

**Surgical outcomes in pediatric liver transplantation:  
SPLIT experience with first transplant**

**Background:** Liver transplantation has become an accepted method of treatment for children with end-stage liver disease. Increasing success and broader indications have increased the number of potential recipients and necessitated modifications in the method of donor allocation and the surgical technique. Survival rates correlate with the primary illness, age, and status of the patient before surgery. The purpose of our analysis is to identify the factors associated with post-transplant morbidity and survival in patients receiving a first transplant.

**Methods:** The study used prospective data collected by the Studies of Pediatric Transplantation (SPLIT) since 1995, with the present analysis based on the SPLIT's 8<sup>th</sup> annual report (December 1995-June 2004). Thirty-nine participated centers in the U.S. and Canada have registered 2,400 patients, 1,736 of these receiving at least one transplant (2 to 235 patients per center). Demographics included age, sex, race, weight, and the liver failure's etiology. The graft type including whole organ transplant or a variant such as orthotopic piggyback, and the donor's type (cadaveric versus living-related) were recorded. The vascular and biliary reconstruction methods, and the blood transfusion requirements were included to determine the extent and magnitude of surgery. The number and types of complications within the first 30 post-transplant days were recorded.

**Results:** Fifty-five percent of the cadaveric transplants were performed as standard orthotopic procedures, and 39.9% as orthotopic piggyback, the latter were used in 95.9% of the living-related transplants. From all cadaveric donors, 60.8% were whole organs, 22% were reduced, and 13% split. Only 31.9% of patients 12 months or younger received a whole organ compared with 48.2% of patients aged 1-4 years, 66.5% aged 5-12, and 76.4% of those who were 13 years or older. Univariate analysis unadjusted for any other potentially important covariates showed that patients receiving livers from cadaveric whole organs had improved patient and graft survival compared to cadaveric reduced, split, or live organ recipients ( $p < 0.0002$ ). Recipient age was a significant predictor of patient survival ( $p < 0.03$ ).

Roux-en-Y choledochojejunostomy was the predominating type of biliary reconstruction in patients aged less than 1 year. Duct-to-duct anastomosis was more frequently used in those patients aged 13-17 years, and rarely among those aged 1-4 years. Internal biliary stents were used in 82.6% (717/867) of transplants. The average amount of blood per kg body weight used for transplant recipients of cadaveric donor organs was lower than required for live donor organs (68.1 cc/kg versus 81.1 cc/kg, respectively), as was the average amount of blood transfusion from the cell saver (27.7 cc/kg for cadaveric donor recipients and 46.0 cc/kg for live donor recipients). Increasing age of the patients was associated with decreased amounts of packed and cell saver blood after adjustment for body weight. Vascular complications, bleeding, and biliary tract complications most frequently required reoperation. The vascular complications tended to decrease with age ( $p < 0.0001$ ). Biliary complications were more prevalent in living-related transplants (17.5%) and in split (12.1%) and reduced (10.5%) organ recipients compared to those who received whole organs (5.4%) ( $p < 0.0001$ ). Wound complications were similarly more prevalent in living-related organ recipients (7.1%), split (4.6%) and reduced organ recipients (5.1%) compared to patients who received whole transplants (2.1%) ( $p < 0.001$ ). Three or more reoperations were conducted in 9.9% of living-related recipients, in 8.8% of the recipients receiving a reduced organ, and in 5.8% of those with a split organ ( $p < 0.001$ ). Only 1.4% of the whole organ recipients were thus affected. Analysis of data by year of transplant suggests a steady decline since 1999 with 38.4% undergoing reoperation in 2000, 36.8% in 2001, 34.1% in 2002, 29.6% in 2003, and 26.5% in 2004. Multivariate analysis identifying (RR for death) found fulminant liver failure (2.43) and other (2.33) at increased risk for death compared to patients with biliary atresia; LDLT (1.55), RLT (1.54), and SLT (1.74) versus whole; ABO compatible (1.95) and incompatible (2.46). The 1-year patient survival was 91.4, 86.4, 84.5, 80.8 for whole, LDLT, SLT, and RLT, respectively

**Conclusion:** Cadaveric technical variant grafts are more morbid and the number of complications is inversely proportional to the patients' age. Reduced-size transplants also have a higher incidence of biliary and extra-hepatic complications including wound sepsis intestinal perforation. The continuing technical advancement in the field is expected to further decrease the complications and reoperation figures.