Transjugular Intrahepatic Portosystemic Shunts in Liver Transplant Recipients: Technical Considerations and Review of the Literature

Nilesh H. Patel, M.D.,[1] Jay Patel,[1] George Behrens, M.D.,[1] and Anthony Savo, M.D.[2]

ABSTRACT

Transjugular intrahepatic portosystemic shunt (TIPS) is an accepted therapeutic option for the treatment of complications of portal hypertension, such as refractory variceal bleeding, refractory ascites, refractory hepatic hydrothorax and Budd-Chiari syndrome, in cirrhotic livers. However, portal hypertension is uncommon after liver transplantation, and when it occurs, it has been related to hepatic vein outflow obstruction, small liver donor size, rejection, or recurrence of the original disease. There are few reports in the literature addressing TIPS experience in liver transplant patients. This review will address the published experience of TIPS procedures in liver transplant patients, including indications, technical issues, complications, and outcomes.

KEYWORDS: Transjugular intrahepatic portosystemic shunt, liver transplantation, portal hypertension

Objectives: Upon completion of this article, the reader should understand (1) the indications for TIPS in a post liver transplant patient, (2) the various surgical techniques for liver transplantation, (3) how the altered anatomy may create some technical challenges in creating a TIPS shunt, and (4) the short-term outcome after TIPS in a liver transplant patient based on the existing literature.

Accreditation: Tufts University School of Medicine (TUSM) is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

Credit: TUSM designates this educational activity for a maximum of 1 Category 1 credit toward the AMA Physicians Recognition Award. Each physician should claim only those credits that he/she actually spent in the activity.

According to the data from United Network for Organ Sharing, the number of liver transplantations (LTs) performed in the United States are increasing every year, with 5672 in 2003, 6169 in 2004, and 4419 in 2005 as of August 31. Surprisingly, the waiting period for liver transplantation and the death rate among patients on the waiting list have increased by a factor of more than 10 in the last decade.[1] The most common reason for liver transplantation in the United States is end-stage cirrhosis related to hepatitis C virus (HCV). Approximately 95% of all patients who undergo liver transplantation because of HCV disease will have viremia after transplantation,[2] more than 50% will develop an acute lobular HCV hepatitis in the first year,[3] and 15 to 25% of them will

Transjugular Intrahepatic Portosystemic Shunts: An Update; Editors in Chief, Brian Funaki, M.D., Peter R. Mueller, M.D.; Guest Editor, Hector Ferral, M.D. *Seminars in Interventional Radiology*, volume 22, number 4, 2005. Address for correspondence and reprint requests: Nilesh H. Patel, M.D., Department of Radiology, Rush University Medical Center, 1653 West Congress Parkway, Chicago, IL, 60612. [1]Department of Radiology and [2]Department of Surgery, Rush University Medical Center, Chicago, Illinois. Tel: +1(212) 584-4662. 0739-9529,p;2005,22,04,329,333,ftx,en;sir00333x.

have cirrhosis within few years after LT. The hepatitis B virus (HBV) has less than 30% recurrence, but usually recurrence is more severe than with HCV. Primary sclerosing cholangitis and primary biliary cirrhosis have roughly a 10 to 20% recurrence rate, which also occasionally requires retransplantation.

The development of portal hypertension after LT is unusual and unexpected as the diseased liver has been replaced by a normal organ. The etiology of portal hypertension in post-LT patients has not yet been established. However, it has been associated with hepatic blood outflow obstruction, disparity between the donor's and recipient's liver size,[4,5] as well as in the diameter of the vessels,[6] and decrease of vascular compliance of sinusoids during acute cellular rejection.[7]

The indications to perform a TIPS procedure in the liver transplant patient are similar to those in the cirrhotic patient: essentially recurrent variceal bleeding and the presence of refractory ascites and/or hepatic hydrothorax. Refractory ascites and/or hepatic hydrothorax represents a serious dilemma to the physician, because it has been linked to an increase in the incidence of abdominal infections, prolonged hospitalization, deterioration of renal function, and tendency toward lower survival rates in these patients.[6,8] Numerous cases of massive ascites caused by stenosis or twisting or kinking of the caval anastomosis have been reported. However, subsequent endovascular therapies with angioplasty and/or stenting of the lesion have proven to be effective in these cases.[9–11]

