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CASE REPORT

Liver transplantation utilizing a severely fractured graft: every organ counts

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ABSTRACT

In our current era where shortage of liver grafts is commonplace, utilization of traumatic liver grafts may represent an opportunity to expand the organ donor pool without compromising graft survival. However, data on liver transplantation using a fractured liver allograft is scarce, with only small case series and reports found in the literature. In this report, we describe our experience with utilizing a liver graft with grade IV hepatic fracture for transplantation. At 12 months follow up, the recipient has excellent graft function and has regained an excellent quality of life. We demonstrate that the ability to safely use a fractured liver graft represents an additional avenue for expansion of the deceased donor population, especially in regions with prolonged waitlist times.

Key words. Liver trauma. Liver transplantation. Organ pool expansion.

INTRODUCTION

Trauma is the second most common cause of death in all deceased donors and of those with abdominal trauma, as many as 40% have hepatic injuries.[1] In our current era where shortage of liver grafts is commonplace,[2] utilization of traumatic liver grafts may represent an opportunity to expand the organ donor pool without compromising graft survival. As non-operative management of hepatic injuries becomes increasingly common, it is not surprising to have hemodynamically stable, eligible brain-dead donors with significant liver injury pre-procurement. However, data on liver transplantation using a fractured liver allograft is scarce, with only small case series and reports found in the literature. Herein, we describe the successful transplantation of a liver graft with a grade IV laceration and present a review of the literature on outcomes following liver transplantation with fractured grafts.

CASE REPORT

The donor was a 29 year old female with a history of illicit drug use who was found down at home in asystolic arrest. She had return of circulation after 6 rounds of cardiopulmonary resuscitation and 5 rounds of epinephrine, but subsequently progressed to brain death. Her initial liver function tests revealed normal bilirubin levels, but a peak aspartate aminotransferase of 4,188 units per liter (U/L) and an alanine aminotransferase of 1,460 (U/L); the latter two values decreased to 218 and 469 U/L at the time of procurement. Prior to the donor evaluation, a computed tomography (CT) scan performed as part of the initial admission evaluation revealed a large amount of blood in the peritoneal cavity and a grade IV hepatic fracture through the left lobe without evidence of hepatic vasculature injury (Figures 1A-1C). Bilateral rib fractures and a depressed fracture of her distal sternum suggested that the liver fracture was likely from the resuscitative chest compressions. Of note, although our center accepted this liver offer, the liver graft had been declined by the five other liver transplant centers within our donation service area prior to visualization of the computed tomography scan images and prior to inspection of the liver.

The recipient was a 58-year old male with a diagnosis of nonalcoholic steatohepatitis related cirrhosis. This has been complicated by portal vein thrombosis, hepatic encephalopathy, hydrothorax and ascites with a history of associated spontaneous bacterial peritonitis. The patient had been listed for transplant for a year prior to this organ offer. His renal function had been declining secondary to

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Figure 1. A, B, C. *Computed tomography slices depicting a grade IV liver laceration through segment IV (arrow), with surrounding hemoperitoneum. There was no evidence of major vascular injury.*

