Transpl Int (1999) 12: 383–386

BRIEF REPORT

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Native hepatectomy after auxiliary partial orthotopic liver transplantation

Received: 22 October 1998
Received after revision: 15 January 1999
Accepted: 26 February 1999

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Abstract In countries where a living donor is the only source of the graft, the limited size of the graft is of serious concern when considering extending the procedure to adult recipients. In order to overcome this problem, auxiliary partial orthotopic liver transplantation (APOLT) was applied to the concept that the residual native liver would support the graft function until the graft expanded enough to work by itself. We herein report on a 20-year-old woman with primary sclerosing cholangitis (PSC), who received a small-size liver graft by APOLT. Computed tomography and scintigraphy showed that the graft had regenerated sufficiently 1 month after the operation. The diseased residual native liver is potentially carcinogenetic. Therefore, second-stage native hepatectomy was done 35 days after the first operation. Histopathologic examination of the resected native liver revealed biliary cirrhosis with PSC but no evidence of cholangiocarcinoma. Second-stage native hepatectomy after APOLT seems to be a curative treatment for chronic end-stage liver disease with graft size mismatch that may be as good as orthotopic liver transplantation.

Key words Auxiliary partial orthotopic liver transplantation · Primary sclerosing cholangitis · Small-size liver graft · Second-stage native hepatectomy

Introduction

Liver transplantation from living donors is being increasingly performed and has achieved improved results, usually in coordination with a cadaveric organ program. In Japan, the concept of brain death is still not fully accepted and cadaver livers are not available, so this technique is often the only treatment for patients with chronic end-stage liver disease. Because of an expanding waiting list, we have been compelled to extend our specifications for living donor liver transplantation from young children to older children, and even to adults. Our recent analysis showed a poor survival rate in larger patients receiving small-sized grafts [2].

Auxiliary partial orthotopic liver transplantation (APOLT) was initially developed for the treatment of patients with fulminant and subfulminant hepatic failure, in whom the preserved native liver has the potential to regenerate [1]. Recently, this technique has also been used in patients with noncirrhotic metabolic liver diseases [6]. We have applied this technique for patients receiving small grafts, in whom the native liver is intended to support graft function until sufficient regeneration occurs. In such a case, where the residual native liver is potentially carcinogenetic, removing it after APOLT is essential. We performed second-stage native hepatectomy after APOLT in primary sclerosing cholangitis (PSC).

Case report

An 18-year-old woman presented in 1996 with fatigue and fever. In 1997, liver biopsy confirmed stage-4 chronic hepatitis associated with PSC [5]. Endoscopic retrograde cholangiopancreatography

demonstrated multiple strictures of the hepatic ducts and mild dilatation, consistent with sclerosing cholangitis. A computed tomography (CT) scan and ultrasound of the liver showed no evidence of a mass lesion. There was no evidence of colitis on colonoscopy. Laboratory values included 3000×10^3 RBC/mm^3, 8.0 g hemoglobin/dl, 25.3% hematocrit, 2.2×10^3 platelets/mm^3, and 1700 WBC/mm^3 with normal differentials. Prothrombin time and activated prothrombin time were 14.4 s and 42.1 s, respectively. Other laboratory findings demonstrated: aspartate aminotransferase 132 IU/l, alanine aminotransferase 113 IU/l, total bilirubin 1.6 mg/dl, albumin 3.2 mg/dl. Tumor markers such as carcinoembryonic antigen, carbohydrate antigen 19–9, and α-fetoprotein were within the normal limits. Hepatitis B surface antigen and antibody as well as hepatitis C antibody were all negative. Although liver dysfunction was not severe, liver transplantation seemed necessary, as there was progressive cholangitis and social disability. Also, in the living-donor liver transplantation, parents become unsuitable donor candidates because of aging.

