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ORIGINAL ARTICLE

Successful outcome following transplantation of an injured liver from a nonheart beating donor

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Summary

Nonheart beating donation (NHBD) of the liver is a relatively new potential source of grafts. Guidelines to indications and contraindications to donation from controlled nonheart beating donors are still being formulated. We report a successful case of transplantation of a liver from a controlled nonheart beating donor who sustained significant injuries following a road traffic accident. Emergency laparotomy with peri-hepatic packing was performed to control haemorrhage from lacerations in segments VI and VII. Forceful packing resulted in an area of focal ischaemia in segment VI. Trauma to the liver should not be considered an absolute contraindication to controlled NHBD.

Introduction

The current shortage of organs for transplantation has led to renewed interest in donation after cardiac death, otherwise known as nonheart beating donation (NHBD) [1]. Increasing experience in donor selection has led to significant improvement in outcome after liver transplantation from controlled nonheart beating donors (NHBDs) with complication and patient survival rates approaching that of heart beating donation (HBD) [2,3]. Criteria for use of controlled NHBD are being refined by clinical experience. Transplantation of traumatized livers from HBDs has been successfully performed [4–6]. We report a successful outcome following transplantation of a liver with multiple lacerations from a nonheart beating donor.

Case report

A 25-year-old male was admitted to a district general hospital with blunt abdominal trauma and a significant head injury following a road traffic accident. He suffered a cardiac arrest at the scene of the accident for a period of 20 min, and required cardiopulmonary resuscitation. An abdominal computed tomography (CT) scan demonstrated multiple lacerations involving segments VI and VII. At emergency laparotomy, a haemoperitoneum and a grade 2 liver injury consistent with preoperative imaging were seen. Peri-hepatic packing of the right side of the liver was performed locally. Thirty-six hours later, the full extent and irreversible nature of the neurological injury became apparent, and as brain death criteria were not fulfilled, the decision to withdraw treatment was made by the attending physician and the patient's family. He was referred for consideration for NHBD, and consent was given by the family. At this time, the serum aspartate transaminase (AST) was elevated at 834 IU/l (normal range 10–50 IU/l), but the serum bilirubin level was normal, and the prothrombin time was 11.1 s.

The patient was withdrawn from ventilatory support in the anaesthetic room. Following cardiac arrest, death was declared by the attending physician, and a stand off time of 5 min was observed prior to commencement of the surgical procedure. A modified Casavilla technique was utilized to retrieve the donor liver [7]. The procedure

involves a full-length midline laparotomy to access and drain the inferior vena cava above the iliac confluence with a Foley catheter. A large bore cannula is then inserted in the aorta, and perfusion commenced. A rapid thoracotomy is performed and a long clamp is applied to the aorta just above the diaphragm. The superior mesenteric vein is cannulated for portal perfusion. Preservation fluids used are Marshall's solution for aortic and University of Wisconsin solution for portal perfusion respectively. Heparin (20 000 units) is added to the first liter of both solutions which are perfused under mild pressure (40–60 mmHg). The procedure continues in a similar manner to conventional multi-organ retrieval.

The warm ischaemic time was 11 min (defined by systolic blood pressure <50 mmHg to perfusion of the aorta). The liver weighed 1823 g, and was an appropriate size for the intended recipient, with normal vascular anatomy. Superficial tears were seen involving the posterior right lobe. More significantly, an area of parenchymal underperfusion was visible because of liver compression by packing. Perfusion was continued on the back table with University of Wisconsin solution at a pressure of 60 mmHg, and the ischaemic area in segment VI slowly perfused to a similar degree as the remainder of the liver. Both kidneys were also retrieved.

The donor liver was transplanted into a 50-year-old blood group matched male weighing 80 kg with Hepatitis C virus related end stage liver disease, with a cold ischaemic time of 5.6 h. Intraoperative findings included ascites, macronodular cirrhosis, moderate portal hypertension and incomplete portal vein thrombosis. The portal vein was skeletonized to the level of the confluence and thrombectomized. The donor liver was implanted using a piggyback technique, with a standard approach to all other anastomoses. Portal reperfusion was performed prior to common hepatic arterial anastomosis. The ischaemic area of the liver was gently manipulated intraoperatively to encourage perfusion. There was a significant reperfusion injury, which required temporary vasopressor support. Serum lactate levels rose to 3.9 and 4.7 mmol/l at 30 and 60 min, respectively, following reperfusion from a preperfusion level of 3 mmol/l (normal range 0.5–2.2 mmol/l). The patient remained cardiovascularly stable for the remainder of the procedure. The total operative time was 4.9 h with blood loss of 2.1 l.

