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Reno-portal shunt for liver transplant, an alternative inflow for recipients with grade III–IV portal vein thrombosis: Tips for a better outcome



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ABSTRACT

INTRODUCTION: Portal vein thrombosis (PVT) poses an extremely difficult problem in cirrhotic patients who are in need of a liver transplant. The prevalence of PVT in patients with cirrhosis ranges from 0.6% to 26% Nery et al. (2015) [1]. The presence of PVT is associated with more technically difficult liver transplant and in certain cases can be a contraindication to liver transplant. The only option for these patients with extensive PVT would be a multi-visceral transplant, the later unfortunately has a much higher morbidity and mortality compared to liver only transplant Smith et al. (2016) [2]. An alternative approach is needed to provide a safe and reliable outcome.

PRESENTATION OF CASE: In this case series, we present our experience with reno-portal shunt as an alternative inflow for the liver allograft.

DISCUSSION: This approach appears to be safe with good long-term outcome. Although this technique has been described before, we provide additional considerations that produced good outcomes in our patients.

CONCLUSION: We believe that meticulous preoperative planning with high-resolution triple phase CT imaging with a measurement of the diameter of the spleno-renal shunt along with a duplex scan measuring flow through the shunt is key to a successful transplantation. Moreover, appropriate donor liver size is also of extreme importance to avoid portal hypoperfusion.

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1. Introduction

Portal vein thrombosis (PVT) poses an extreme challenge in cirrhotic patients who are in need of a liver transplant. The prevalence of PVT in patients with cirrhosis ranges from 0.6% to 26% [1]. The presence of PVT is associated with more technically difficult liver transplant and in certain cases can be a contraindication to a liver transplant. Such patients with extensive PVT are commonly offered a multi-visceral transplant, which unfortunately have associated with a much higher morbidity and mortality compared to a single-organ liver transplant [2]. An alternative approach is needed to provide a safe and reliable outcome. In this case series, we present our experience with reno-portal shunt as an alternative inflow for the liver allograft. This approach appears to be safe with good long-term outcomes. This report is in compliance with the guidelines

outlined in SCARE criteria [3], and has been reported in line with the PROCESS criteria [4].

2. Case 1

Our first patient was a 57-year-old man with a history of liver cirrhosis secondary to hepatitis C, genotype 1a. His liver cirrhosis was complicated by ascites, esophageal varices, and hepatic encephalopathy. His past medical history was also positive for type II diabetes mellitus and hypertension.

At the time of transplantation, the patient was already hospitalized due to acute kidney injury and hepatic encephalopathy for over 2 months. His MELD score was 32. Preoperatively, hepatorenal syndrome was managed using intermittent albumin infusions, octreotide and sympathomimetic agents such as midodrine as indicated.

Preoperative CT of his abdomen showed grade III PVT with cavernous malformation (Fig. 1). His surgery posed a unique challenge due to the chronic grade III portal vein thrombosis, with a com-

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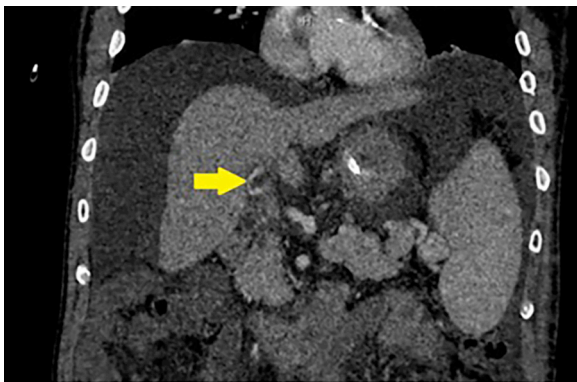


Fig. 1. Arrow showing Cavernous malformation of the portal vein.



Fig. 2. Arrow showing spleno-renal shunt.

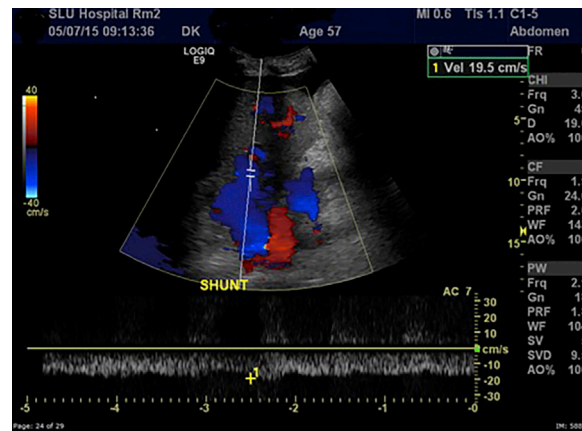


Fig. 3. Duplex scan showing antegrade flow through spleno-renal shunt.

