

# Transjugular Intrahepatic Portosystemic Shunt (TIPS): Treatment of Esophageal Variceal Bleeding

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*Management of esophageal variceal bleeding continues to be a difficult problem for the practicing physician. TIPS is an interventional radiologic procedure that involves creating a channel within the liver between the portal vein and the systemic circulation using an expandable metallic stent. Ten patients underwent TIPS at St Francis Medical Center and the technical success rate was 100%. Complications have been minimal. One patient has died from progressive hepatic failure and carcinoma, and 1 patient underwent liver transplantation. The remaining 8 patients have a patent TIPS in place and have not rebled.*

## Introduction

Ideal management of acute variceal bleeding in the 1990s requires a closely coordinated effort between the primary care physician, gastroenterologist/hepatologist, surgeon, and interventional radiologist. All patients with suspected acute variceal bleeding should be managed in the intensive care unit with adequately trained nursing personnel. The latter play a critical but often unappreciated role in the minute-to-minute patient management. The goals of this team effort are to achieve hemodynamic stability, to prevent and treat complications, and to control bleeding. All 3 goals must be addressed simultaneously and within hours of the patient's admission.

Major causes of early mortality from these bleeding episodes include aspiration pneumonia, renal failure (from hypovolemia), encephalopathy, sepsis and multi-organ system failure. These complications can be managed by aggressive fluid resuscitation, correction of coagulation defects, lactulose, gut bacterial decontamination with broad-spectrum, non-absorbable antibiotics, and nutritional support.

There have been many modalities used to control bleeding, such as vasopressin/somatostatin infusion, balloon tamponade, endoscopic sclerotherapy (EST), endoscopic band ligation, surgical portosystemic shunts, and esophageal transection. In recent years, EST has emerged as the treatment of choice to achieve hemostasis acutely and prophylactically. Notwithstanding all efforts, end-stage liver disease still has a dismal 5-year survival rate. The natural history of variceal bleeding is such that 50% to 60% of all bleeding will stop no matter what therapy is

used.<sup>1</sup> About 20% to 30% of variceal hemorrhages will be massive and may result in death.<sup>1,3</sup> Furthermore, less than 40% of these patients will be alive one year after their first variceal bleed.<sup>1,4</sup> The ultimate treatment, and the only one that also will eliminate the underlying liver disease, is liver transplantation; the scarcity of donors, however, limits its widespread use.

We now add TIPS to our list of treatment alternatives. TIPS is an interventional radiologic procedure that creates an artificial shunt through the liver parenchyma from the portal vein to the systemic circulation with the use of an expandable metal stent.<sup>5</sup> It is essentially a side-to-side portocaval shunt without the morbidity and mortality of a surgical procedure.

## Methods and Materials

This study is a retrospective review of the early cases of transjugular intrahepatic portosystemic shunts performed at St Francis Medical Center. Patients were referred from throughout Hawaii and Guam for assistance in management of esophageal variceal bleeding.

All patients underwent extensive evaluation with laboratory data to include assessment of renal function, liver function, coagulation parameters, and ammonia level. Esophago-gastroduodenoscopy had been performed on all patients either at St Francis or by referring gastroenterologists to confirm the presence of esophagogastric varices. All patients underwent abdominal ultrasound with Doppler to assess patency of the hepatic and portal venous systems and the status of the liver.

Prior to TIPS, all patients received intravenous hydration and prophylactic antibiotics with cefoxitin. TIPS was performed in the special procedures room of the radiology department, and an anesthesiologist was present to monitor the patient and provide intravenous sedation.

The technique as described by Dr Ernest Ring at the University of California at San Francisco was used.<sup>6</sup> A jugular vein puncture was performed and a catheter and guide wire were advanced through the superior vena cava. An initial pre-TIPS inferior vena cava pressure was obtained. The right or middle hepatic vein was then catheterized, and a 16-gauge Colapinto needle was passed from the hepatic vein into the right or left portal vein. A guide wire and catheter then were advanced into the main portal vein, a pre-TIPS portal vein pressure was obtained, and the pre-TIPS portal vein-IVC gradient was calculated. A portal venogram was performed to confirm correct placement and to assess anatomy and visualize esophageal varices. The parenchymal tract between the hepatic and portal veins was dilated with an angioplasty balloon. A metallic stent then was placed in the tract, a post-TIPS

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portal vein-IVC gradient was obtained and a portal venogram was repeated to assess the shunt. Esophageal varices were embolized with stainless steel coils if significant flow in the varices persisted after stent placement.

