CASE REPORT

Auxiliary Liver Transplantation for Acute Liver Failure

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Background: Auxiliary partial orthotopic liver transplantation is a technique where part of diseased native liver is removed and replaced with healthy donor liver so that, the left behind native liver could later regenerate**. Case characteristics:** 2½-year-old girl with acute liver failure due to Hepatitis A. She underwent a successful auxiliary partial orthotopic liver transplantation. **Outcome:** Successful native liver regeneration and immunosuppression withdrawal after two and half years of surgery. **Message:** In selective cases of acute liver failure, auxiliary partial orthotopic liver transplantation could provide a chance for native liver regeneration and immunosuppression-free life.

Keywords: *Cirrhosis, Hepatitis A, Liver regeneration.*

Acute liver failure (ALF) in children is a rare but potentially fatal disorder, which could lead to multiorgan failure and death within days to weeks of onset. Liver transplantation (LT) is an accepted form of treatment that improves the survival in ALF patients, who fulfill the criteria for liver transplantation. In children with virus-induced ALF, International normalized ratio (INR) >4 or factor V levels <25% of normal should be considered for liver transplantation [1]. The standard orthotopic liver transplant (OLT) technique involves removal of the entire failing liver from the recipient and replacing it with a healthy donor liver. Auxiliary partial orthotopic liver transplant (APOLT) is a specialized technique where either the right or the left lobe of diseased native liver is removed and replaced with healthy donor liver. Given the tremendous regenerative capacity, there is a potential for the failed native liver to regenerate over a period of time.

CASE REPORT

A 2½-year-old child from the Arabic Gulf with Hepatitis A induced ALF developed hepatic encephalopathy and was intubated and ventilated. As the child fulfilled liver transplantation criteria, she was stabilized and airlifted to our center for Living Related LT. At the time of surgery, she had already been ventilated for 12 days and was critically ill with INR of 6, lactate of 5.5 mmol/Land bilirubin of 17.8 mg/dL. The native left liver lobe of the child was resected and replaced with left lateral segment from the donor, who was her paternal uncle. She was started on standard immunosuppression with tacrolimus and steroids. Her lactate and INR normalized in two days and bilirubin normalized in seven days. Postoperative period was complicated by hypotension requiring inotropic support, sepsis, narcotic withdrawal, and prolonged ventilation necessitating tracheostomy. She was off-ventilator two weeks after APOLT, and was discharged home four weeks after surgery.

Di-isopropyl iminodiacetic acid (DISIDA) scan at four weeks after APOLT showed that transplanted left lobe of the liver contributed to 96% of the total liver function (***Fig.* 1a**) and computer tomography (CT) volumetry showed diseased native liver (right lobe) volume of 146 cm^3 and graft (left lobe) of 455 cm^3 (***Fig.* 1b**). Histopathology of the native liver showed near total absence of hepatocytes, consistent with Hepatitis A induced ALF. The child was followed up with serial DISIDA scan and CT volumetry on a 6-monthly basis. At 2 years post APOLT, DISIDA scan and CT showed that native liver has regenerated and contributed to 43% of liver function (***Fig.* 1c**) and around 50% of total liver volume (***Fig.* 1d**) respectively, with histopathology showing restoration of normal architecture of the native liver. Based on these positive indicators, immunosuppression was gradually weaned off over the following six months, allowing low-grade rejection of the graft, which progressively lead to fibrosis and graft atrophy. CT and DISIDA scan done immediately after stopping immunosuppression confirmed that native right lobe contributed to 96% of total function (***Fig.* 1e**) and 83% (421 cm^3) of total liver volume (***Fig.* 1f**) respectively. This implied that the native liver has regenerated in

