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Infection rates with and without T-tube splintage of common bile duct anastomosis in liver transplantation

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Abstract Stenting the bile duct over a T-tube after orthotopic liver transplantation (OLT) is the preferred method of biliary reconstruction. However, because of complications associated with the use of the T-tube, we evaluated the effect of various biliary anastomoses following 100 consecutive OLT (83 records were available for long-term evaluation) and assessed the clinical outcome of abandoning routine T-tube splintage. Of 16 OLT recipients with T-tube splintage (one died immediately following OLT and was excluded from the study), 6 patients (40 %) developed six episodes of septicaemia secondary to biliary and/or intra-abdominal sepsis. Four of these six patients had a biliary leak (27 %). Of 57 patients with duct-to-duct anastomosis without T-tube splintage, 7 patients developed biliary leak (12.3 %) and only 1 developed septicaemia (1.7 %) secondary to biliary and intra-abdominal sepsis ($P = 0.0002$). Of 11 patients with either a gallbladder conduit or Roux loop, only 1 patient had a biliary leak (9 %) and there were no septicaemic episodes. In conclusion, direct duct-to-duct anastomosis resulted in significantly less morbidity due to infection without T-tube splintage than the use of a T-tube following OLT, but there were no significant differences in leakage and stricture rates.

Key words Infection, liver transplantation · Liver transplantation, common bile duct anastomosis · Bile duct anastomosis, infection

Introduction

Orthotopic liver transplantation (OLT) is now considered a routine procedure for patients with end-stage chronic liver disease. However, despite recent advances in preservation, immunosuppression, surgical techniques and better management of complications [3, 6, 10, 11], complications continue to occur frequently. Biliary complications are still common, although the morbidity and mortality related to biliary tract drainage techniques following OLT have dropped significantly over the last decade [1]. Stenting the bile duct with a T-tube after OLT is the preferred method of biliary reconstruction to monitor the bile output from the transplanted liver, to allow radiological access to the biliary tree and to prevent late strictures from forming [2, 3]. However, there are complications associated with the use of a T-tube: leaks, biliary tree sepsis, frequent radiologic studies and dislodgement of the tube [5, 7, 8]. We have now replaced T-tube splintage with duct-to-duct anastomosis without the use of a T-tube. In this study, we reviewed the results of 100 consecutive biliary anastomoses following OLT in terms of the morbidity and mortality of infection.

Table 1 Infection complication rate in relation to biliary reconstruction

Technique	Leaks	Septicaemia due to intra-abdominal sepsis and/or biliary tree	Unidentitied source of septicaemia
Gallbladder conduit/Roux loop ($n = 11$)	1 (9%)	0	1 (9%)
Duct-to-duct anastomosis with T-tube ($n = 15$)	4 (27%)	6 (40.0%)	2 (13.3%)
Duct-to-duct anastomosis without T-tube ($n = 57$)	7 (12.3%)	1 (1.7%)*	4 (7.0%)**

* $P = 0.0002$ and ** $P = 0.0004$ compared to duct-to-duct with T-tube

Patients and methods

The first 96 patients who underwent 100 OLT at the Royal Free Hospital were included in this study. OLT was performed by previously described techniques [9]. Thirteen patients were later eliminated from the study, four who died within the first 72 h (sepsis not implicated) and nine for whom complete bacteriological data were not available because their records were incomplete (one patient died due to sepsis). Four patients had a second transplant during the study period. Of the remaining 83 patients, 11 had either a primary Roux loop reconstruction ($n = 9$) or gallbladder conduit ($n = 2$), 16 had duct-to-duct anastomosis with T-tube splintage (all latex rubber T-tube) and 56 had duct-to-duct anastomosis without a T-tube.

In the two cases in which the gallbladder conduit was used, anastomosis was fashioned between donor gallbladder and donor common hepatic duct, and between donor gallbladder fundus and recipient bile duct. Both anastomoses were splinted by a T-tube. Where Roux-en-y reconstruction was used (small caliber ducts, primary sclerosing cholangitis, size disparities between donor and recipients ducts and prior transplantation), the donor bile duct was anastomosed end-to-side onto the Roux loop of the jejunum without splintage. Direct duct-to-duct anastomosis was performed using interrupted 5/o PDS sutures and, if a T-tube was used, it was inserted into the recipient duct just above the duodenum distal to the line of anastomosis with one limb of the T-tube crossing the anastomosis. All T-tubes were routinely left in place for 3 months before removal. The donor gallbladder was excised immediately after all types of reconstructions except for the gallbladder conduit. The gallbladder conduit was used early in the series for two cases, but has not been used since in this unit.

