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Techniques for Transjugular Intrahepatic Portosystemic Shunt Reduction and Occlusion

Andrew G. Taylor, MD, PhD, Kanti P. Kolli, MD, and Robert K. Kerlan Jr., MD

Transjugular intrahepatic portosystemic shunts (TIPS) effectively lower portal pressure and are commonly used to manage selected patients with variceal bleeding. Unfortunately, significant consequences are not infrequently encountered as a result of this diversion of portal venous flow. These consequences include disabling hepatic encephalopathy as well as hepatic decompensation. To manage these complications, therapeutic options include TIPS reduction and TIPS occlusion. TIPS reduction is the favored technique because of the potential for venous thrombosis and recurrent variceal hemorrhage after acute TIPS occlusion. Techniques and indications for TIPS reduction and TIPS occlusion are reviewed.

KEYWORDS TIPS reduction, hepatic encephalopathy, shunt, portal hypertension

Clinical Evaluation of the Patient

Following successful Transjugular intrahepatic portosystemic shunts (TIPS) creation, new or worsened hepatic encephalopathy (HE) may be observed in 22% to 50% of patients.[1] Presumably, the encephalopathy is because of splanchnic blood return to the systemic circulation without filtration through the hepatic parenchyma. Other contributing factors include overproduction of enteric neurotoxins by intestinal flora, as well as increased permeability of the blood-brain barrier in patients with end-stage liver disease.[2,3] Moreover, HE may be exacerbated by anesthesia and sedative medicines administered in the peri-procedural period as well as co-existent bacterial infection such as spontaneous bacterial peritonitis. Whether the decline in hepatic function is related to portosystemic shunting or diminished hepatic function, most investigators believe that nitrogenous compounds, most notably ammonia, lead to the development of HE. These compounds may enter the brain and lead to alterations in neurotransmission producing fluctuations in concentration and consciousness.[4]

Clinically the manifestations of HE range from minor confusion to coma. The major physical finding for HE is asterixis, a flapping tremor of the hand that occurs when the hand and wrist is maximally extended. Though not specific for HE, it is most commonly observed in patients with liver-related encephalopathy. The West Haven classification[5] of impairment related to metabolic encephalopathy is commonly used:

Stage 0—Lack of detectable changes in personality or behavior. Asterixis absent.

Stage 1—Trivial lack of awareness, shortened attention span, impaired addition or subtraction, hypersomnia, insomnia, or inversion of sleep pattern, euphoria or depression. Asterixis can be detected.

Stage 2—Lethargy or apathy disorientation, inappropriate behavior, and slurred speech. Obvious asterixis.

Stage 3—Gross disorientation, bizarre behavior, semistupor to stupor. Asterixis generally absent.

Stage 4—Coma.

In the vast majority of patients, new or worsened encephalopathy following TIPS can be controlled by reducing protein in the diet and using nonabsorbable antibiotics and nonabsorbable disaccharides (lactulose) to minimize neurotoxin production by the gut microflora and its subsequent absorption.[6]

Indications for the Procedure

Despite the observation that the majority of patients can be managed medically, up to 7% of patients develop refractory encephalopathy following TIPS creation.[7]

Department of Radiology and Biomedical Imaging, University of California, San Francisco, CA.

Address reprint requests to Andrew G. Taylor, MD, PhD, Department of Radiology and Biomedical Imaging, University of California San Francisco, 505 Parnassus, Room M-361, San Francisco, CA 94143. E-mail: andrew.taylor@ucsf.edu

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Moreover, the HE is often associated with a decline in hepatic function. In these individuals, the only alternatives are expedited orthotopic liver transplantation (OLT) or reduction or occlusion of the TIPS. TIPS reduction or occlusion may be mandated in the acute postprocedural period because of accelerated liver failure, but more often it is weeks to months later after medical management has been maximized. It should also be recognized that, in these patients, liver function continually declines because of their underlying hepatic pathology, and that the TIPS may accelerate this process through ischemia or other mechanisms.