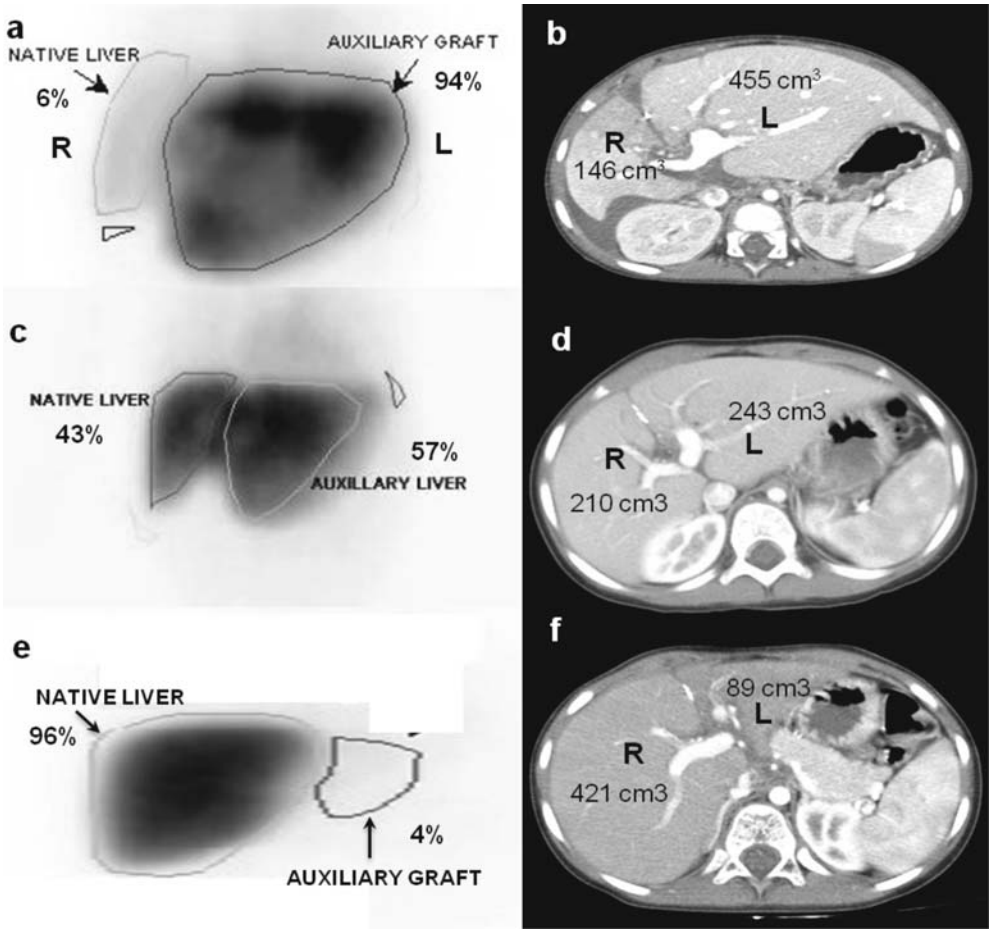

FIG.1 *Serial DISIDA scan at 1, 24 and 30 months after APOLT showing gradual recovery of native liver (right lobe) function (a,c,e); and corresponding CT images of gradual volumetric regeneration of native liver (right lobe) (b,d,f). L: left lobe (transplanted liver), R; right lobe (native liver).*

terms of volume and functionality. The child is completely off all immunosuppressive medications and has normal liver function tests.

DISCUSSION

Though first case of successful liver regeneration after APOLT for ALF was reported in 1991, only few centers perform this procedure as it is technically challenging [2]. One center reported 100% mortality with APOLT in ALF, with none surviving long enough to stop immuno-suppression, while another center reported 85% survival in children with ALF who underwent APOLT [3,4]. The reason behind failure of native liver regeneration is difficult to predict based on quantitative hepatocyte loss. Quaglia, *et al*. [5] showed that new hepatocytes could be derived from both mature cholangiocytes and putative progenitor cells located within the bile ductular epithelium. The patients in whom the native liver failed to regenerate are not at disadvantage as they just need to continue immunosuppressive medications similar to patients having standard OLT.

Candidate selection for APOLT in ALF is crucial and ideally suits patients with a one-time insult leading on to ALF such as drug poisoning, acute viral hepatitis and that of indeterminate etiology. Cirrhotic liver disease is a contraindication for APOLT as there will be problems in portal flow to native liver due to portal hypertension and also there is a possibility of malignant transformation in the left over cirrhotic native liver. Though autoimmune liver disease and Wilson diseases could present as ALF, these livers would be cirrhotic at the time of presentation. Performing APOLT in a cirrhotic liver defies the whole purpose of this technique, as these patients would need the donor organ support lifelong and weaning of immunosuppression might not be possible. In ALF, there is massive liver cell necrosis due to the disease process. In standard OLT whole liver is removed, but in APOLT

the retained necrotic liver can release several cytokines causing hemodynamic and metabolic instability during post-operative period. This complication has to be anticipated and managed appropriately by the intensivist.

Once the volume and function of native liver **(**based on CT and DISIDA scan**)** is approximately equal to the transplanted liver, immunosuppression should be gradually weaned over several months, so that the transplanted liver graft atrophies slowly. Abrupt immunosuppression withdrawal might lead on to hepatic artery thrombosis and graft infarction, which might require surgical removal of the graft.

In selective cases of ALF, APOLT preserves native liver and provides a chance for native liver regeneration and immunosuppression-free life. The fact that children have a longer life expectancy, offering a medication- free life makes APOLT an attractive option. Appropriate case selection, surgical expertise and post-operative management are the key elements in successful outcome of APOLT in ALF.

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