There were no immediate perioperative complications. On postoperative day 1 the serum AST was markedly elevated at 13 886 IU/l, with a serum bilirubin of 75 μmol/l, an international normalized ratio (INR) of 1.53, and a lactate of 1.5 mmol/l (Fig. 1). Abdominal ultrasound (USS) demonstrated patent vessels with no evidence of biliary dilation, and a small subhepatic collection. By day 5, the serum AST had fallen to 96 IU/l, and the INR and lactate levels were within normal range (Fig. 1). A CT scan on day 8 demonstrated normal enhancement of the hepatic parenchyma with no features of segmental ischaemia or infarction. A 15 cm subhepatic collection was visible extending from the porta inferiorly. At USS, serous fluid was aspirated and the collection resolved with conservative management. A 3-day course of methylprednisolone was prescribed at day 8 for rejection with an AST rise to 153 IU/l. The patient was discharged home well 3 weeks post-transplant. The explant demonstrated an incidental 1.5 cm well differentiated right lobe hepatocellular carcinoma with a 0.5 cm satellite lesion in a cirrhotic liver with features of chronic hepatitis. The patient currently remains well, with normal liver enzymes and synthetic function 9 months following liver transplantation. Of additional interest, both recipients of the donor kidneys also remain well 6 months following transplantation with serum creatinine levels of 122 and 76 μmol/l, respectively.

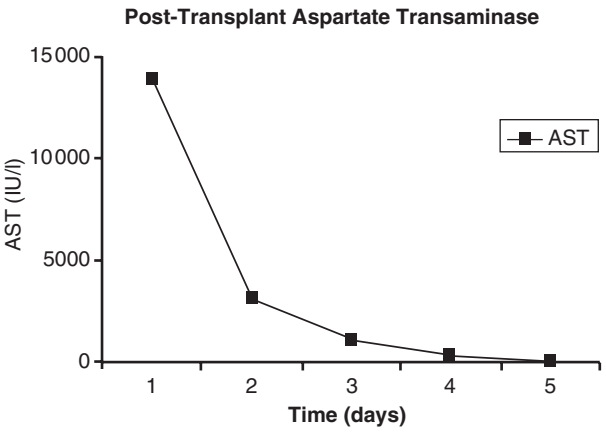

Figure 1 Recipient aspartate transaminase levels following transplantation. Postoperative day 1 AST level of 13 886 IU/l fell rapidly by day 5 to 96 IU/l.

Discussion

The limited availability of organs for transplantation has led to relaxation of selection criteria for livers, and the inclusion of marginal donors. Transplant surgeons have been reluctant to utilize traumatized livers because of concerns regarding the additive effect of parenchymal damage to reperfusion injury related to warm and cold ischaemia, the risk of haemorrhage and subsequently, of septic complications including intrahepatic abscesses related to bile duct shear injuries, or pseudoaneurysm formation [8]. Although, transplantation of traumatized livers has been associated with a higher rate of primary nonfunction (PNF) in a small series of patients, good patient and graft survival rates have been reported with mild to

moderate liver injuries [5]. Their use appears to be safe with careful selection.

The successful transplantation of a traumatized liver from a controlled NHBD has not been previously reported. Areas of concern in this case included the presence of elevated transaminase levels combined with a grade 2 liver injury and compression from packing. Therapeutic perihepatic packing provides control of haemorrhage, and permits resuscitation and stabilization of the patient [9]. In this case, irreversible neurological injury led to withdrawal of treatment and NHBD. Organs from NHBDs have increased warm ischaemic time and reduced tolerance to cold storage, which may adversely affect tissue viability and graft function. In this case, the donor was a young, relatively haemodynamically stable, category III NHBD with an intensive care stay of <2 days. The time from withdrawal to cardiac arrest was short, and resulted in minimal warm ischaemic time. Importantly, cold ischaemic time was limited to 5.6 h. A reduction in PNF of NHBD grafts to 10.8% within 60 days has been reported when cold ischaemic time is <8 h [1]. In our experience, of 32 orthotopic liver transplantations from NHBDs we have observed one PNF associated with a cold ischaemic time of 14 h (P. Muiesan, M. Rela, N. Heaton, unpublished data).

Although there were multiple capsular tears in the right posterior liver, the main parenchymal injury was secondary to packing and compression, with excellent perfusion of the remainder of the liver. We believe the use of back-table pressure perfusion was beneficial. The markedly elevated serum AST level at day 1 reflected the effect of the localized packing injury, but subsequently it fell rapidly reaching near normal levels by day 5 (Fig. 1). However, we and others have observed higher day 1 serum AST levels in NHBD compared with HBD recipients as a consequence of the greater ischaemic injury [3]. Postoperative graft function was excellent, and there were no significant postoperative complications during a 21 day hospital stay. Currently, there are no signs of cholangiopathy which has been reported by some groups as a complication of NHBD [10].

The presence of grade 1–2 liver trauma in association with liver packing should not contraindicate liver transplantation. Inclusion of this group of patients would potentially contribute to expand the donor pool, which is urgently needed to cope with current demands.

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