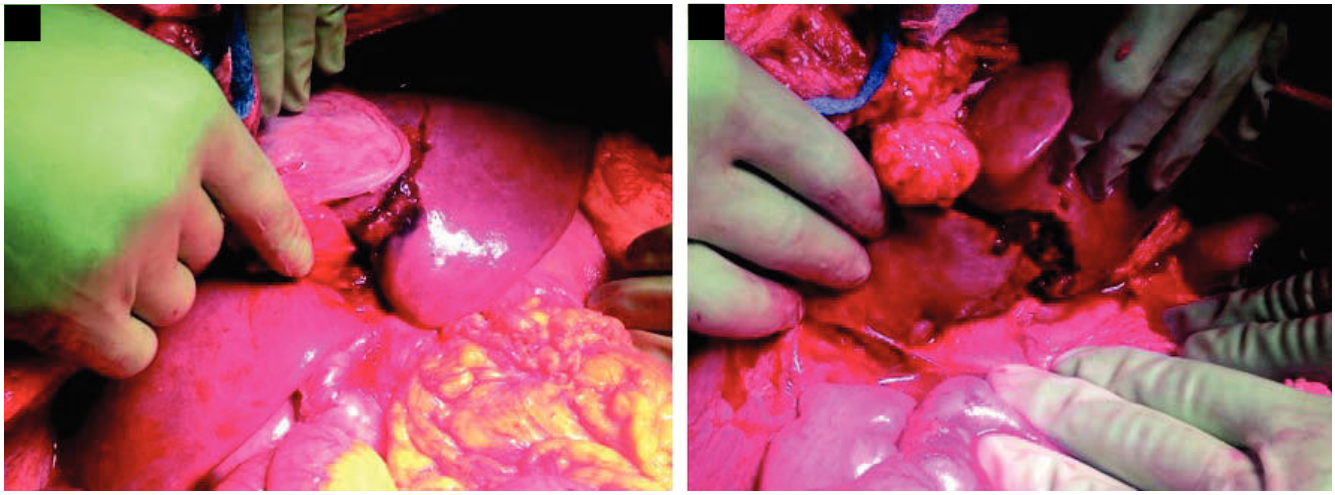

Figure 2. A. *Intraoperative anterior view of the fractured liver graft, depicting the injury through segment IV.* ***B.*** *Posterior view of the fractured liver graft, with a hematoma bridging the right and left hepatic lobes.*

Type II hepatorenal syndrome, and at the time of transplant he was transferred from an outside hospital where he had been admitted for his decompensated liver disease. Despite his model for end-stage liver disease score (MELD) of 25, given the prolonged waitlist time in our Region, he was sequence 57 on the match run. Given his low MELD score for what is needed to be in contention for liver offers in our Region, the patient had previously consented to expanded criteria donors with the hopes of obtaining a liver offer.

The donor procurement was performed in the standard fashion. Intraoperatively, there was no evidence of biliary leakage. A through-and-through fracture in the liver just medial to the falciform ligament was noted with no evidence of active bleeding (Figures 2A and 2B). The explant hepatectomy was performed in the standard fashion with care taken to not further disrupt the hepatic fracture. During the back table bench work, flushing of the common bile duct confirmed the absence of a biliary leak. At this point, the decision was made to proceed with the transplantation, and the recipient team was notified to proceed. The liver transplant was performed in a routine fashion utilizing a piggyback technique. Recipient portal vein thrombectomy was performed prior to implantation of the graft. The cold ischemic time was 244 min, and the warm ischemic time (time out of ice to portal reperfusion) was 16 min. The graft demonstrated immediate function and the patient was discharged on postoperative day 31 to a rehabilitation facility. His follow-up computed tomography scan at 6 months revealed a healed hepatic fracture (Figure 3). Twelve months following liver transplantation the patient has excellent graft function and has regained an excellent quality of life, with normal liver enzyme levels (aspartate aminotransferase 11, alanine aminotransferase 13, alkaline phosphatase 81, total bilirubin 0.3).

DISCUSSION

Historically, there has been skepticism around utilization of fractured liver grafts due to concerns of hemor-

rhage, bile leaks and subsequent septic complications. In recent years, however, there have been reports on utilization of fractured liver grafts after reduction hepatectomy with acceptable outcomes (Table 1). Nevertheless, despite these reports (the last of which was in 2009), there continue to be reservations in utilization of fractured liver grafts, as evidenced by the liver graft in the current report being declined by the five other centers within our long waitlist Region. We suspect that the likely reason for transplant surgeons declining the liver graft was due to the high infectious risk nature of the donor and/or the presence of the severe hepatic fracture. Being the only center interested in this high-risk graft allowed us to utilize this organ in a patient with a relatively low MELD (for our Region) but with symptoms of severely decompensated liver disease. Indeed, we were able to utilize a liver graft with a grade IV laceration without needing to perform backtable reduction hepatectomy, and obtained excellent postoperative graft function. As such, this case thus serves to heighten awareness of an important strategy to increase the donor pool as the gap between organ supply and demand persists. Further, it aims to highlight the importance of having a transplant surgeon review axial imaging and the liver graft itself prior to making a decision of accepting or declining a traumatic graft as radiologic interpretation does not necessarily correlate with transplantability of an organ.