Immunosuppressive therapy was given in accordance with standard protocol: cyclosporin, prednisone and azathioprine. Acute cellular rejection episodes were treated with intravenous methylprednisolone or OKT3 if resistant cellular rejection occurred.

All patients received intravenous antibiotic prophylaxis for 3 days: ampicillin 4.0 g, netilmicin 7.0 mg/kg and metronidazole 500 mg daily.

Cholangitis was defined as a rising temperature of 38 °C or more, a rise in white blood cell count to above 15×10^9/l with increasing jaundice and/or a biopsy suggesting sepsis. Confirmation was by bile culture and/or demonstration of a leak or obstruction by endoscopic retrograde cholangiography (ERCP) without papillotomy or by percutaneous transhepatic cholangiography (PTC) with routine antibiotic cover in patients without a T-tube. Peritonitis was diagnosed if the ascitic fluid neutrophil count was greater than 250 cells/mm^3 and if a pathogen was isolated. Intra-abdominal abscesses were diagnosed by an ultrasound scanning, as a collection of fluid drained surgically or aspirated under ultrasound guidance, in which microscopy showed pus cells, and culture yielded one or more organisms.

Septicaemia was defined as a positive blood culture and three symptoms of severe general infection (body temperature above 38.5 °C, pulse above 100 cpm, drop in systolic blood pressure below 90 mmHg, leucocyte count above 10000 l).

After appropriate cultures were taken, infective episodes were treated with the same antibiotic regimen as that used for prophylaxis unless cultures had shown unusual sensitivities, in which case an alternative regimen was adopted. This usually entailed the replacement of ampicillin by vancomycin 2.0 g and netilmicin by either ciprofloxacin 1.0 g or amikacin 15 mg/kg/daily. Treatment was given for 1 week if there was an appropriate clinical response.

The different types of biliary anastomoses were compared by the chi-square test.

Results

The etiology of end-stage liver disease and most common indications for performing OLT in patients with duct-to-duct anastomosis without T-tube drainage (D-D) and patients with duct-to-duct anastomosis with T-tube drainage (D-D + T) were broadly the same, with 75% of cases accounted for by primary biliary cirrhosis, hepatitis B and C, alcoholic cirrhosis, cryptogenic cirrhosis, primary hepatocellular carcinoma and the like. Both groups were similar in age (mean age 44.5 years), distribution of men and women (42 males, 41 females) and UNOS status at the time of transplantation (data not shown).

Of the 11 patients with either gallbladder conduit or Roux loop, only 1 patient had a biliary leak (9%; Table 1) and there were no infectious episodes. Sixteen transplant recipients had D-D + T. One died immediately following the OLT and was excluded from the study. Six of the remaining 15 patients (40%) had an episode of septicaemia secondary to biliary (cholangitis) and/or intra-abdominal sepsis (peritonitis and intra-abdominal abscess); four of the six (27%) had a biliary leak (Table 1). Of the 57 patients with D-D, 7 had a biliary leak (12.3%) and only 1 patient had septicaemia (1.7%; Table 1), which was secondary to intra-abdominal sepsis (two distinct episodes with two different or-

Table 2 Causative organisms for biliary and intra-abdominal sepsis

Organism	Biliary and intra-abdominal sepsis No. of infective episodes	Unknown source No. of infective episodes
Gram-negative		
Acinetobacter	2	1
Stenotrophomonas maltophilia	1	1
Klebsiella spp.		1
Ps. aeruginosa	1	
Klebsiella pneumoniae		1
Enterobacter cloacae	1	
E. coli		1
Aeromonas spp.		1
Gram-positive		
Enterococcus spp.	3	
St. Epidermidis	2	
Mixed infection		
Klebsiella spp./Bacteroides spp	3	1
Enterobacter aerogenes/ Citrobacter freundii	1	
Citrobacter freundii/ Enterococcus spp/ St. aureus	1	
Enterococcus spp/Candida	1	

Table 3 Outcome of anastomotic leaks

Technique	Leaks	Outcome
Conduit/Roux loop ($n = 11$)	1 (9%)	Roux loop
Duct-to-duct with T-tube ($n = 15$)	4 (27%)	2 Roux loop 2 T-tube removal + duct suture
Duct-to-duct without T-tube ($n = 57$)	7 (12.3%)	6 Roux loop 1 Conservative

ganisms). At laparotomy there was dehiscence of the biliary anastomosis.

The rates of biliary tree and intra-abdominal sepsis-induced septicaemia were significantly different between the patients who underwent D-D anastomosis and those who had D-D + T ($P = 0.0002$).

