Partial Left Lateral Segment Transplant
From a Living Donor

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A shortage of liver donors for low-weight transplant recipients has prompted the development of procedures for liver-reduction, split-liver, and living related donor transplantations. For pediatric recipients weighing less than 10 kg, the left lateral segment is often still too large. We describe the procedure of monosegmental transplantation using segment II after segment III was resected in situ from a living related donor. Successful monosegmental transplantation is technically feasible and is a valid alternative to be considered for cases of size discrepancy between the recipient's volume and the donor's left lateral segment.

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The main obstacle to the development of pediatric liver transplantation is the disparity between available small-sized donors and the exponential growth of waiting lists. This situation is even worse when recipients weigh less than 10 kg. The development of procedures for liver-reduction, split-liver, and living related donor transplantations has partially palliated this situation. There is a group of low-weight pediatric patients who cannot benefit from these procedures, either because the left lateral segment of a cadaver donor is too big for the recipient's abdomen or because this segment taken from a living donor was, until recently, the maximum reduction that could be achieved. Living related donors are frequently ruled out because the sizes of segments II and III exceed the recipient's abdominal capacity. Under these circumstances, implantation of a single segment can save the life of infant patients. This report discusses the use of pediatric monosegmental transplantation using a liver segment resected in situ from a living related donor.

Materials and Methods

Case Presentations

Patient 1 is an 8-month-old girl, weighing 7.25 kg, with biliary atresia who underwent transplantation from a living related donor in March 1997. The donor mother was 26 years old and weighed 64 kg.

Patient 2 is an 11-month-old girl, weighing 7 kg, with a history of Kasai-type portal enterostomy at the age of 3 months caused by biliary atresia who underwent transplantation from a living related donor in April 1998. The donor father was 28 years old and weighed 56 kg.

Surgical Procedure

Donor surgery. Abdominal approach by bilateral subcostal incision was used. The falciform and left triangular ligaments were sectioned, as well as the pars flaccida and condens of the gastrohepatic omentum. After dissecting the portal vascular pedicle and the left hepatic vein, intraoperative ultrasound was used to confirm the distribution of these structures in the left lateral segment. Once the portal structures (hepatic artery, portal vein, and bile duct) and the left hepatic vein were isolated, the liver parenchyma was excised well to the right of the attachment of the falciform ligament (Fig. 1). The portal pedicle was identified with ultrasound guidance within the left lateral segment, and the parenchyma was sectioned caudal to the portal path (Fig. 2). Couinaud's segment III was resected in situ (Figs. 3 and 4), taking care not to injure the portal and suprahepatic structures of segment II (Fig. 5). Both cut surfaces were sprayed with fibrin glue.

The computed tomographic scan volume of the lateral segment donated for patient 1 was 340 g, and for patient 2 was 290 g. The volumes of implanted segments II were 170 and 160 g, respectively, measured by fluid displacement. The volumes of resected segments were 170 and 130 g, respectively.

Recipient surgery. We used the piggyback procedure for the hepatectomy of the diseased liver. The left suprahepatic vein was implanted in a new ostium on the anterolateral surface of the vena cava using the ostium of the right suprahepatic vein as one of the sides of this triangular orifice. The ostium of the donor suprahepatic vein was sectioned as close to the hepatic parenchyma as possible to avoid outflow problems. The openings in the middle and left suprahepatic veins were closed. Portal reconstruction was performed by end-to-end anastomosis. The graft was then revascularized, and hemostasis was performed. Once completed, the hepatic artery was reconstructed with the aid of microscopy (original magnification ×10). Biliary reconstruction was performed with a Roux-en-Y loop with interrupted polypropylene 7/0 sutures with extramucosal knots.

Patient 1 developed obstructive jaundice during follow-up caused by stenosis of the hepatojejunostomy, which required percutaneous therapy. Patient 2 experienced a

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Figure 1. The liver parenchyma is excised well to the right of the attachment of the falciform ligament.

Figure 2. The parenchyma is sectioned caudal to the portal path.
Figure 3. Couinaud's segment III is resected in situ, preserving vascular structures of segment II.

Figure 4. Couinaud's segment III is resected in situ, preserving vascular structures of segment II.
transient postoperative bile leak generated in the surgical site of the parenchymal excision. Both patients are currently alive, with good functional grafts.

Discussion

In 1984, Bismuth and Houssin described the reduced-size liver technique, which was widely used in Europe and the United States in an attempt to compensate for the shortage of pediatric donors. The split-liver and living related donor techniques emerged as an extension to that procedure. Until then, Couinaud's segments II and III were the maximum liver reduction achieved. For optimal donor selection, we performed angiography and magnetic resonance imaging of the biliary tract to exclude patients with inappropriate anatomic variations.

These implants are frequently confronted with the issue of size discrepancy between the recipient's small abdominal cavity and the excessive size of the ablated left lateral segment. Preoperative anthropometric measures of recipients sometimes failed to predict the correct volume for each abdominal cavity, making the implantation very difficult and dangerous. An increase in intra-abdominal pressure after closing the wall of a pediatric recipient implanted with a larger-than-appropriate segment produces serious hemodynamic imbalances and, in some cases, acute liver outflow disorders and/or portal thrombosis. The use of synthetic mesh can temporarily solve this situation, although this undoubtedly makes the procedure more complex and results in increased morbidity and mortality. The resection of segment III after implanting the left lateral segment because of the technical impossibility of closing the abdominal cavity without tension has been described. This resection of a recently revascularized liver increases the complication rate as a result of hemostasis disorders within the first hours of implantation.

The possibility of implanting a liver segment in a low-weight recipient has been described in the literature. Couinaud and Houssin described the theoretical feasibility of implanting a single segment. They concluded that segments II, VII, and VIII could be reduced separately. Strong et al described a case in which segment III was obtained on the back table after having resected segment II of a left lobe from a cadaver donor. To facilitate the resection of segment II, a metal segment was introduced in the lumen of the left suprahepatic vein. Menth et al implanted segment II from a cadaver donor after performing hyperreduction on the back table, aided by the injection of methylene blue in the portal branch of segment III. In our experience, it was not necessary to use anatomic resection; we performed peripheral resection of liver parenchyma, respecting the left major portal pedicle.

The distribution of the portal and suprahepatic vascular structures within the gland can be visualized by means of intraoperative ultrasound. Continuous guidance during the excision of the parenchyma shows the proximity of these segmental branches and helps in situ ligature, as in the 2 cases described in our series. The possibility of performing this procedure in vivo makes it possible to rule out areas of ischemia difficult to diagnose on the back table. The use of this technique allowed us to implant 2 recipients with segment II from living related donors that would have otherwise
been ruled out because of excessive volume of the left lateral segment (II to III). After resecting segment III, the left lateral segment was reduced to 50% and 55% of its initial volume, which allowed closure of the abdominal wall without using a prosthetic mesh.

**Conclusion**

Successful monosegmental transplantation is technically feasible and is a valid alternative to be considered for cases of size discrepancy between the recipient's volume and the donor's left lateral segment.

**References**