Transpl Int (1994) 7 [Suppl 1]: S111–S113

J.B. Piper
P.F. Whitington
E.S. Woodle
K.A. Newell
E.M. Alonso
J.R. Thistlethwaite

Living related liver transplantation in children: a report of the first 58 recipients at the University of Chicago

J. B. Piper · P. F. Whitington
E. S. Woodle · K. A. Newell · E. M. Alonso
J. R. Thistlethwaite (✉)
University of Chicago, MC 5026,
5841 S. Maryland Avenue,
Chicago, IL 60637, USA

Abstract From November 1989 58 living donor liver transplants were performed in 56 children ranging in age from 1 month to 13 years. Donors were adults (> 18 years of age) with a close relationship to the recipient. ABO compatibility and normal donor health were required. Liver segments two and three were transplanted in 53 cases, and segments two, three and four in 5 cases. Actuarial patient survival at 2 years was 89%; graft survival was 76%. Six recipients died: four secondary to sepsis and two because of post-transplant lymphoproliferative disease. The main cause of graft loss was arterial thrombosis, occurring in six patients (10%). Since refinement of the technique, there have been few donor complications, but these have included a biliary tract injury and a hepatic artery thrombosis. Both donors are well, without long-term adverse sequelae. Overall, the outcome of living donor transplantation is excellent; morbidity has been encountered in a small number of donors.

Key words Living donor liver transplantation · Children

Introduction

Donor organ shortage remains one of the major problems in liver transplantation. This is especially true for the paediatric population where the epidemiology of liver disease concentrates the need for transplantation into patients less than 2 years of age [5]. Even with the development of reduced-size liver transplantation, children often wait until they are severely ill in order to achieve priority for receiving a cadaver donor organ. When a programme of living donor liver transplantation (LDLT) was started at the University of Chicago, two major advantages were anticipated: (1) transplantation of children early in the course of their disease, when their medical condition was stable, and (2) relatively short cold ischaemic times and uniformly good quality grafts from healthy normal donors, avoiding primary non-function. We report here the outcome of LDLT and the reasons for the improved survival seen with this technique.

Materials and methods

Selection of donors, and recipients

From November 1989 to October 1993, we performed a series of 58 LDLT on 56 children ranging in age from 1 month to 13 years. The first 20 patients were done under a strict investigational review board protocol which required a 2-week consent process, involvement of the Ethics Department and a psychiatric evaluation of the donor and the immediate family group [2]. Following a favourable review of our first 20 cases, the subsequent 38 were done whenever clinically indicated. The 2-week consent process was no longer required as this discriminated against children who were critically ill. The donors were selected from adults over the age of 18 who had a close relationship with the recipient family, usually a relative. Donors

were selected by use of ABO compatibility, cross-match results, graft and recipient size matching as obtained by CAT-scan volumetric analysis, and arterial anatomy based on angiographic studies. After an appropriate donor was identified, the transplant was scheduled electively. In the case of patients requiring emergency transplantation, the donor workup was completed in as short a time was 2 days.

Operative procedures

Donor and recipient operative procedures have been previously described [1, 2]. In brief, left lateral segmentectomy or left hepatectomy was performed without interruption of the hepatic artery, portal vein or vena cava blood flow. The graft artery was extended with the donor reversed saphenous vein. The graft portal vein was also lengthened, in the last 32 cases, with cryopreserved iliac vein from cadaver donors.

The recipient operation was done in the standard fashion for segmental grafts [1, 2]. During recipient hepatectomy, the vena cava was left intact. The orifice of the hepatic vein(s) were then anastomosed to the vena cava in a triangulated fashion, rotating the graft 45° clockwise in the process. The hepatic artery was routinely anastomosed to the infrarenal aorta in all children less than 5 years of age. The biliary anastomosis was done utilizing a Roux-en-Y hepatico jejunostomy.

Results

Donor survival and complications

The donors consisted of 31 mothers, 19 fathers, 4 uncles, 1 aunt, 1 cousin, 1 grandmother and 1 friend of the family. All donors had normal liver function studies and no history of underlying liver disease prior to being selected. There were no deaths in any of the donors in our series.