There were seven patients with septicaemia of unknown origin; however, the bacteria isolated suggested an intra-abdominal source in most of them (Table 2). Two of these patients had a T-tube. Considering septicaemic episodes as a whole, the percentages of septicaemia in each group were as follows: conduit/Roux loop group, 1 patient (9%); D-D + T group, 8 patients (54%); and D-D group, 5 patients (9%; Table 1).

The differences between the groups with and without a T-tube were statistically significant ($P = 0.0004$; Table 1). The causative organisms for biliary and intra-abdominal sepsis in all groups studied were mainly of gastrointestinal origin (Table 2). In the one patient who had biliary leak of the 11 patients with either gallbladder conduit or Roux loop, a Roux loop conversion was required (Table 3). In the D-D + T group, four patients had biliary leak; in two of these, the T-tubes were removed at 3 months, followed immediately by biliary peritonitis necessitating laparotomy and oversewing of the T-tube exit point from the bile duct (Table 3). Two other patients required Roux loop conversion (Table 3). In the D-D group, seven patients had biliary leak; six required Roux loop conversion and one was treated conservatively (Table 3).

There was no significant difference in leak rate between the splinted and the nonsplinted groups that had direct duct-to-duct anastomosis (P = NS, chi square). In cases where laparotomy was performed for a biliary leak, the cause was invariably associated with ischemic necrosis of the donor duct. No cases of hepatic artery thrombosis were found in this group of patients. Only unsplinted D-D anastomoses were complicated by strictures and this occurred in 6 of 57 cases (10.5%). All of these successfully underwent endoscopic or percutaneous dilatation. There were no reported episodes of infection following ERCP or PTC.

Discussion

In the present study, insertion of an external biliary drain (T-tube splintage) following OLT (15 patients) was associated with a higher rate of gram-negative septicaemia secondary to biliary tree or intra-abdominal sepsis, i.e. 6 patients (each with one episode) of 15 (40%). Four patients had biliary leak (27%), as compared to 1 of the 57 patients (1.7%) who had D-D anastomosis without T-tube splintage. Seven patients developed biliary leak (12.3%). If septicaemia of unidentified origin (but with bacteria isolated, suggesting an intra-abdominal source in most of them) is considered, this septicaemic rate is even higher: 54% in the D-D + T group versus 9% in the D-D group. The latter is now our standard anastomotic procedure.

Several investigators have reported that T-tube-related complication rates vary between 10% and 29% [1, 3, 4, 6, 10]. Stenting the bile duct over a T-tube after OLT is still the preferred method of reconstruction. The advantages underlining this technique include the ability to:

1. monitor the bile output from the transplanted liver, which reflects liver dysfunction in general but is a relatively poor test in terms of specificity;
2. allow radiological access to the biliary tree (however, in a previously published study, the need for ERCP

and PTC were decreased in the no T-tube group [5]. It was also established by our previously published study that diagnostic and interventional radiological access to the biliary tree is readily and reliably available via the percutaneous and endoscopic routes; therefore T-tube drainage is hardly justifiable on these grounds alone [7]);
3. prevent late stricture formation.

There has been no study that has demonstrated that the placement of a T-tube decreases the incidence of anastomotic strictures. Two previously published studies demonstrated that stricture rate formation was not significantly affected by T-tubes [5, 7]. In our recently published study [7], we found that there was no significant difference in biliary leak and stricture formation between the splinted and the nonsplinted group, and that the T-tube itself may be the cause of problems such as biliary tree sepsis, bile sludging or inspissation and biliary leak [7]. Regardless of the kind of biliary anastomosis, it was previously reported that the use of a rubber T-tube instead of tubes of silicon or other materials may be one reason for the low rate of T-tube complications, as it incites enough inflammatory reaction to minimize the risk of leaks from the exit site [4]. Although a rubber T-tube was used in our center, we had a high rate of biliary leaks (27%). It was also reported that the timing of the T-tube removal influences the incidence of leakage. Prolonged T-tube stenting (at least 3 months) was advocated to minimize stricture or leak after removal [10]. However, in our centre all T-tubes were routinely left in place for 3 months before removal.

This is the first study indicating that the presence of a T-tube is related to a higher incidence of septicaemia due to intra-abdominal sepsis and/or biliary tree (40%) than abandoning T-tube usage (1.7%). Two patients from the D-D + T group (13.3%) and six patients from the D-D group (10.5%) required Roux loop conversion. The anastomotic strictures seen in our unsplinted duct-to-duct reconstruction were easily dilatable by ERCP or PTC balloon dilatation. No patient has yet required a second dilatation (or any other procedure) with follow-up of 6–12 months.

In summary, direct duct-to-duct anastomosis without T-tube splintage results in significantly less morbidity due to infection than that with T-tube splintage.

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