The patient's parents requested that living donor liver transplantation be performed. Because her father has severe fatty liver, her mother was selected as a donor candidate (ABO identical; 42 years old). The CT-calculated volume of the donor's left lobe including the left and middle hepatic veins (segments 2, 3, and 4) was 361 cm^3, and the recipient's body weight was 72 kg, which meant that the graft-to-recipient weight ratio (GRWR) was 0.50 [3]. The patient underwent APOLT in January 1998.

The surgical technique was as follows: The extended lateral segment with the middle hepatic vein (segments 2, 3, part of segment 4, and left part of segment 1; 425 g) of the recipient was removed, and the left lobe graft (355 g) from the donor was positioned orthotopically. The common trunk with middle and left hepatic veins of the graft was anastomosed to the newly formed orifice of the common trunk with the middle and left hepatic veins of the recipient by end-to-end fashion. The left portal vein of the graft was anastomosed to the recipient's portal trunk by the branch patch technique. The right portal branch to the residual native liver was interrupted to secure sufficient blood flow to the graft. An end-to-end anastomosis between the left hepatic artery of the graft and that of the recipient was done using an operating microscope. Biliary drainage was accomplished by a bilioenteric anastomosis between the left hepatic duct and a Roux-en-Y jejunal loop. To facilitate second-stage native hepatectomy, we performed ligation and division of the short hepatic veins between the residual native liver and the inferior vena cava (IVC). Then, the right hepatic vein (RHV) was isolated and encircled with 3–0 nylon string to make the detection of RHV easy at the next operation. The outcome after surgery was that liver function tests revealed a return to normal soon after the operation.

The CT-calculated volume of the residual native liver and the graft were 781 cm^3 and 550 cm^3, respectively, 2 weeks after the operation, changing to 507 cm^3 and 582 cm^3 (GRWR 0.87) at 1 month after surgery (Fig. 1A,B).

Doppler ultrasonography demonstrated that blood flow to the graft was 11 ml/min per kilogram immediately after the operation and was 12 ml/min per kilogram by 1 month postoperatively. Arterial flow was always detected in both the native and transplanted livers and no portal flow was detected in the native liver, as expected.

[^{99m}Tc]-galactosyl serum albumin scintigraphy was done to estimate the functioning hepatocyte mass [4]. There was a steady increase in the uptake of tracer by the graft. Two weeks after surgery, the native liver accumulated 37% tracer and 63% of the radioactivity was found in the graft, while the level of radioactivity was changed to 25% and 75%, respectively, 1 month after APOLT (Fig. 2A,B). Histopathologic examination of the resected native