The portosystemic pressure gradient is lower after liver transplantation; therefore variceal bleeding as a manifestation of portal hypertension is extremely rare. Previous reports have demonstrated that almost all cases respond to medical or endoscopic therapy. TIPS creation for the management of variceal bleeding after liver transplantation is feasible when the medical treatment has failed.

TIPS IN LT

Anatomic Considerations

The procedural planning for TIPS in liver transplant patients rests in the knowledge of the new anatomical configuration and vascular anastomoses as a result of the surgical technique. The interventional radiologist must be aware of the various transplant techniques to plan the approach and execution of the shunt.

The standard (conventional) orthotopic LT is done by end-to-end anastomosis of the donor's to the recipient's suprahepatic vena cava, followed by similar end-to-end anastomosis of the infrahepatic vena cava (Fig. 1). This technique requires cross-clamping of the recipient's inferior vena cava and results in a period of decreased renal perfusion. The donor's portal vein is anastamosed to the recipient's portal vein in an end-to-end fashion.

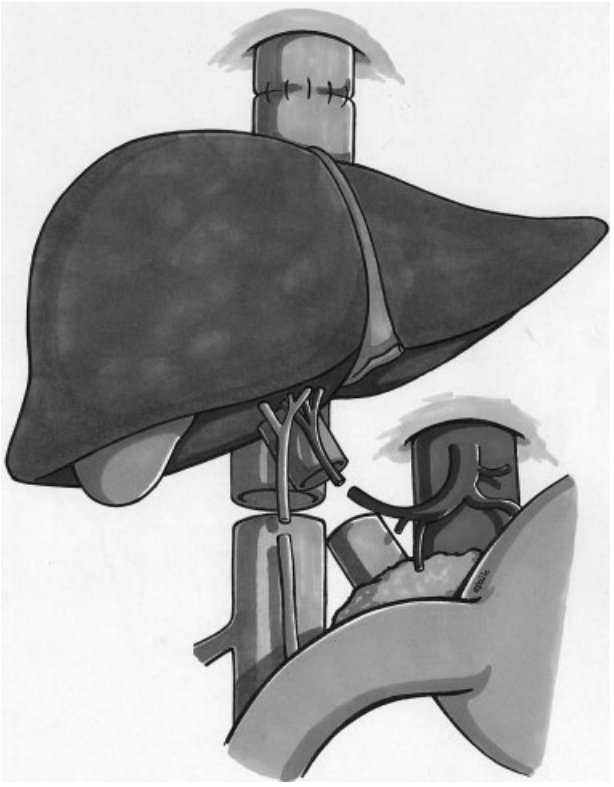

Figure 1 Standard (conventional) orthotopic liver transplant.

The piggyback technique of liver transplantation is done with the recipient's vena cava left intact. The donor's suprahepatic vena cava is anastamosed to recipient's right-middle hepatic veins. The recipient's inferior vena cava (IVC) blood flow is not interrupted with any untoward sequela to renal perfusion. The donor's portal vein is anastamosed to the recipient's portal vein in an end-to-end fashion (Fig. 2).

The cavo-caval technique of liver transplantation is done with the donor's suprahepatic vena cava anastamosed directly to the recipient's vena cava in a side-to-side fashion. The donor's portal vein is anastamosed to the recipient's portal vein in an end-to-end fashion (Fig. 3).

For pediatric recipients, transplantation of left-lateral segments split from cadaveric donor or a living donor has become a standard practice. This technique of liver transplantation consists in end-to-side anastomosis between donor's left or right hepatic vein to the recipient's IVC (Fig. 4). There is an end-to-end anastomosis between donor's left or right portal vein to the recipient's portal vein.