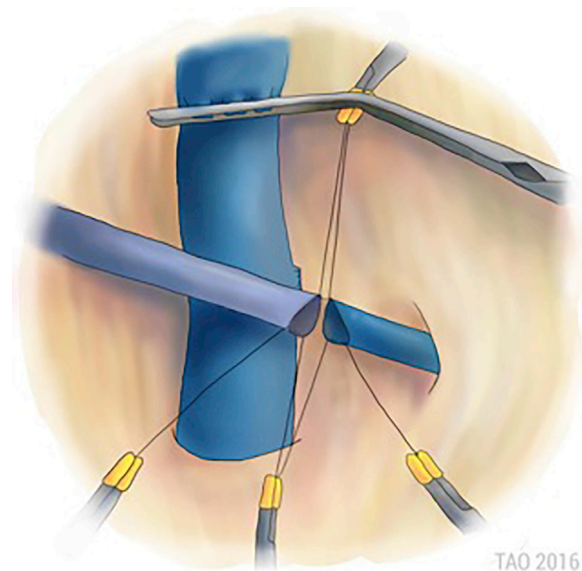


Fig. 4. Drawing showing donor iliac vein interposition graft anastomosis to the recipient left renal vein. Please note a Satinsky clamp should be applied for proximal control of the left renal vein, this was omitted from the drawing for a better view of the anastomosis.

plete obstruction of the portal vein and superior mesenteric vein confluence. We reviewed his imaging carefully and there appeared to be a large spleno-renal shunt that was 10 mm in diameter (Fig. 2). Moreover, large splenic size served as an indicator of flow through the spleno-renal shunt, and guaranteed sufficient portal flow to the new allograft. Based on these findings, we opted to proceed with a reno-portal anastomosis to provide inflow for the liver allograft. We then measured the flow through the spleno-renal shunt via duplex scan, which demonstrated an antegrade flow towards the renal vein with a velocity between 19.5 cm/sec and 40 cm/sec (Fig. 3). A suitable donor became available, however, the patient's serum sodium was 120 mmol/L. We were concerned for postoperative central pontine myelinolysis (CPM) due to the expected rapid rise in serum sodium with possible large volume blood transfusion [5]. Despite medical therapy, the patient sodium remained persistently close to 120 mmol/L. Prior to transplantation, the patient was transferred to the ICU and hemodialysis was initiated in an effort to raise his sodium gradually. We were able to increase his sodium was 129 mmol/L just prior to transplant.

The donor liver size was estimated using volumetry measured on CT scan. The total liver volume was 1800 mL. Standard liver procurement protocol was performed with in situ cold preservation using University of Wisconsin solution [6]. The portal vein was procured in the standard fashion and was cut at the confluence of the superior mesenteric vein and splenic vein. Long iliac vein conduits procurement is essential as they are used as an interposition graft between the recipient left renal vein and the donor portal vein. The

back table preparation of the liver is performed in similar fashion to any liver transplant.

The patient was taken to the operating room and partial venovenous bypass was utilized via a percutaneous approach through the femoral and internal jugular veins. In order to maintain serum sodium and electrolytes within acceptable ranges, intra-operative continuous veno-venous hemodialysis (CVVHD) was initiated. Following completion of the hepatectomy, full Kocherization of the duodenum was performed. Dissection of the inferior vena cava was undertaken until the left renal vein could be fully visualized and carefully isolated. We then utilized a TA stapler (30 mm with white load) to transect the left renal vein at the junction of the IVC after placing a Satinsky clamp proximally to control the vein close to the renal hilum. The donor's iliac vein interposition graft was anastomosed to the recipient's left renal vein in an end-to-end fashion (Fig. 4). The donor's portal venous inflow was established by anastomosing the interposition graft to the donor portal vein (Fig. 5). On reperfusion, the patient remained hemodynamically stable, warm ischemia time was 56 min.

Volume flow measurements obtained using a Transonic system showed that the portal flow was 1400 mL/min after reperfusion.

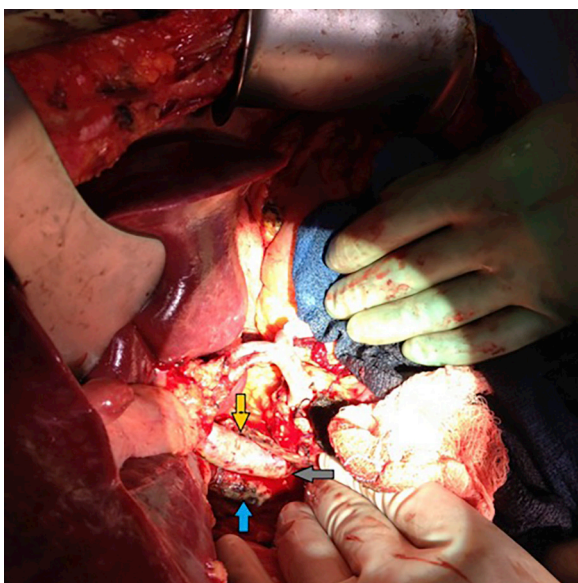


Fig. 5. Intra-operative view of donor iliac vein interposition graft.

