Segmental Living Liver Transplantation as An Alternative Method

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Summary: *To overcome the organ shortage problem, in addition to cadaver orthotopic liver transplantation we have started the performance of living donor partial liver transplantation. The program was initiated in children, but was later extended to include the adult patients as well. From December 9, 1988 to April 21, 1992, twelve living donor partial liver transplantations were performed at our center. Only two of the twelve recipients were children under 10 years of age. The diseases which lead to liver failure in these patients were: biliary atresia in one, Byler's disease in two, Wilson cirrhosis in one, cryptogenic cirrhosis in two, chronic active hepatitis in two. The predominant diagnosis in adult recipients of portial liver transplants in living donors, was HB Ag (+) postnecrotic cirrhosis. One of these postnecrotic cirrhosis patients had also a hepatoma confined to the liver. The donors were mothers in three cases, fathers in four cases, spouses in three cases, and siblings in two cases. The splitting of the liver is started from the anferior edge of the segment IV, 2-3 cm medial to the falciform ligament. None of the donors required blood transfusion. All of the living related partial liver grafts began producing bile on the operating table. The intra operative period was uneventful in all cases. Out of twelve patients that have been transplanted so far, three are alive with good liver function. Other patients died due to extrahepatic causes. None of the donors showed any serious postoperative complications and they all are alive and in good health with normal liver functions.*

Key Words: Segmental liver transplantation, Alternative method

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Potential candidates for liver transplantation still have a significant risk of dying before a donor becomes available. This highly critical shortage of cadaver liver aalografts has been the cause of death for more than 50% of the chronic liver disease patients on our waiting list. To overcome this problem, in addition to cadaver orthotopic liver transplantation we have started performing living donor partial liver transplantation. The program was initiated in children but was later extended to include adult patients as well (1,2).

MATERIAL and METHOD

From December 9, 1988 to April 21, 1992 twelve living donor partial liver transplantations were performed at our center. Only two of the twelve living donor partial liver transplant patients were children under 10 years of age. One was a 10 months old boy with biliary atresia and the other was a three years old boy with Byler's disease. The other two children were an 11 years old girl with Byler's disease and a 10 years old boy with fulminating Wilson's cirrhosis. Two of the patients were adolescent males (15 and 16 years of age) with cryptogenic cirrhosis. The remaining six patients were adults with ages ranging from 20 to 53 years. Two of these had hepatitis B antigen (HBAg) positive chronic active hepatitis one of whom was a 20 years old man and the other a 40 years old woman. The predominant diagnosis for adult recipients of par-

tial liver transplants living donors was HBAg (+) postnecrotic cirrhosis. One of these postnecrotic cirrhosis patients had also a hepatoma confined to the liver.

The donors were mothers in three cases, fathers in four cases, spouses in three cases, and siblings in two cases. The ages of the donors varied between 18 and 57 years (average 38.6 years). All of the recipient-donor pairs were ABO compatible. HLA typing showed HLA-A, B and DR fullmatch in two, 1 HLA-A, B and 1 DR mismatch in two, 2 HLA-A, B and 1 DR mismatch in four, 1 HLA-A, B and O DR mismatch in one, O HLA-A, B and 1 DR mismatch in one, 3 HLA-A, B and O DR mismatch in one and 4 HLA-A, B and O DR mismatch in one case.

The patient and the family are fully informed about the risks and benefits of partial hepatectomy and partial liver transplantation. After this interview with the patient and his family, should the family decide to become donor candidates, blood group, HLA tissue typing, and crossmatch are performed. In addition to the routine laboratory tests, a doppier ultrasonography is done to check if the portal vein is patent in the recipient. The donor also undergoes routine laboratory tests plus a scintigraphy and an ultrasonography of the liver is performed prior to celiac angiography. Left hepatic artery is considered to be suitable for anastomosis if it is wider than 2mm in the angiography. Percutaneous liver biopsy is routinely done from both the donor and the recipient prior to transplantation.

On the day of surgery, first the donor is taken to the operating room. After central venous lines and a urinary catheter is placed, a bilateral subcostal incision is done. Following the abdominal exploration, the left hepatic artery is dissected in the porta hepatis. Then the falciform ligament is cut very close to the abdominal wall and the diaphragm. Left hepatic vein and the left portal vein are dissected nex. The left hepatic duct is either dissected following portal vein dissection or is left to the and of the splitting procedure. The splitting of the liver is started from the anterior edge of the segment IV, 2-3cm medial to the falciform ligament (Table 1). Previously, electrocautery was used to cut the liver tissue and clamps were applied to vessels and bile ducts and tied with 3-0 vicril. In the last 2 cases, we started using an ultrasonic aspirator (Selector, The Surgical Technology Group, Hampshire, England) to divide the liver tissue and this decreased the blood loss and the time of the splitting procedure. At the beginning of the splitting procedure in the donor, the recipient is taken to the operating room. After necessary lines and catheters are placed, the abdomen is opened through a bilateral subcostal incision. Then hepatectomy is performed preserving the inferior vena cava. The stumps of the common hepatic artery, portal vein, and common bile duct are left long enough to facilitate the anastomosis and to decrease the unhepatic phase in the recipient, are not transected until the splitting procedure in the donor is almost finished.

First the left hepatic duct in the split liver is clamped and transected, then the portal vein, left hepatic artery, and left hepatic vein are transected in this sequence.

We used to place a T-tube in the donor common bile duct but left this practice in the last case. Before the abdomen is closed a part of the omentum is laid over the raw surface of the liver. Subhepatic drainage is routinely done. None of the donors required blood transfusion.