Procedure

The right internal jugular vein approach is used for creation of the TIPS in patients with transplanted liver except in case of piggyback LT. The use of the left

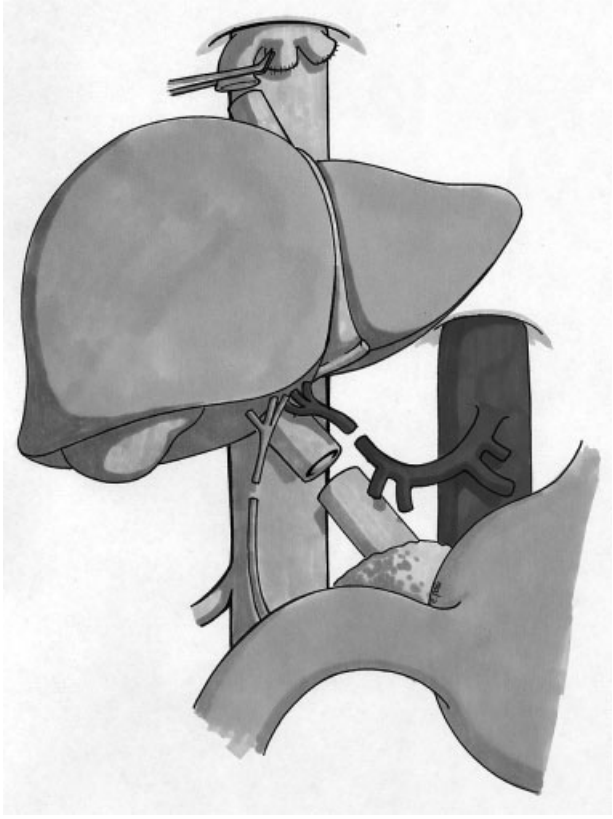

Figure 2 Orthotopic liver transplant using Piggyback technique.

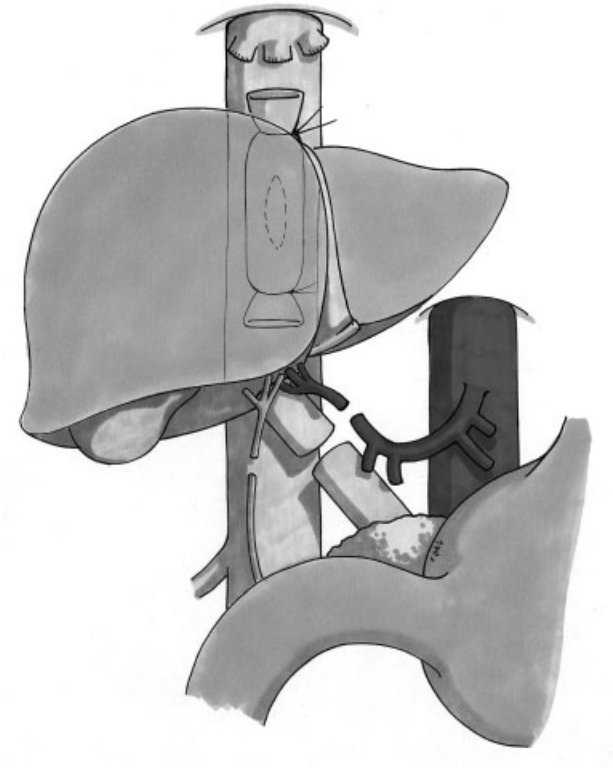

Figure 3 Orthotopic liver transplant using Cavo-caval technique.