Patients were observed post-TIPS for procedural complications, evidence of encephalopathy, progressive liver failure, or recurrence of bleeding. Following TIPS, abdominal ultrasound with Doppler was performed every 3 months for the first year to assess velocity across the TIPS and direction of flow within the portal vein.

## Results

Ten patients underwent transjugular intrahepatic portosystemic shunt at St Francis Medical Center during the 11-month period between March 15, 1993 to February 15, 1994. Of these 3 women and 7 men, the mean age was 48.4 years (range 38 to 73 years). The etiology of liver failure included alcoholic cirrhosis in 6 patients, and 1 patient for each of the following: Cryptogenic cirrhosis, hepatitis C, hepatitis B/hepatoma, and hepatitis C/ alcoholic cirrhosis. All 10 patients had esophageal variceal bleeding, and 1 patient also had severe ascites which was refractory to medical management. These patients had 2 to 4 episodes of variceal bleeding, and 6 patients had multiple sclerotherapy sessions. Six patients were actively bleeding within 1 week prior to TIPS, and 1 patient was bleeding in the 24 hours prior to the procedure.

TIPS was performed by a single interventional radiologist (LL) and the technical success rate was 100%. There was technical difficulty in 1 patient who required 2 sessions to complete the TIPS. In this particular case, the portal vein could not be located; a portal venogram via a superior mesenteric artery injection was performed to identify the course of the portal vein, and the TIPS was then successfully performed. The mean portal vein-inferior vena cava gradient was 21.9 mm Hg pre-TIPS and 10.3 mm Hg post-TIPS. All procedures were accomplished under local anesthesia with intravenous sedation. The mean procedure length was 2.7 hours (range 1.3 to 4.0 hours).

All patients remained in the intensive care unit or the post-anesthesia recovery room for a 24-hour period following TIPS. The mean hospital stay following TIPS was 4 days (3 to 5 days). The only procedural complication was a pneumothorax, which was successfully managed with tube thoracostomy.

Patients have been followed for 12 months post-TIPS. One patient died as a result of progressive liver failure and hepatocellular carcinoma 2 months following TIPS. One patient underwent a successful liver transplant 228 days following TIPS. The shunt was noted to be patent in his explanted liver. Of the 8 remaining cases, 1 patient developed a stenosis of the draining hepatic vein at 2 months. This was manifested by recurrent ascites and hydrothorax which had been initially controlled with the TIPS. The stenosis was successfully restented, and this patient currently is doing well. In this series of patients, the primary shunt patency rate is 90% and the secondary patency rate is 100%. One patient demonstrated clinical evidence of encephalopathy, which was controlled with lactulose. This patient had mild encephalopathy prior to TIPS. The mean ammonia pre-TIPS was 39.7  $\mu\text{mol/L}$  and in the peri-procedure period this increased to a mean of 81.4  $\mu\text{mol/L}$ . Three patients are currently on lactulose for an elevated ammonia, but none of these patients has clinical symptoms of encephalopathy. One patient had a significant rise in AST from 37 IU/L to 1104 IU/L

(this patient suffered no consequences and his AST has since returned to normal), otherwise there was no significant change in bilirubin, AST, protime, or alkaline phosphatase in any of the remaining patients during the immediate post-procedure period. No patient has had recurrence of variceal hemorrhage.

## Discussion

The first human intrahepatic portosystemic shunts were done in the early 1980s by Colapinto et al, who created a tract in the liver using a balloon catheter. These channels generally occluded within 30 days because of the elasticity of the liver parenchyma.<sup>7</sup> The first successful TIPS in a human was performed in Germany in 1988 by Richter et al using an expandable metallic stent devised by Palmaz.<sup>8</sup> Since this first shunt, the procedure has been widely accepted in both the academic and community settings.

There is a growing body of data now available in the literature reporting efficacy and short-term follow-up.<sup>6,9-14</sup> The largest published series are by LaBerge et al<sup>6</sup> and Roessle et al,<sup>11</sup> both with 100 patients. Although randomized, double-blind studies comparing TIPS with other forms of therapy are not available, some reproducible results have been reported and preliminary conclusions can be drawn.