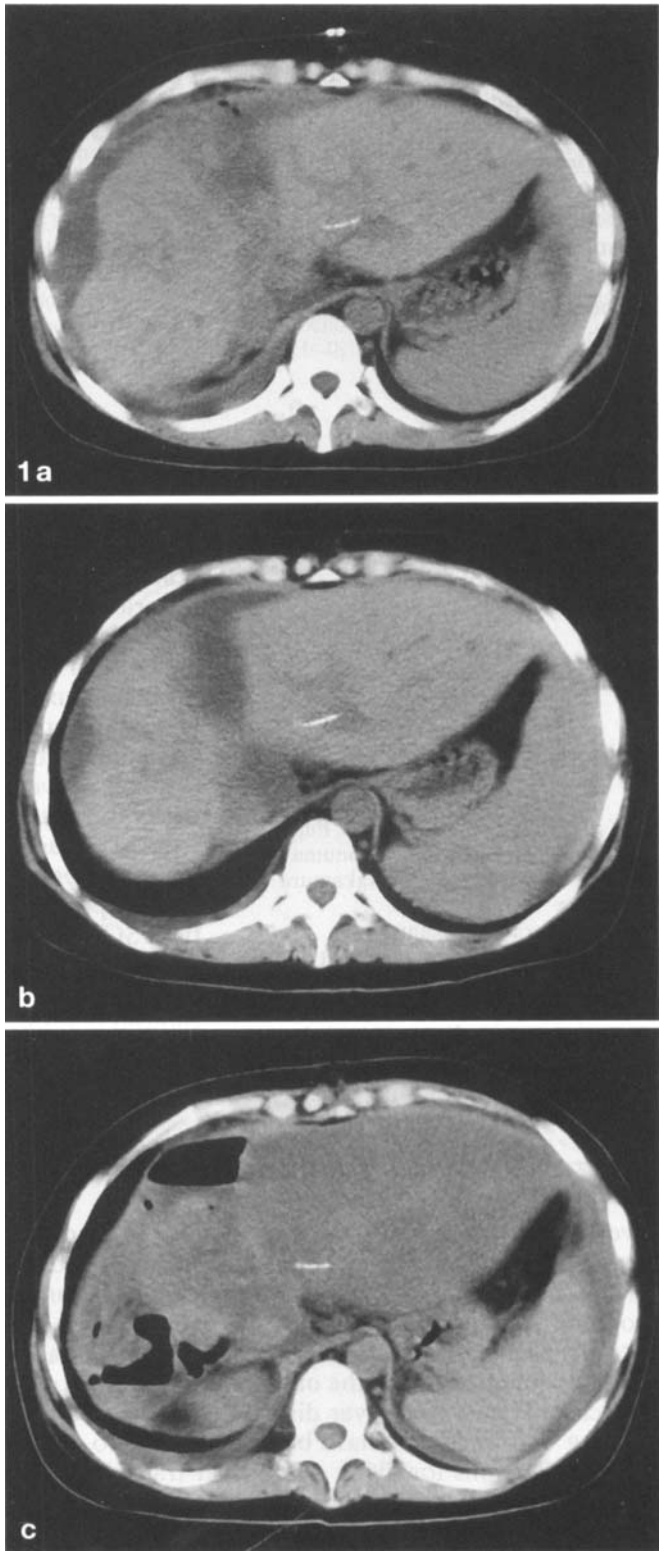

Fig. 1a, b Computed tomography scans. **a** Two weeks after auxiliary partial orthotopic liver transplantation (APOLT). **b** One month after APOLT. **c** Two weeks after second-stage hepatectomy

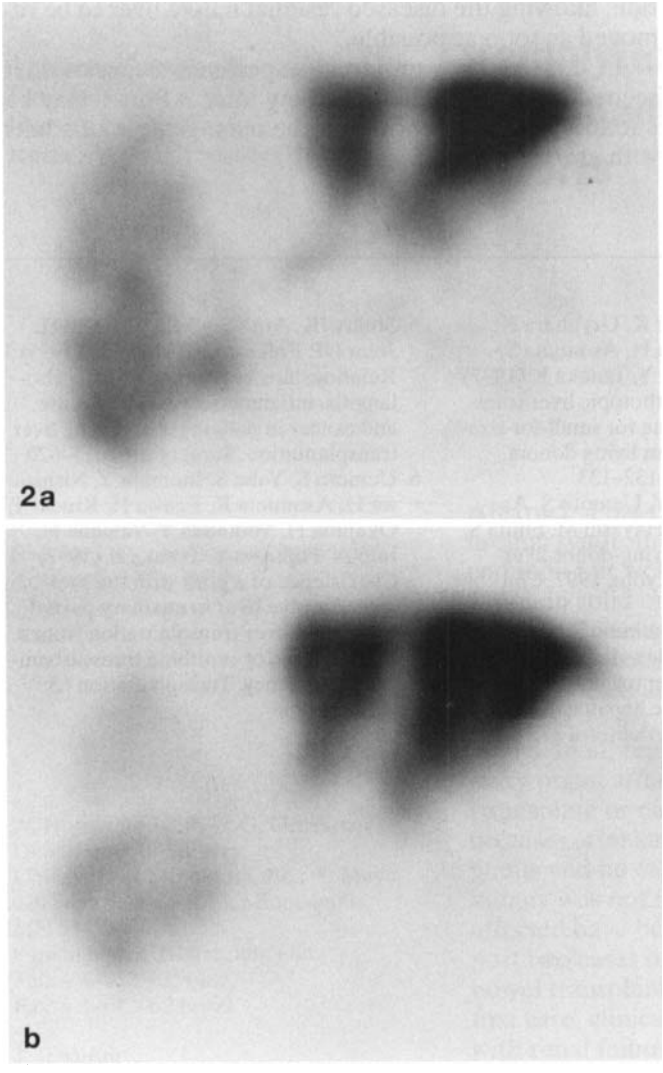

Fig. 2 a, b [^{99m}Tc]-galactosyl serum albumin scintigraphy. **a** Two weeks after APOLT. **b** One month after APOLT