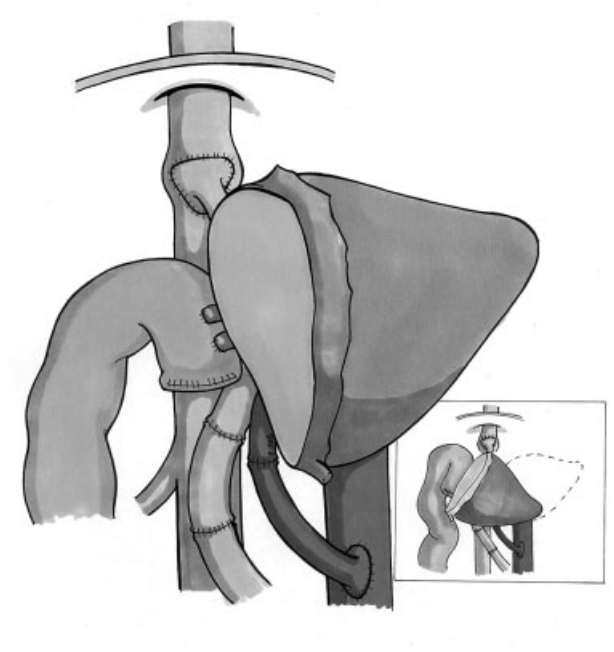

Figure 4 Split donor liver transplant in children.

internal jugular vein approach in the latter may facilitate catheterization of the hepatic vein.

The main difficulty in creation of TIPS in a patient with liver transplant is catheterization of the hepatic veins. Our experience as well as others is that TIPS creation is not difficult in patients who have had LTs performed using the standard (conventional) or piggyback technique. However, those with liver transplant using cavo-caval technique in which the donor's retrohepatic IVC is anastamosed side-to-side to the recipient's IVC makes catheterization of the hepatic veins quite challenging, especially when a severe caval anastamotic stenosis is present. In these cases, it may be simpler to attempt a gun-sight approach to create a direct cava to portal vein TIPS.

The intraparenchymal relationship of the hepatic veins to the portal veins is as in a native cirrhotic liver. Therefore, the conventional method of directing the transhepatic intraparenchymal needle passes from the accessed hepatic vein to the targeted portal vein branch, which is the same as in a native liver. Carbon dioxide balloon occlusion portography helps to delineate the relationship of the accessed hepatic vein to the target portal vein, helping to facilitate the successful creation of the TIPS. Once access is gained to the targeted portal vein, the steps to completion of the TIPS are exactly identical to that in a native cirrhotic liver.

Outcome

In our review of the literature, we found three studies and scant case reports of TIPS placement after LT, demonstrating that is feasible and could also serve as a

bridge for retransplantation.[12–15] Table 1 is a summary of a literature review of patients who had a liver transplant requiring TIPS, and we included our experience in this table as well. It is difficult to report hard data at this time due to the limited experience. The indications for TIPS were refractory ascites, refractory hydrothorax, and refractory variceal bleeding. TIPS appears to be useful in improving the symptoms, and TIPS also can be used to temporize patients until a viable allograft becomes available for retransplantation. The long-term outcomes

Table 1 Summary of All Patients Undergoing TIPS after Liver Transplantation: Review of Studies