TIPS has been performed on patients with cirrhosis of all etiologies, the most common being Laennec's cirrhosis. Patients of all Child's classes have been included. Liver function tests are usually abnormal. Patients aged 5 years to 84 years have been treated, with men treated more frequently than women.<sup>6,9-14</sup>

The most common indication has been recurrent bleeding esophageal varices, refractory to endoscopic sclerotherapy. Additional indications include acute variceal bleeding not responsive to sclerotherapy or due to gastric or ectopic varices, and ascites refractory to medical therapy.<sup>6,9-11,13-15</sup>

Early studies reported technical success rates of 75%,<sup>16-17</sup> but more recently, because of the refinement of the technique, this has improved to 90% to 100%.<sup>6,10-11,14-15,18-20</sup>

TIPS has been shown to be effective in controlling variceal bleeding in 86% to 100% of cases and in decreasing ascites in 70% to 100% of cases.<sup>6,9-15</sup> After creation of the shunt, portal blood flow has been shown by Doppler sonography to increase by 250%.<sup>11</sup> A reduction of the portal-systemic gradient by 50% to 75% usually is achieved.<sup>9,11,15</sup> Portal venography performed during the procedure usually shows immediate decompression of esophageal varices.<sup>6</sup> Endoscopy performed within a month of the procedure has confirmed resolution of the varices in almost all cases.<sup>21</sup>

Improvement of the ascites occurs rapidly over the days following the procedure; increased renal blood flow results in increased urine volume, improved creatinine clearance, and natriuresis.<sup>22</sup> These findings also explain improved renal function in some TIPS patients with renal insufficiency.<sup>23</sup>

The incidence of complications directly related to the procedure is less than 5%; these include complications of placing a central venous catheter (pneumothorax, hemothorax, neck hematoma), fever, stent migration, bleeding (hemoperitoneum, liver hematoma, hemobilia), hepatic artery injury, bile duct injury, renal failure, and respiratory failure.<sup>6,11,24</sup>

Long-term complications seen with portacaval shunts also can be seen with TIPS, since TIPS is essentially a side-to-side portacaval shunt without an incision. Progressive liver failure can occur because blood flow is diverted from the hepatocytes.

LaBerge et al<sup>6</sup> had a 9% mortality from progressive liver failure because a large number of their patients had severe (Child's C) cirrhosis. On the other hand, Roessle et al, who had fewer Child's C patients, had no deaths from progressive liver failure.<sup>11</sup> Both authors describe asymptomatic transient elevations in liver functions in some of their patients.

Progressive liver failure also can be manifested as new onset or worsening of hepatic encephalopathy. This has been a major problem with surgical portacaval shunts.<sup>25</sup> The incidence in TIPS patients appears to be 15% to 30%. The encephalopathy is usually not severe and is usually well-controlled with lactulose.<sup>5,6,20,26-29</sup>

Long-term shunt patency poses a major question. The best available data is 3 year follow-up by LaBerge et al (80% primary patency and 100% secondary patency) and Roessle et al (67% primary patency and 100% secondary patency).<sup>11,30</sup> Other investigators with shorter follow-up of 12 to 18 months have reported primary patency of 17% to 82% and secondary patency of 83% to 97%.<sup>12-13</sup> Thus, the best estimate at this time, based on the above data, is that up to 33% of these shunts will fail in 3 years.

These authors also have shown, however, that failed shunts due to stenosis or occlusion usually can be reopened through a transjugular approach, resulting in secondary patency rates approaching 100%. In order to detect shunt stenosis before shunt failure and rebleeding occurs, Doppler sonography now is being used.<sup>32-33</sup> A strategy of close surveillance and early reintervention may be the answer to long-term patency.

Current research is also focusing on the biochemical and cellular processes that control the response of blood elements and the vessel wall to the metallic stent. Stents coated with heparin and other materials are being studied in experimental models.<sup>34</sup>

The results of TIPS in the first patients at our center have been encouraging and are comparable to those reported in the literature. So far, we have achieved 100% technical success and have had no recurrent bleeding. One shunt stenosis, manifested by recurrent ascites, was successfully restented and complications have been few. Long-term patency rates and changes in hepatic synthetic function will need to be observed closely. Like other centers, a number of our patients will undergo liver transplantation. In these patients, TIPS will have served as a valuable bridge to transplantation, preventing life-threatening variceal hemor-

rhage before an appropriate donor organ becomes available.