These factors must be balanced against the risks of reducing a needed portosystemic shunt. Whether variceal bleeding or refractory ascites was the indication for creating the TIPS, the patient would again be at increased risk for recurrent hemorrhage or reaccumulation of ascites if the TIPS shunt is occluded or reduced.

Technique

Historically, three basic methods have been used to reduce flow through the TIPS shunt as follows:

(1) TIPS occlusion,
(2) TIPS reduction with bare metal stents, and
(3) TIPS reduction with covered stents.

TIPS Occlusion

Soon after the introduction of TIPS for the management of complications related to portal hypertension, cases of refractory HE and liver failure were encountered.

A technique to occlude the shunt using coils was described by Paz-Fumagalli et al.[8] An alternative technique to acutely occlude the TIPS shunt was subsequently described by Kerlan et al[9] and Haskal et al.[10] This innovative technique involved placement of an occlusion balloon within the intrahepatic tract leading to thrombosis of the stent. Theoretically, the stent could be recanalized at a later time allowing for placement of a smaller diameter shunt. Unfortunately, fatal outcomes have been reported with acute shunt occlusion from continued progressive liver failure, recurrent variceal hemorrhage, and presumed acute hemodynamic alterations.[11] Therefore, this technique is seldom utilized.

TIPS Reduction With Bare Metal Stents

Before the ready availability of commercial stent grafts, multiple attempts were made to reduce the portosystemic flow in patients after TIPS creation using smaller diameter bare metal stents. Haskal and Middlebrook[12] described a technique to insert a Wallstent (Boston Scientific, Middletown, MA) constrained in its mid-portion with a silk suture. Subsequently, the insertion of bare metal Palmaz stents (Johnson and Johnson, New Brunswick, NJ) within the TIPS was described.[13] In this procedure, the stent was partially dilated at the portal end and completely dilated at the hepatic end to anchor it within the TIPS shunt. Both techniques produce flow reduction because of turbulent flow through the interstices of the stents, but the degree of reduction and the corresponding elevation of portal pressure was difficult to predict. In an attempt to control this, Gerbes et al[13] injected Ethibloc (Ethicon, Norderstedt, Germany) to obliterate the space between the original TIPS and the reducing stent. However, utilization of bare metal stents is now seldom performed because of the ready availability of stent grafts.

A novel technique was described by Forauer and McLean[7] to use a constrained self-expanding TIPS stent for the purpose of TIPS revision. This TIPS reduction was accomplished by inserting the self-expanding stent, constrained externally by a balloon-expandable stent (Palmaz, Johnson and Johnson, New Brunswick, NJ), into the previously placed TIPS. In so doing, the diameter of the original TIPS stent was reduced to diminish the HE, but with the potential to enlarge the stent if the portal decompression was insufficient. This technique could be potentially applied to the insertion of commercially available stent grafts.

TIPS Reduction With Stent Grafts

The advent of commercial stent grafts from a number of vendors has considerably improved the precision and efficiency with which the diameter of the TIPS shunt can be reduced (Fig. 1). Basically, 3 methods have been described as follows:

(1) Insertion of a balloon-expandable bare metal stent parallel to a new stent graft within the originally placed TIPS (Fig. 1A).
(2) Insertion of a constrained self-expandable stent graft or incompletely dilated balloon-expandable stent graft within the TIPS (Fig. 1B).
(3) Insertion of a commercially available tapered stent graft within the TIPS (Fig. 1C).

As these are the most commonly used techniques used currently, the details of the procedures are described later.

Required Equipment

(1) Insertion of a balloon-expandable bare metal stent parallel to a new stent graft within the originally placed TIPS (Fig. 1A).

(1) Large (10-12 F) sheath of sufficient length to reach the portal vein from a right internal jugular access. As an alternative, parallel sheaths 7-10 F in diameter can be placed.
(2) In all, 8 or 10 mm self-expandable stent graft, 50-60 mm in length. A number of devices have been used including
  (i) Viatorr and Viabahn (WL Gore, Flagstaff, AZ)
  (ii) Wallgraft (Boston Scientific, Watertown, MA)
  (iii) Fluency (Bard, Murray Hill, NJ)