	Patient No.	Child Class	Age/ Sex	Cause of Liver Disease	Time from Transplantation to TIPS (mo)	Reason for TIPS	Follow-up after TIPS
Amesur et al[13]	1	A	38/M	Hepatitis C	18	Ascites	Alive 32 mos
	2	B	58/M	Hepatitis C	35	Ascites	Retransplant 6 wk
	3	B	42/M	Hepatitis C	42	Ascites	Died 1 wk
	4	B	43/M	Wilson's disease	74	Ascites	Died 1 wk
	5	C	55/F	Primary biliary cirrhosis	57	Ascites	Died 4 wk
	6	C	40/M	Hepatitis C	6	Ascites	Retransplant 2 wk
	7	A	33/F	Primary sclerosing cholangitis	133	Bleeding	Alive 36 mos
	8	B	43/M	Hepatitis C	73	Bleeding	Retransplant 3 mo
	9	B	39/F	Hepatitis C	150	Bleeding	Retransplant 7 mo
	10	B	44/F	Primary biliary cirrhosis	145	Bleeding	Retransplant 2 mo
	11	C	57/M	Hepatitis C	72	Bleeding	Died 4 wk
	12	B	53/M	Hepatitis C	26	Bleeding	Alive 3 mo
Van Ha et al[14]	1	C	5/M	Biliary ductal plate malformation	11	Ascites	Retransplant 4 d
	2	B	16/M	Biliary atresia	18	Varices	Retransplant 4 mo
	3	A	18/M	Wilson's disease	113	Ascites	Alive 22 mo
	4	C	67/M	Cryptogenic cirrhosis	3	Ascites	Alive 66 mo
	5	C	59/F	Primary biliary cirrhosis	101	Ascites	Died 5 mo
	6	C	45/F	Primary biliary cirrhosis	4	Ascites	Died 4 d
Richard et al[15]	1		41/M	Cryptogenic cirrhosis		Ascites/bleeding	Alive 6 mo
Lerut et al[12]	1	C	36	Hepatitis B		Planned retransplant	Well at 14 mo and successful retransplant
	2	B	56	Hepatitis C		Ascites	Well at 28 mo; died at 32 mo
	3	C	59	Secondary biliary cirrhosis		Bleeding	Died 1.5 mo of necrotic pancreatitis
	4	B	47	Hepatitis C		Ascites	Died 4 mo
	5	B	41	Hepatitis C		Redo biliary surgery	Well at 36 mo
	6	B	52	Hepatitis C		Ascites	Well at 7 mo; died at 8.5 mo
	7	B	53	Hepatitis C		Ascites	Moderate at 14 mo
	8		31	Veno-occlusive disease		Ascites/hydrothorax	Moderate at 6 mon; died awaiting retransplant
Authors' experience	1	B	70/M	Transplant rejection	5	Ascites	Died 2 ds
	2	B	57/F	Hepatic outflow obstruction	12	Ascites	Two TIPS revisions at 1 wk and 3 wk
	3	B	48/M	Hepatitis C	14	Ascites	Two TIPS revisions at 12 wk and 55 wk
	4	B	56/M	Hepatitis C	9	Ascites	Retransplant 1 y

and overall survival in these patients has not been established.

The incidence of TIPS dysfunction (stenosis or thrombosis) in this patient subset is unknown. In theory the rate may be lower because these patients may be receiving immunosuppressant medications, which may diminish neointimal proliferation. With the recent use of the VIATORR® endoprosthesis (W.L. Gore, Flagstaff, AZ), there is potential for improved patency rates. Studies have proved an increase in shunt patency when expanded polytetrafluoroethylene (ePTFE)-covered stents are used.[16,17] Maleux et al confirmed no technical difficulty during primary LT, despite the presence of an ePTFE-covered endoprosthesis implanted extending into the IVC.[18]

The side effects and complications of TIPS placement after LT are similar to patients with native livers, such as slight increase in the rate and severity of encephalopathy and acute liver failure. Lerut et al described changes in the pharmacokinetics of medications like cyclosporine or tacrolimus as a side effect after TIPS insertion, resulting in a significant increase of their levels in blood, and therefore risk of hepatonephrotoxicity. For this reason close monitoring is mandatory.[12]

CONCLUSION

The primary indications for TIPS in a patient with an LT are refractory ascites, refractory hepatic hydrothorax, and recurrent variceal bleeding. TIPS is technically feasible in LT patients. The procedural planning for TIPS in LT patients rests in the knowledge of the new anatomical configuration and vascular anastomoses as a result of the surgical technique. The interventional radiologist must be aware of the various transplant techniques to plan the anatomical approach for successful creation of the shunt. The TIPS procedure after transplantation has the same indications established as for nontransplant patients.[19–21] TIPS is effective in the control of refractory ascites, refractory hepatic hydrothorax, and variceal bleeding. We recommend the use of an ePTFE-covered stent for the TIPS to ensure optimal long-term patency. TIPS could serve as a bridge to retransplantation. The impact of TIPS on overall patient survival has not yet been established.