## Summary

The management of bleeding esophageal varices continues to be one of the greatest challenges for the practicing physician. Recent advances in endoscopic techniques, pharmacologic intervention, surgical decompression procedures and liver transplantation have resulted in a more hopeful outlook for patients with this problem. TIPS has now been added to the list of possible therapies. Despite impressive short-term results, more data, including controlled clinical trials comparing TIPS with standard treatment options, are needed to determine relative long-term patency, efficacy, and overall survival. Notwithstanding, TIPS has become widely used in the treatment of bleeding esophageal varices because of its relative noninvasiveness, safety, and excellent short-term results. Its future, although uncertain, is promising.

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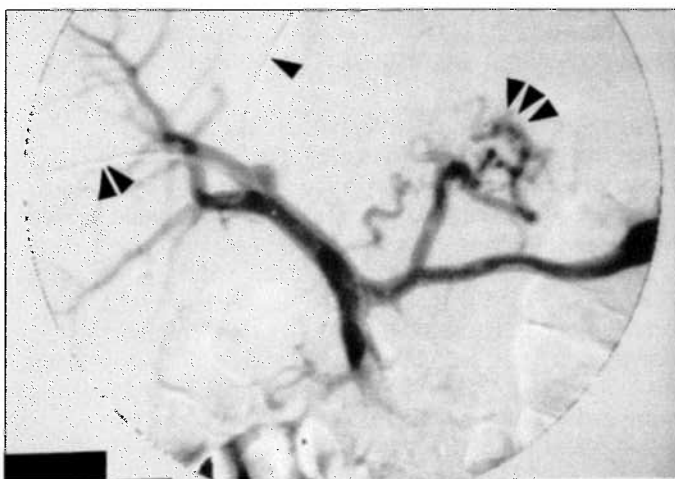


Fig 1.—Contrast radiograph showing TIPS catheter (single arrowhead) running from hepatic to portal vein, a percutaneous catheter (double arrowhead) within the portal vein, and esophageal varices (triple arrowheads).

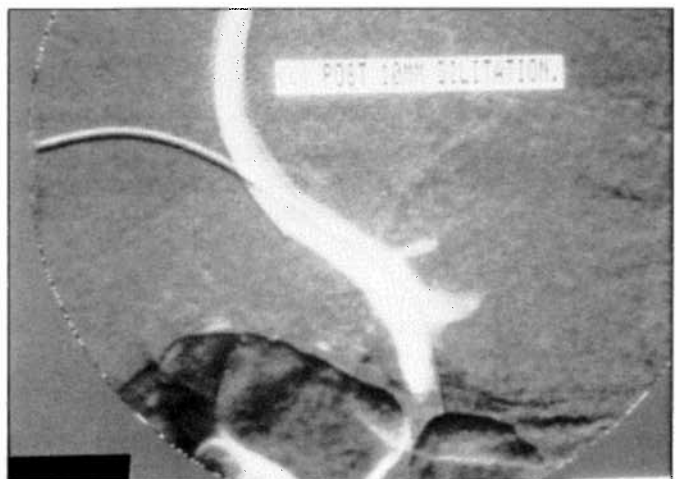


Fig 2.—Radiograph showing contrast flowing through newly created shunt running from portal to hepatic vein.

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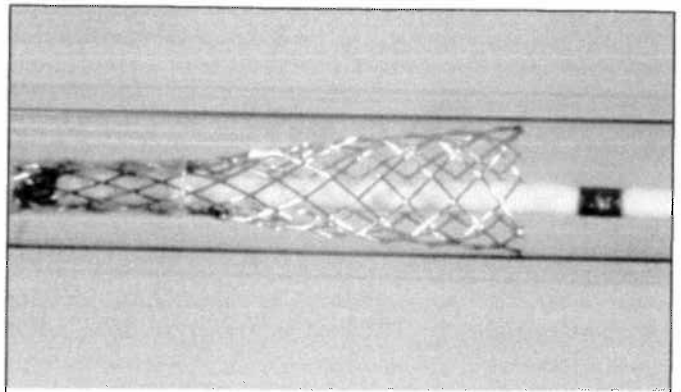


Fig 4.—Same stent expanded as it is used.

