Transfusion Free Surgery: Single Institution Experience of 27 Consecutive Liver Transplants in Jehovah's Witnesses

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BACKGROUND: Despite the risks associated with transfusion, the medical community continues to view blood as a safe and abundant product. In this article, we provide an effective strategy to accomplish orthotopic liver transplantation without transfusion.

STUDY DESIGN: From June 1999 through July 2004, 27 liver transplantations were performed in Jehovah's Witness patients at the USC-University Hospital (24 adults, 3 children). Nineteen of these were living donor (LD) and eight were deceased donor (DD) liver transplants. Preoperative blood augmentation with erythropoietin and iron was achieved. At induction, all LD and six of eight DD recipients underwent acute normovolemic hemodilution (ANH), and the operation was conducted under conditions of moderate anemia. Cell scavenging techniques were used. Acute normovolemic hemodilution and salvaged blood were returned as needed during bleeding or on completion of transplantation.

RESULTS: The preoperative liver disease severity score was higher in the deceased donor group. We had 100% graft and patient survivals in the LD group, and 75% in the DD recipients. Two DD recipients died. The remaining are all alive and well, with a mean followup of 965 days (range 266 to 1,979 days) in the LD group and 624 days (range 119 to 1,132 days) in the DD group.

CONCLUSIONS: Preoperative blood augmentation and acute normovolemic hemodilution provide a safe cushion against operative blood loss. Elective living donor liver transplantation allows full implementation of a transfusion-free strategy in the setting of early hepatic failure, portal hypertension, and anemia. This feat is an important step toward global standardization of transfusion-free surgical practice and an important response to widespread blood shortages and transfusion risks. (J Am Coll Surg 2005;201:412–417. © 2005 by the American College of Surgeons)

Liver transplantation is the standard of care for patients with end stage liver disease. The discrepancy between the number of patients awaiting transplantation and the number of available deceased donor organs has led to modifications of the organ allocation policy, with emphasis now being placed on the severity of liver disease and associated renal dysfunction (model for end-stage liver disease score).[1] The associated coagulopathy, anemia, malnutrition, and severe portal hypertension have made this procedure more daunting and the use of blood products almost universal.[2] Using conventional surgical standards, it would be a clinical improbability to perform liver transplantation with success in Jehovah's Witness patients. This subset of patients has allowed us a distinctive opportunity to develop strategies toward a transfusion-free environment, with the ultimate aim of being able to translate this practice to all general surgical procedures.

Competing Interests Declared: None.

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METHODS

Patient population

From June 1999 through June 2004, 27 Jehovah's Witness patients underwent liver transplantation. The data collected for the purposes of this article were approved

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Abbreviations and Acronyms

ANH = acute normovolemic hemodilution
DD = deceased donor
LD = living donor

by the IRB and confidentiality was maintained. Three patients were children, ages 6 months, 11 months, and 3 years. For the purposes of consistency, the data analyzed refers to the 24 adult patients. Sixteen patients underwent living donor liver transplantations and eight underwent deceased donor whole liver transplantation. All patients were Jehovah's Witnesses who had signed a "Refusal to Permit Blood Transfusion" form that served as a legal release of liability. The patients were provided with a "Personal Decision and Release" form that specified consent for the use of various secondary blood fractions such as albumin, cryoprecipitate, factor VIIa, aprotinin, and aminocaproic acid. The blood product restrictions and inclusions agreed on during the administrative phase were legally binding during the operative phase, even to the point of death.

Preoperative management

Preoperatively, the aim was to increase the red cell mass to a normal or hypernormal level, and to decrease portal hypertension selectively. Erythropoietin in conjunction with iron sulfate and folic acid were used to support blood augmentation. Erythropoietin was used at a dose of 20,000 U subcutaneously twice a week or 40,000 U once a week for the duration of the preoperative period. If and when the hematocrit reached 45 g/dL, erythropoietin was held and serial monitoring continued. Despite anemia in patients with decompensating cirrhosis, the targeted hematocrit in the majority of our patients was achieved within 2 months. For unexplained reasons, patients with associated renal dysfunction responded slowly and appeared to be relatively resistant to the use of erythropoietin. Transjugular intrahepatic portal-systemic shunt was used primarily as therapy for upper gastrointestinal bleeding and less frequently to decrease portal hypertension in patients with pronounced varices.

Operative approach

All patients underwent liver transplantation at USC University Hospital by the same surgical team. The anesthesia management was similar to that used in non-Jehovah's Witness patients. Pulmonary artery catheter and transesophageal echocardiogram were used in all patients. In three patients who had severe renal dysfunction preoperatively, intraoperative dialysis was performed. The intraoperative coagulation profile was monitored with a thromboelastogram (TEG). Cell saver was used intraoperatively in all patients. Acute normovolemic hemodilution (ANH) was performed in all living donor (LD) recipients. Two of the eight deceased donor recipients had a low preoperative hematocrit and did not tolerate the removal of blood for the purposes of ANH.

Postoperatively, laboratory tests were drawn in pediatric blood tubes once a day for the duration of the hospital stay. Regular steroid induction, followed by maintenance therapy with tacrolimus and prednisone with or without mycophenolate mofetil was used.

RESULTS

Patient population

There were 5 women and 19 men in this series (Table 1). The mean age at the time of transplantation was 47.8 years (range 18 to 66 years). The causes of the underlying liver disease were hepatitis C cirrhosis (n = 15), primary sclerosing cholangitis (n = 4), cryptogenic cirrhosis (n = 3), alpha 1 antitrypsin deficiency (n = 1), and autoimmune hepatitis (n = 1). Two of the 8 deceased donor (DD) patients and 8 of the 16 LD recipients had upper gastrointestinal bleeding before transplantation. Transjugular intrahepatic portal-systemic shunt was performed in seven patients before transplantation: in five as a therapy for bleeding gastrointestinal varices, and in the remaining two as prophylaxis to decrease portal pressure preoperatively in patients with pronounced varices. Seven patients (one DD recipient and six LD recipients) had a history of earlier abdominal operations: two had laparoscopic cholecystectomy, one open cholecystec-

Table 1. Preoperative Clinical Profile

Characteristic	Deceased donor (n = 8)	Live donor (n = 16)
Mean age, y (range)	54.3 (47–66)	44.6 (18–62)
Previous gastrointestinal bleeding, n	2	8
Ascites, n	5	11
Encephalopathy, n	5	8
TIPSS	2	5
Previous abdominal surgery, n	1	6

TIPSS, transjugular intrahepatic portal systemic shunt.

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