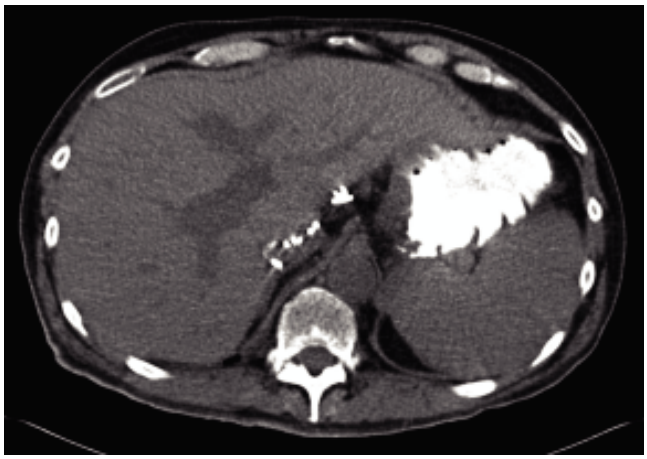

Figure 3. *Postoperative follow-up computed tomography scan 6 months after transplantation depicting a healed hepatic fracture.*

In the largest series published, Geenen and colleagues analyzed the Australian National Liver Transplantation Unit's database and described 15 patients receiving liver grafts with macroscopic trauma (11 adults, 4 pediatric recipients).[3] Of the described hepatic trauma in this prior report, the majority of the injuries were classified as mild, consisting of nine grade III or less liver injuries. Of the 15, only three cases of liver trauma were identified prior to organ procurement, with the decision pre-procurement to discard the right lobe and only use the left lateral segment of the allograft following a back table reduction hepatectomy. There were two cases of initial poor graft function, but no allograft failure reported. There were four recipient mortalities, all of which were not associated with the use of the injured donor liver as all had excellent initial graft function. It should be noted that although the majority of experience reported in the literature pertaining to liver transplantation utilizing a fractured graft deals with organs from deceased donors, there is a single report in the literature describing successful living donor liver transplant using a left lobe graft obtained from a donor who had sustained a grade IV central liver injury after being involved in a traffic accident.[4]

Careful consideration of certain factors is paramount for the success of a transplanting a fractured liver graft, as shown in table 2. Indeed, identification of a lobar vascular injury or back table identification of an ill-defined cut

Table 1. Review of reports on utilization of traumatic liver grafts for transplantation.

1st author, year	n	Injury	Cold ischemic time (mins)	Mortality	Follow-up with good graft function
Broering, 1999	14	-	-	2	6-month: 64%
Avolio, 2000	1	Grade II	540	0	26 months
Tucker, 2005	1	Grade II	336	0	9 months
Benedetto, 2007	1	Grade IV	360	0	2 months
Geenen, 2009	15	Grade I – 7 II – 1 III – 1 IV – 2 V – 2	576	4	3-month: 100% 1-year: 80%
Chen, 2009	1	Grade IV	97	0	7-years

Table 2. Considerations for transplanting a fractured liver graft.

• Maintenance of hemodynamic stability until the time of procurement.
• Preoperative axial imaging to further define the vascular anatomy.
• Assessment for bile stained ascites.
• Evaluation of biliary tree of liver graft on the back table if bile stained ascites present.

edge leak may require reduction hepatectomy prior to implantation. Roux-en-y-hepaticojejunostomy is a viable strategy for managing non-edge bile leaks, such as a severed bile duct. Lastly, as mentioned above, the ability to review a contrast computed tomography scan prior to proceeding with organ procurement greatly facilitated the decision making process in allowing for the success of the liver transplant. Notably, the elevated liver enzymes observed in the described donor was felt to be a result of shock liver from the initial cardiac arrest and was thus not thought to be a contraindication to the utilization of the liver graft for transplant.

We demonstrate that severe traumatic liver injury should not be an absolute contraindication for potential organ donation. Rather, only after full consideration, including review of available axial imaging, should a decision on whether to accept or decline a traumatic graft be made. With the demand for liver grafts continuing to outpace the supply, the ability to safely use a fractured liver graft represents an additional avenue for expansion of the deceased donor population.

ABBREVIATIONS

- **MELD:** Model for End-Stage Liver Disease.

GRANT SUPPORT AND FINANCIAL DISCLOSURES

None.

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