The partial liver graft is then perfused with UW solution through the left portal vein, left hepatic artery, and left hepatic duct. First, the graft's hepatic vein was anastomosed to the left hepatic vein stump of the recipient. This

Table I: Results of The Living Donor Partial Liver Transplantation

Patient	Recipient Age/sex	Cause of Liver Failure	Recipient Blood Group	Donor Relation	Donor Age	Donor Blood Group	Mismatch A,B/DR	Current Status
1	10 months male	Biliary atresia	A	Mother	31	A	O/O	Died on the 14th day due to cerebral edema
2	20 years male	Chronic active hepatitis	A	Father	56	A	O/O	Died on the 12th day due to cerebral hemorrhage
3	11 years female	Byler's disease	O	Mother	47	O	2/1	Died on the 56th day due to pulmonary infection
4	15 years male	Cryptogenic cirrhosis	A	Father	42	O	0/1	Died 10 months after tx. due to chronic rejection
5	31 years male	Postnecrotic cirrhosis	B	Sister	26	B	1/0	Died on the 10th day due to liver failure
6	40 years female	Chronic active hepatitis	A	Spouse	42	A	2/1	Died on the 8th day due to outflow obstruction
7	57 years male	Postnecrotic cirrhosis	A	Spouse	49	O	2/1	Died on the 5th day due to outflow obstruction
8	10 years male	Wilson's cirrhosis	O	Father	34	O	1/1	Living since 28.12.91 with normal liver function
9	32 years male	Cryptogenic cirrhosis	A	Father	55	A	1/1	Died on the 13th day due to intraabdominal bleeding
10	44 years male	Postnecrotik cirrhosis +Hepatoma	A	Spouse	41	O	4/0	Living since 3.2.1992 with near normal liver function
11	16 years male	Postnecrotic cirrhosis	A	Sister	20	A	3/0	Living since 11.4.1992 with normal liver function
12	3 years male	Byler's disease	B	Mother	22	B	2/1	Living since 19.4.1992 with normal liver function

practice was also changed after we encountered some problems due to outlet obstruction. Now we are anastomosing the left hepatic vein of the partial liver graft to a newly created opening in the inferior vena cava with interrupted 3-0 prolene. Next the portal vein is anastomosed to the recipient's portal vein using 5-0 prolene, and a continuous suture for the back row and interrupted sutures in the front. Before the portal anastomosis is completed the liver graft is perfused with 500ml of 5% dextrose in water and 100ml of 20% human albumin. At this point the vascular clamp on the left hepatic vein is removed and the portal anastomosis is completed. Next the left hepatic artery is anastomosed to the common hepatic artery of the recipient with 6-0 interrupted prolene sutures. Saphenous or mesenteric vein grafts can be used if the hepatic artery of the partial liver graft is short.

Following the vessel anastomosis, a Roux-and-Y segment is prepared and a hepaticojejunostomy is performed using an 8 Fr. catheter as a stent. The falciform ligament is attached to the recipient's falciform ligament to prevent the rotation of the graft. At the and of the procedure, the appearance of the liver resembles that of a trisegmentectomy. Before the abdomen is closed, a part of the omentum is laid over the raw surface of the liver and the subdiaphragmatic space is drained. 1-11 (aver-

age: 2.4) units of blood was transfused to the recipients.

Routinely, three intraoperative liver biopsies are done, one before partial hepatectomy, one after perfusion, and one following recirculation.

RESULTS

All of the living related partial liver grafts began producing bile on the operating table. The intra-operative period was uneventful in all cases. However, cerebral edema developed in the first case on the third postoperative day and this patient died 2 weeks later. Marginal graft function with cholestasis and coagulopathy was associated with cerebral hemorrhage and resulted in the death of the second patient on the 12th postoperative day. The third patient lived for 56 days but succumbed to pulmonary infection. The fourth patient was the longest survivor but he too died at the and of 9 months due to chronic rejection. The fifth patient died from liver failure due to irreversible acute rejection on the 10th postoperative day. The next two patients died due to liver failure caused by hepatic vein outflow block. The 8th patient has been living for over three months with normal liver function. The 9th patient died on postoperative day 13 due to sepsis and DIC. The 10th patient was the one with hepatoma and he has been living for over two months and his liver functions and general condition is improving. The 11th patient was transplanted on April 11, 1992 and is doing well with good liver function. The last patient was operated on April 19, 1992 and is having a very smooth postoperative period with excellent liver function.

None of the 12 living donors showed and serious postoperative complications and they all are alive and in good health with normal liver functions.

DISCUSSION

The first successful orthotopic liver transplantation was performed in 1967 by Starzl et al (2,3). Shortly thereafter, Calne et al. (4) also began performing orthotopic liver transplantations. These two pioneering teams were followed by many other centers. After cyclosporin entered into clinical use, the survival rates in liver transplantation steadily increased from 30% to over 70%. At present, liver transplantation is the most widely accepted radical treatment for and stage liver failure (5,6). It is known that left lateral lobe of the liver is sufficient for an adult after extended right hepatic lobectomy (8) and partial liver transplantation in children (9). With this reasoning, we started performing living donor partial liver transplantations in adults, as well as in children (2).

Although we have encountered some unfortunate complications during the postoperative period in some patients, the 10 month survival of a 15 year old boy and the two 10 and 44 year-old recipients who have been living for over 3 and 2 months, respectively, encouraged us as to the applicability of partial living donor hepatic transplantation to recipients over 10 years of age. Also it is worth mentioning that none of the partial liver living donors had any serious postoperative complications.

CONCLUSION

Our technique of living donor partial liver transplantation has proven to be harmless for the donor and beneficial for the recipient. We believe that, living donor partial liver transplantation can be another alternative in prolonging the lives of chronic liver failure patients, children and adults alike, who otherwise would die due to shortage of cadaver livers.

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