liver revealed stage-4 frank cirrhosis with PSC. There was no evidence of cholangiocarcinoma.

We performed second-stage native hepatectomy at 35 days after transplantation. The graft had undergone hypertrophy and the native liver had undergone compensatory involution. There were relatively strong adhesions around the residual native liver, but the dissection from the IVC could be performed easily by fingers because of the preparation of the RHV during the first operation, and the native liver was removed easily after transacting the right hepatic artery and common bile duct.

Liver function tests returned to normal soon after surgery. The CT-calculated volume of the graft was 700 cm^3 2 weeks after the second operation (Fig. 1C). Histopathologic examination of the residual native liver gave similar findings to the first portion, with no evidence of cholangiocarcinoma. The patient is currently doing well, with normal liver function and no recurrence of PSC.

Discussion

After years of domestic debate regarding the social acceptance of brain death in Japan, a new law permitting organ retrieval from brain-dead donors with the consent of the family came into force on October 16, 1997. However, a cadaver liver has not yet become available and we are not sure whether our new organ-sharing network for cadaver donors can cover the increasing demand from patients with chronic end-stage liver disease.

APOLT is the most recent technical innovation in the treatment of patients with fulminant hepatic failure or metabolic liver diseases. The advantage of APOLT is the continuing presence of the native liver, which can sustain the patient's life in the event of vascular complication or severe rejection. APOLT also makes it possible to avoid continuous immunosuppression [1]. Another advantage of APOLT is its potential for the application of gene therapy.

In our experience, larger patients receiving small-sized grafts show poor survival: 50.5% when the GRWR is less than 0.8, compared with 85.2% when the GRWR is 1.0–3.0 in elective and ABO-compatible transplant procedures [2]. In order to overcome the negative impact of inadequate graft size, we performed APOLT in adults with chronic end-stage liver disease receiving small-sized grafts. In APOLT using a small-sized graft, the native liver, which is partially left in situ (usually the right lobe) is expected to support the function of the newly transplanted graft liver in the immediate early postoperative period. After the transplantation, the graft liver will expand its function with volume, while the native liver cannot enlarge or maintain its function. So, after enough enlargement of the graft liver, hepatic function in response to the demand of the recipient is expected to be totally provided by the graft liver. However, experience with APOLT is still very limited and many questions remain to be solved; for example, the diseased residual native liver has carcinogenetic potential.

PSC shows a downhill course leading to end-stage liver failure or cholangiocarcinoma (33%–42% incidence), and death usually occurs at a median of 10–12 years after onset. Liver transplantation should be performed early in the course to avoid the lethal complication of cholangiocarcinoma [5]. In the present case, the diseased residual native liver was removed as soon as there was sufficient graft regeneration. Histopathologic examination showed no difference between the native liver removed at the first and second operations. Second-stage native hepatectomy after APOLT seems to be a curative treatment for chronic end-stage liver disease that may be as good as orthotopic liver transplantation.

Because we performed ligation of the short hepatic vessels between the native liver and IVC as well as free-

ing the RHV from IVC during transplantation, although there were strong adhesions around the residual native liver, second-stage hepatectomy was done easily and safely.

When second-stage native hepatectomy is planned, interruption of the right portal branch to the residual native liver is effective in inducing rapid graft regeneration, allowing the diseased residual native liver to be removed as soon as possible.

In conclusion, our initial experience suggests that second-stage native hepatectomy after APOLT may be a feasible and safe option for the management of adults with graft size mismatch.

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