79.7 (79.5)	0.88
Warm ischemia time (minutes)	40.9 (15.2)	46.8 (86.4)	0.67
Donor age at donation (years)	35.7 (11.1)	34.3 (10.3)	0.35
Donor BMI	26.6 (3.9)	26.7 (3.9)	0.74
Donor Female	128 (55.1%)	20 (50.0%)	0.83
Donor relationship to recipient			0.55
Parent	5 (2.1%)	1 (2.5%)	
Child	77 (33.1%)	17 (42.5%)	
Sibling	37 (15.9%)	6 (15.0%)	
Other blood relative	23 (9.9%)	5 (12.5%)	
Non-blood relative	36 (15.5%)	7 (17.5%)	
Unrelated	54 (23.2%)	4 (10.0%)	

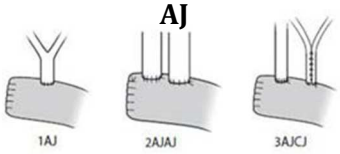
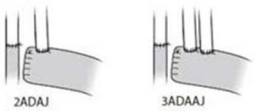
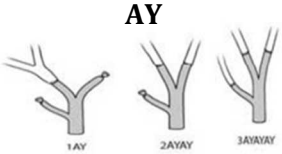
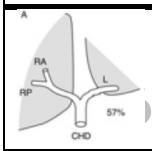
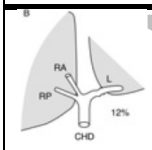
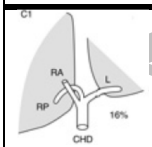
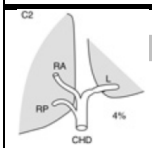
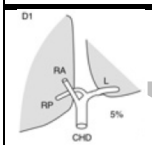
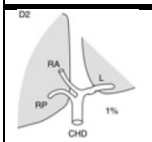
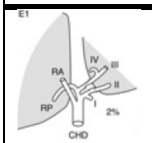
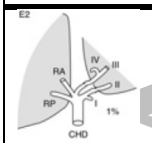
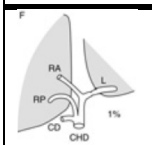
*Two samples t-tests were used for continuous variables and chi-squared tests were used for categorical variables.

Table 2. Recipient anatomic characteristics (n=272)

n (%) or mean (std.)	Right lobe grafts (n=232)	Left lobe grafts (n=40)
Graft weight (gm)	805.2 (169.2)	478.2 (91.8)
Back table ligation of segmental veins	19 (8.1%)	0
Middle hepatic vein included		
Yes	23 (9.9%)	34 (85.0%)
No	209 (90.0%)	5 (12.5%)
Unknown	0	1 (2.5%)
Right lobe hepatic venous reconstruction		
Right vein includes all segments and anastomosed to vena cava	126 (54.3%)	
Right vein anastomosed to vena cava and v6 anastomosed separately	39 (16.8%)	
Right vein anastomosed to vena cava plus V8 anastomosed to vena cava without interposition	15 (6.4%)	
Right vein anastomosed to vena cava plus V8 anastomosed to vena cava with interposition	13 (5.6%)	
Right vein anastomosed to vena cava plus V5 anastomosed to vena cava with interposition	13 (5.6%)	
Right vein anastomosed to vena cava plus V5 and V8 anastomosed to vena cava with interposition	22 (9.4%)	
V5, V6, V7, V8 anastomosed separately with interposition for V5 and V8	4 (1.7%)	
Venous conduit type		
Cryopreserved vessel	1 (0.4%)	
Fresh homologous vessel	28 (12.0%)	
Fresh autologous vessel	10 (4.3%)	
PTFE conduit	11 (4.7%)	
Unknown/not applicable	182 (78.4%)	40 (100.0%)
Left lobe venous reconstruction		
Common orifice left and middle hepatic vein to recipient vena cava		22 (55.0%)
Common orifice left and middle hepatic vein to recipient common orifice of left and middle hepatic vein		18 (45.0%)
Number of hepatic venous anastomoses		
1	165 (71.1%)	40 (100.0%)
2	41 (17.6%)	0
3	22 (9.4%)	0
4	4 (1.7%)	0

n (%) or mean (std.)	Right lobe grafts (n=232)	Left lobe grafts (n=40)
Recipient: portal venous reconstruction		
End-to-end	214 (92.2%)	40 (100.0%)
Interposition graft	18 (7.7%)	0
Portal venous conduit type		
Fresh homologous vessel	9 (3.8%)	0
Fresh autologous vessel	8 (3.4%)	0
Unknown/not applicable	215 (92.6%)	40 (100.0%)
Number of hepatic arteries reconstructed		
1	221 (95.2%)	30 (75.0%)
2	10 (4.3%)	10 (25.0%)
More than 2	1 (0.4%)	0
Number of biliary anastomoses		
1	151 (65.0%)	37 (92.5%)
2	77 (33.1%)	3 (7.5%)
3	3 (1.2%)	0
Unknown	1 (0.4%)	0
Use of Roux-en-Y		
Non-Roux	125 (53.8%)	28 (70.0%)
All Roux	93 (40.0%)	12 (30.0%)
Roux and non-Roux	13 (5.6%)	0
Unknown	1 (0.4%)	0
Accessory duct oversewn	27 (11.6%)	0
Stent used in biliary reconstruction	79 (34.0%)	9 (22.5%)