REFERENCES

1. Everhart JE, Lombardero M, Detre KM, et al. Increased waiting time for liver transplantation results in higher mortality. Transplantation 1997;64:1300–1306
2. Wright TL, Donegan E, Hsu HH, et al. Recurrent and acquired hepatitis C viral infection in liver transplant recipients. Gastroenterology 1992;103:317–322
3. Ascher NL, Lake JR, Emond J, Roberts J. Liver transplantation for hepatitis C virus-related cirrhosis. Hepatology 1994;20:24S–27S
4. Adetiloye VA, John PR. Intervention for pleural effusions and ascites following liver transplantation. Pediatr Radiol 1998; 28:539–543
5. Herzog D, Martin S, Lallier M, Alvarez F. Ascites after orthotopic liver transplantation in children. Pediatr Transplant 2005;9:74–79
6. Cirera I, Navasa M, Rimola A, et al. Ascites after liver transplantation. Liver Transpl 2000;6:157–162
7. Mabrut JY, de la Roche E, Adham M, Ducerf C, Baulieux J. [Peritoneovenous diversion using the LeVeen shunt in the treatment of refractory ascites after liver transplantation]. Ann Chir 1998;52:612–617
8. Hadengue A, Lebrec D, Moreau R, et al. Persistence of systemic and splanchnic hyperkinetic circulation in liver transplant patients. Hepatology 1993;17:175–178
9. Bilbao JI, Herrero JI, Martinez-Cuesta A, et al. Ascites due to anastomotic stenosis after liver transplantation using the piggyback technique: treatment with endovascular prosthesis. Cardiovasc Intervent Radiol 2000;23:149–151
10. Mizuno S, Yokoi H, Yamagiwa K, et al. Outflow block secondary to stenosis of the inferior vena cava following living-donor liver transplantation? Clin Transplant 2005;19: 215–219
11. Borsa JJ, Daly CP, Fontaine AB, et al. Treatment of inferior vena cava anastomotic stenoses with the Wallstent endoprosthesis after orthotopic liver transplantation. J Vasc Interv Radiol 1999;10:17–22
12. Lerut JP, Goffette P, Molle G, et al. Transjugular intrahepatic portosystemic shunt after adult liver transplantation: experience in eight patients. Transplantation 1999;68:379–384
13. Amesur NB, Zajko AB, Orons PD, Sammon JK, Casavilla FA. Transjugular intrahepatic portosystemic shunt in patients who have undergone liver transplantation. J Vasc Interv Radiol 1999;10:569–573
14. Van Ha TG, Funaki BS, Ehrhardt J, et al. Transjugular intrahepatic portosystemic shunt placement in liver transplant recipients: experiences with pediatric and adult patients. AJR Am J Roentgenol 2005;184:920–925
15. Richard HM III, Cooper JM, Ahn J, Silberzweig JE, Emre SH, Mitty HA. Transjugular intrahepatic portosystemic shunts in the management of Budd-Chiari syndrome in the liver transplant patient with intractable ascites: anatomic considerations. J Vasc Interv Radiol 1998;9:137–140
16. Wilson MW, Gordon RL, LaBerge JM, et al. Liver transplantation complicated by malpositioned transjugular intrahepatic portosystemic shunts. J Vasc Interv Radiol 1995; 6:695–699
17. Farney AC, Gamboa P, Payne WD, Gruessner RW. Donor iliac vein interposition during liver transplantation in a patient with a migrated transjugular intrahepatic portosystemic shunt. Transplantation 1998;65:572–574
18. Maleux G, Nevens F, Wilmer A, et al. Early and long-term clinical and radiological follow-up results of expanded-polytetrafluoroethylene-covered stent-grafts for transjugular intrahepatic portosystemic shunt procedures. Eur Radiol 2004;14:1842–1850
19. Rossle M, Haag K, Ochs A, et al. The transjugular intrahepatic portosystemic stent-shunt procedure for variceal bleeding. N Engl J Med 1994;330:165–171
20. Ochs A, Rossle M, Haag K, et al. The transjugular intrahepatic portosystemic stent-shunt procedure for refractory ascites. N Engl J Med 1995;332:1192–1197
21. Rossle M. The transjugular intrahepatic portosystemic shunt. J Hepatol 1996;25:224–231