In the first three donors, a left hepatic lobectomy was performed, although just the left lateral segment was transplanted. This was done because of concern over the blood supply for segment four. All three of these patients had complications. The first donor suffered splenic injury from a retractor, which required intraoperative splenectomy. A bile leak which required reoperation and a perihepatic fluid collection, which required percutaneous drainage, were also encountered. Following these complications, it was elected to change the donor operation so that a left lateral segmentectomy was performed unless more parenchymal tissue was required for the recipient (five patients). Despite an operation sacrificing most of the blood supply to both segments one and four, no sequelae were identified related to ischaemia of these segments. In the subsequent 55 transplants there were two minor and two major complications seen. The minor complications consisted of two lymphoceles in the saphenous vein harvest site of the leg. One of the patients suffering a major complication required biliary reconstruction for a bile leak. The second patient suffered a thrombosis of the right hepatic artery after it was attempted to utilize dual arterial supplies to the left lateral segment, which arose adjacent to each other on the proper hepatic artery. The patient subsequently went on to do well without any long-term sequelae from this complication.

Recipient survival

The patients' primary diagnoses and indications for transplantation included biliary atresia (35), graft failure (4), neonatal hepatitis (3), chronic rejection (3), alpha-one-antitrypsin deficiency (2), sclerosing cholangitis (2), tyrosinaemia (2), other (7). Of the 56 patients 50 were alive and well (89%) with a follow-up time of 1–47 months. Of the 58 grafts 44 were still functioning (76%). In the last 30 transplants, since the procedure was refined, we had a 93% patient (28 of 30) and 83% graft (25 of 30) survival with a 1–25 month follow-up.

The causes of death in our series were sepsis (four cases) and lymphoproliferative disorder (two cases). There were no cases of primary graft dysfunction. The common causes of graft loss were hepatic artery thrombosis representing of the 14 graft losses. Overall, the 10.3% incidence of arterial thrombosis observed is less than the 14.0% incidence we have observed in full sized cadaver donor grafts in this paediatric population [3].

Discussion

LDLT was started in order to overcome a shortage of size-matched organs available for children. Our series has shown, that there is also another important benefit, that is an excellent patient and graft survival. We believe that the excellent survival is secondary to several factors which are specific to this operation. First, children who have early referral to the transplant center are able to be transplanted at an appropriate time in the course of their disease while they are still in relatively good health. This is not possible with cadaver transplants since the waiting time for an organ in small children is often long, a period during which the children become more malnourished and progress in their liver failure. The grafts have also been of uniformly good quality, with none of the 58 grafts being lost to non-function. This is not surprising since living donors are all haemodynamically stable, unlike many cadaver donors. The ischaemic times of the living donor grafts are of short duration, uniformly less than 4 h.

Some groups have been critical of living donor programmes, stating that no individual should be placed in a position of being a donor because of the small but real risk of death. This would be a more acceptable argument if there were enough cadaver organs to transplant all patients without a long waiting period. Currently 9% of all recipients waiting for liver transplants die before an organ can be found [4]. To obtain even this mortality rate, groups are now transplanting organs from the marginal donor. Our results show that living donor grafts have consistently better graft and patient survivals than similar age-matched series, and none of these patients died while waiting for an organ to become available. An ancillary benefit of LDLT is that these free-up organs for children who do not have living donor grafts available to them.

The current position of the University of Chicago is that every child should be offered a living donor graft, and all potential donors evaluated, before the child is considered for a cadaveric transplant. The risk to the donor is real, but justified by the opportunity to participate in the attempt to save the life of someone to whom they have a strong emotional attachment.

References

1. Broelsch CE, Emond JC, Whitington PF, et al (1990) Application of reduced-size liver transplants a split grafts, auxiliary orthotopic grafts, and living related segmental transplants. Ann Surg 212:368
2. Broelsch CE, Whitington PF, Emond JC, et al (1991) Liver transplantation in children from living related donors. Ann Surg 214:428
3. Piper JB, Whitington PF, Woodle ES, et al (1992) Pediatric liver transplantation at the University of Chicago Hospitals. In: Terasaki P (ed) Clinical transplants 1992. UCLA Tissue Typing Laboratory, Los Angeles, p 179
4. UNOS Update 1993; 9(1):30
5. Vital Statistics of the U.S., 1982 (1986) Vol 2, Mortality, Parts A, B. Hyaltsville, MD, p 186