Table 3. Recipient biliary reconstruction by donor biliary anatomy and graft type (right [RL] and left lobe [LL]). Numbers and row percentages are given for each combination. Of the 231 right lobe and 40 left lobe grafts with known recipient reconstruction, 220 RL and 38 LL had data for both recipient and donor.

		Recipient biliary reconstruction				
Donor biliary anatomy	**Graft type**	**1AD**	**2CD**	**AJ** 	**ADAJ** 	**AY** 
Total	n=271	92 34%	34 13%	105 39%	13 5%	27 10%
	RL n=86	44 51%	3 3%	35 41%		4 5%
	LL n=24	17 71%	2 8%	5 21%		
	RL n=41	14 34%	9 22%	17 42%		1 2%
	LL n=3	1 33%				2 67%
	RL n=25	1 4%	11 44%	7 28%		6 24%
	LL n=4	1 25%	1 25%	2 50%		
	RL n=13	1 8%	1 8%	4 31%	4 31%	3 23%
	LL n=0					
	RL n=28	2 7%	2 7%	14 50%	5 18%	5 18%
	LL n=5	2 40%		3 60%		
	RL n=8	1 13%	1 13%	3 38%	1 13%	2 25%
	LL n=0					
	RL n=0					
	LL n=1		1 100%			
	RL n=1		1 100%			
	LL n=1			1 100%		
	RL n=10	1 10%		6 60%	1 10%	2 20%
	LL n=0					
Other (n=8RL) Unknown (n=11RL, 2LL)	RL n=19	6 32%	2 11%	7 37%	2 11%	2 11%
	LL n=2	1 50%		1 50%		