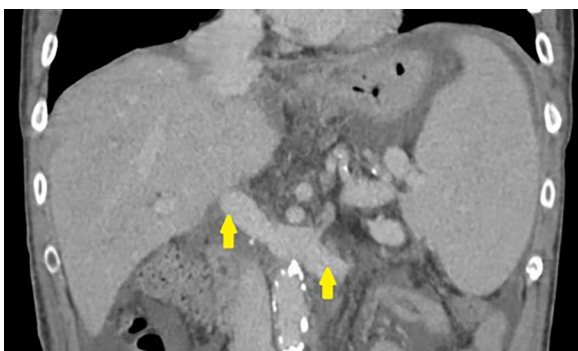


Fig. 6. Post-operative CT showing reno-portal anastomosis.

This indicated >0.5 mL/min/gm liver flow was achieved. Post-operative liver CT showed patent reno-portal anastomosis (Fig. 6).

The patient recovered well and was discharged home on post-operative day fourteen. He initially had some ascites and slight renal dysfunction that progressively resolved over a few months. He survived eleven months until he died from acute myocardial infarction despite a coronary angioplasty. Liver functions remained normal following the OLT.

3. Case 2

Our second patient was a 56-year-old man with a past medical history of NASH cirrhosis as the cause of his liver failure. Preoperative triple phase CT of the liver showed diminutive recipient portal vein with PVT (Fig. 7).

Reviewing the preoperative CT, there was good communication between the superior mesenteric vein (SMV) and splenic vein indicating good splanchnic drainage through a spleno-renal shunt (Fig. 7). The spleno-renal shunt was also large at 12.6 mm (Fig. 8). Once a suitable donor was available with an estimated liver size 1600 gm, the patient underwent an OLT. The procurement, back table and transplantation was done in similar fashion to the first patient. Patient tolerated reperfusion well without any evidence of hemodynamic compromise, warm ischemia time was 43 min. Intra-operative volume flow measurements showed a portal venous flow of 970 mL/min. The patient was discharged ten days postoperatively to a rehabilitation facility and is currently doing



Fig. 7. Arrow pointing to portal vein thrombosis with diminutive portal vein. Patent communication between SMV and splenic vein.



Fig. 8. Large spleno-renal shunt measuring 12.6 mm.

well eleven months post-operatively. He also continues to have normal liver function without any signs of portal hypertension.

4. Discussion

Traditionally considered a contraindication to liver transplantation, portal vein thrombosis and diminished portal venous flow continue to present a significant challenge to the management of end-stage liver disease patients. The prevalence of portal vein thrombosis in patients awaiting liver transplantation is approximately 15% [7–10]. Barring such patients from the option of a transplant is likely to impose significant morbidity and mortality. Therefore, a surgical option is felt to be necessary to provide optimal care to such patients. Several techniques have been described to provide an alternate inflow and allow these patients to receive liver transplant including thrombectomy of occluded portal vein [11,12], porto-caval hemi-transposition [13], meso-portal jump graft using donor iliac vein [14,15] and arterialization of portal vein [16].

Patients with severe portal hypertension from thrombosed portal veins occasionally develop spontaneous spleno-renal shunts as a compensatory mechanism. Using reno-portal shunts as an alternate portal venous inflow for the liver allograft has been described in two case series for patients with previous surgically placed spleno-renal shunt [17] and for patients who underwent living donor liver transplantation [18]. A more recent study from the Cleveland Clinic described their experience using one spleno-portal anastomosis with an iliac jump graft with a good outcome [19].

Our cases highlight the feasibility of this technique in patients with PVT and spontaneous spleno-renal shunt. Reno-portal anastomosis provides a safe alternative for inflow and we believe it provides a better inflow compared to using SMV or inferior mesenteric vein (IMV) with a jump graft because reno-portal shunting options provide an end-to-end anastomosis as compared to the end-to-side anastomosis of alternative inflow options. This end-to-end anastomosis should provide better flow hemodynamics and theoretically should have less kinetic shear injury to the vessel intima and thus less intimal hyperplasia compared to end-to-side anastomosis.

A few observations that we have learned from these cases: First, allograft size is of critical importance. Graft size that is smaller is preferable with maximum graft size of 1800 gm (if recipient habitus and size allows for such). It is essential to maintain at least 0.5 mL/min/gram liver flow in the transplanted allograft to prevent portal hypoperfusion and to maintain left renal vein inflow to greater than 1 L/min. Secondly, a meticulous preoperative workup is needed, including a CT demonstrating spleno-renal shunt diameter of at least 8 mm and preoperative duplex flow measurement that shows a flow rate of at least 10 cm/sec thereby ensuring adequate flow. Another important finding to look for in the preoperative CT is a patent communication between the SMV and splenic vein (Fig. 7), which indicates good splanchnic drainage to systemic circulation and would predict the absence of ascites post OLT.

5. Conclusion

Reno-portal shunt in patients with portal vein thrombosis and a spontaneous spleno-renal shunt is a safe and effective alternative inflow option. Good long-term outcome is expected with meticulous preoperative planning and with choosing the right donor and recipient.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Ethical approval

There was no need for ethical approval.

Consent

All patients involved consented personally or next of kin did.

Author contribution

The corresponding author was the primary surgeon the rest of the authors helped in writing and contributing to the paper.

Guarantor

Corresponding author: Mustafa Nazzal, MD.

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