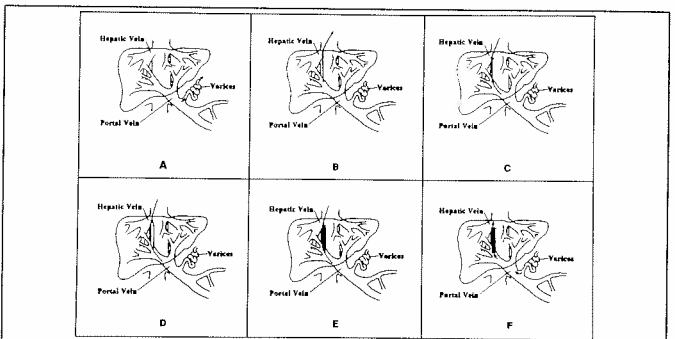


Fig 5.—TIPS. Entering hepatic vein, catheterize the portal vein by traveling through liver parenchyma (B). Guidewire is shown in C; subsequent dilation of tract with balloon (D). Stent is placed and further dilated if necessary (E). After removing catheters, a newly created portal systemic shunt (F).

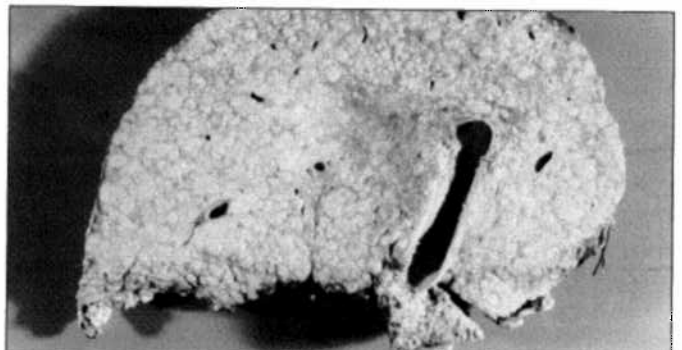


Fig 6.—Oblique cut through excised liver from patient 2 (liver transplantation) showing patent shunt running through liver parenchyma. (Courtesy Department of Pathology, St Francis Medical Center.)

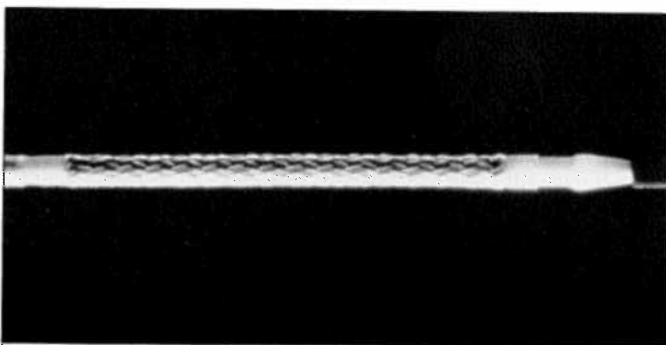


Fig 3.—Stent used in TIPS, closed position.

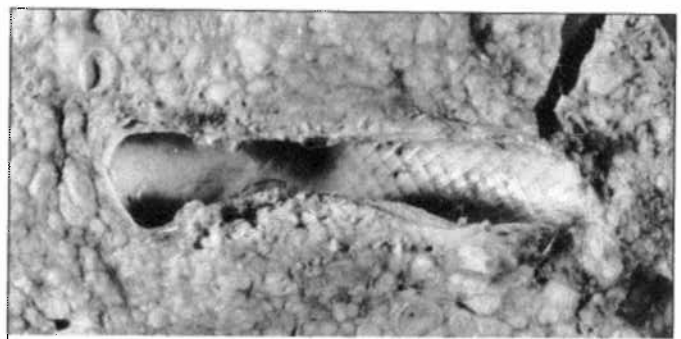


Fig 7.—Close-up view of Fig 6 displaying the stent within the shunt created via TIPS procedure. (Courtesy Department of Pathology, St Francis Medical Center.)