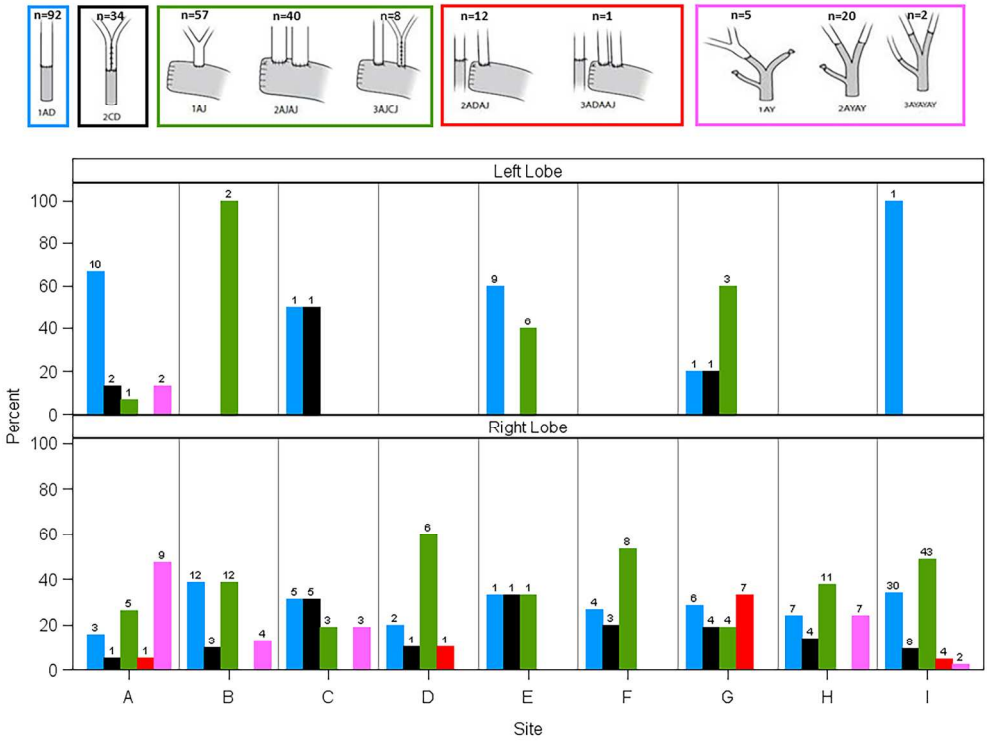


Figure 1

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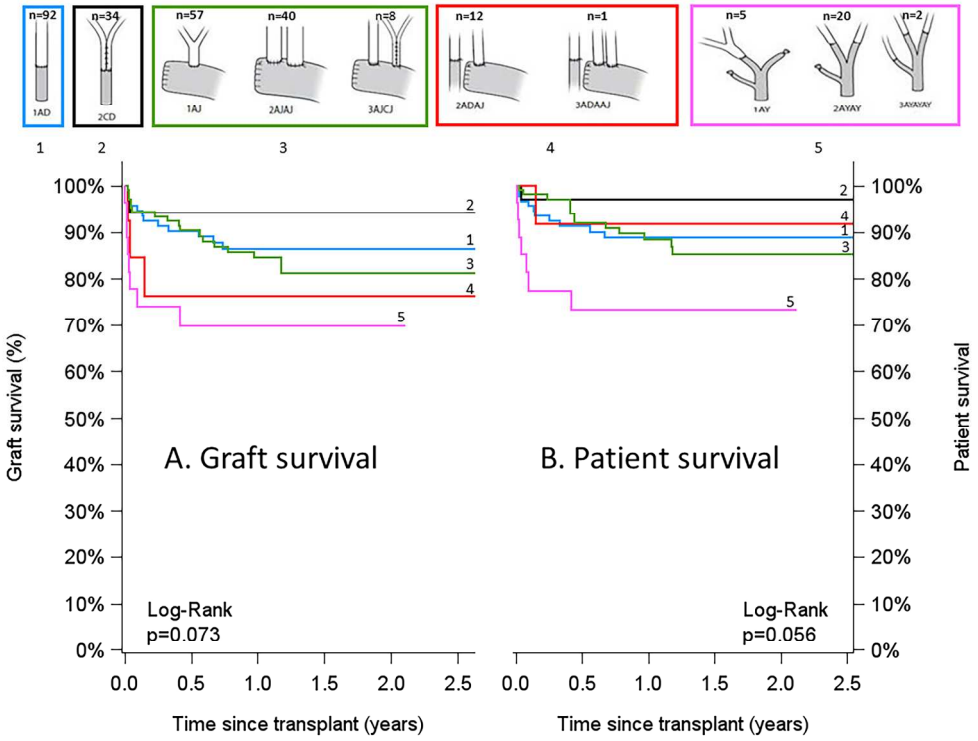

Figure 2

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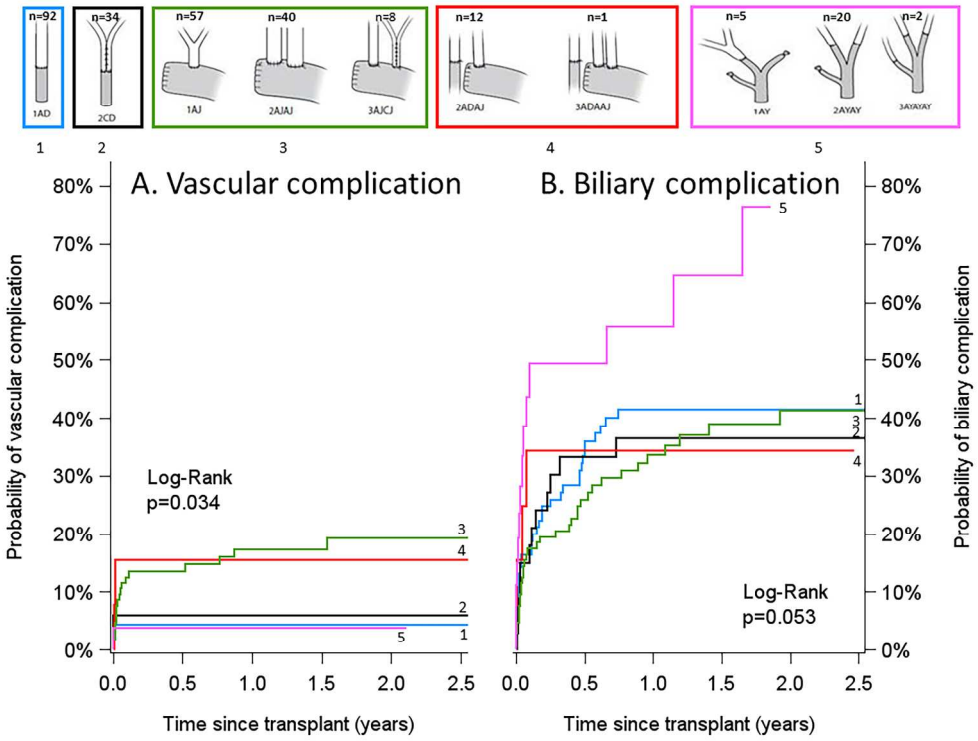

Figure 3

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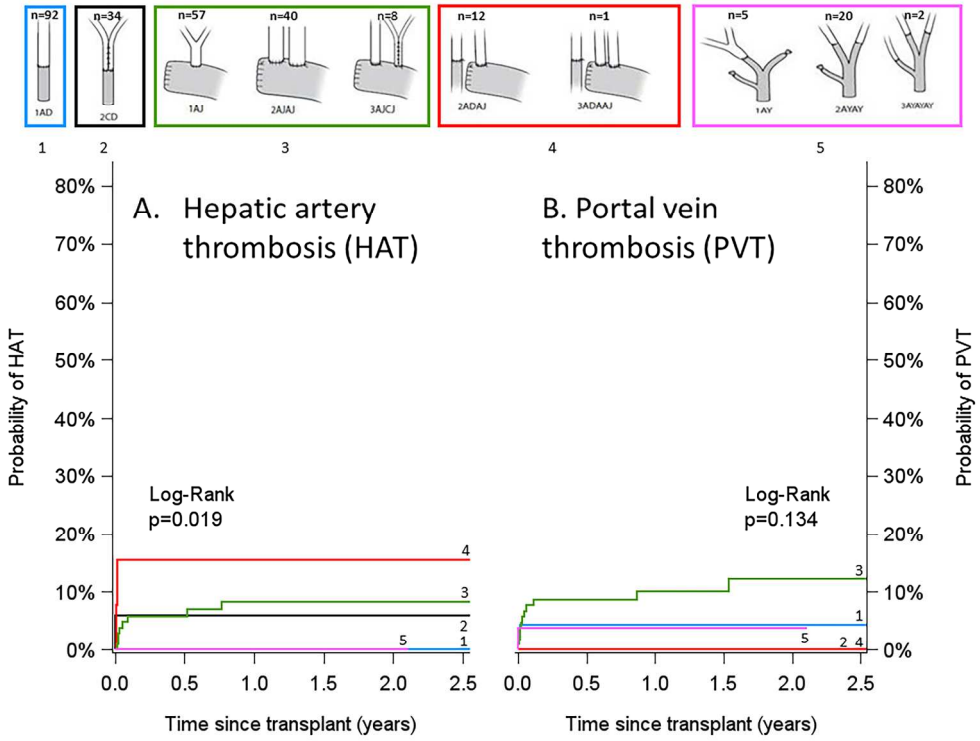

Figure 4

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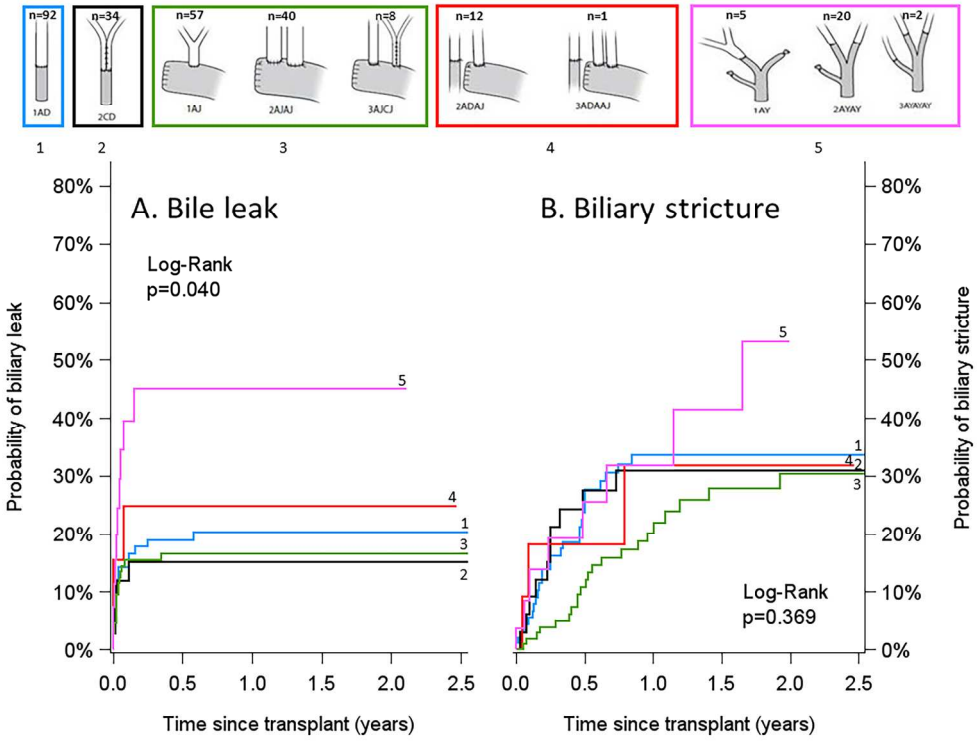

Figure 5

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