Diagn Interv Radiol 2013; 19:61–65

INTERVENTIONAL RADIOLOGY
TECHNICAL NOTE

Recanalization of occlusive transjugular intrahepatic portosystemic shunts inaccessible to the standard transvenous approach

Roberto Miraglia, Luigi Maruzzelli, Angelo Luca

PURPOSE
The aim of this study was to evaluate the feasibility and safety of recanalization of occlusive transjugular intrahepatic portosystemic shunts (TIPS) that are inaccessible to the standard transvenous approach in patients with occlusive bare and covered stents.

MATERIALS AND METHODS
From July 1999 to July 2011, 430 consecutive TIPS were performed at a single institution in patients with chronic liver diseases and complications of portal hypertension. During the follow-up, a TIPS occlusion was detected in 20 cases that could not be crossed using a standard transvenous technique with a hydrophilic guidewire.

RESULTS
Five cases had a bare stent, and 15 cases had a covered stent. In 19 cases (95%), the Colapinto needle technique was used. The Colapinto needle was advanced at the mouth of the occluded TIPS (n=2) or within the thrombus in the middle-distal shunt (n=16) to provide aid in advancing the hydrophilic guidewire into the portal vein. In one patient, after failure of the Colapinto technique, the combined transhepatic and transvenous approach was used. All of the procedures were successfully performed without complications.

CONCLUSION
In patients with occlusive TIPS, stent recanalization is feasible and safe. The Colapinto needle technique should be used as the first approach, reserving the combined transhepatic and transvenous approach only for failure of this technique.

From the Department of Radiology (R.M. ✉ *rmiraglia@ismett.edu*), Diagnostic and Therapeutic Services, Mediterranean Institute for Transplantation and Advanced Specialized Therapies (ISMETT), Palermo, Italy.

Received 11 January 2012; revision requested 6 April 2012; revision received 19 April 2012; accepted 7 May 2012.

Published online 22 June 2012
DOI 10.4261/1305-3825.DIR.5541-12.1

Transjugular intrahepatic portal systemic shunt (TIPS) placement is currently used to treat complications of portal hypertension. TIPS dysfunction can occur when stenosis or occlusion of the shunt results in a loss of portal venous decompression. This occlusion can be due to thrombosis or severe intimal hyperplasia in the uncovered portion of the hepatic vein. Expanded polytetrafluoroethylene (ePTFE)-covered stents have a lower risk of shunt dysfunction, but their use has not eliminated the necessity for continued shunt surveillance. Once TIPS dysfunction is suspected, diagnosis can be further elucidated using Doppler ultrasonography (US). Transvenous catheterization, performed through a jugular approach, can be used to both confirm and treat TIPS dysfunction (1). Briefly, the area of stenosis is crossed with a hydrophilic guidewire and an angiographic catheter is advanced into the portal system. Direct portography and hemodynamic measurements are performed to confirm the presence of a dysfunction. The angioplasty and stent placement are then used to relieve the obstruction. Some patients, however, are not appropriate for standard transjugular approaches for TIPS revision due to severe hepatic vein stenosis or complete stent thrombosis. In these patients, different techniques have been reported, such as a combined transhepatic and transvenous approach, a more invasive transsplenic approach, or the creation of new parallel shunt (2–4). Transjugular access to the occluded stent using a Colapinto needle (Cook Group Inc., Bloomington, Indiana, USA) for extra support, which provides aid in advancing the hydrophilic guidewire into the portal vein, has been previously reported in occluded bare stents (5).

In this study, we report our experience in challenging TIPS recanalizations that are inaccessible to the standard transvenous approach, in both bare and covered occluded stents.

Materials and methods

Study participants were identified based on medical records obtained between July 1999 and July 2011 at our institution. During that time, 430 patients underwent TIPS placement for portal hypertension. Informed consent was not required for this study, but written informed consent was obtained from each patient for each procedure performed after a full explanation of risks and benefits.

All TIPS placements were performed with a jugular vein approach using a standard technique. Access to the portal vein branch was achieved with a combination of US and fluoroscopic guidance. We used Wallstent endoprostheses (Boston Scientific, Natick, Massachusetts, USA) until May 2006, and e-PTFE-covered stents (Viatorr®, W. L. GORE & Associates Inc., Flagstaff, Arizona, USA) thereafter. The stent was deployed to ensure that the distal end would not compromise future surgical interventions, such

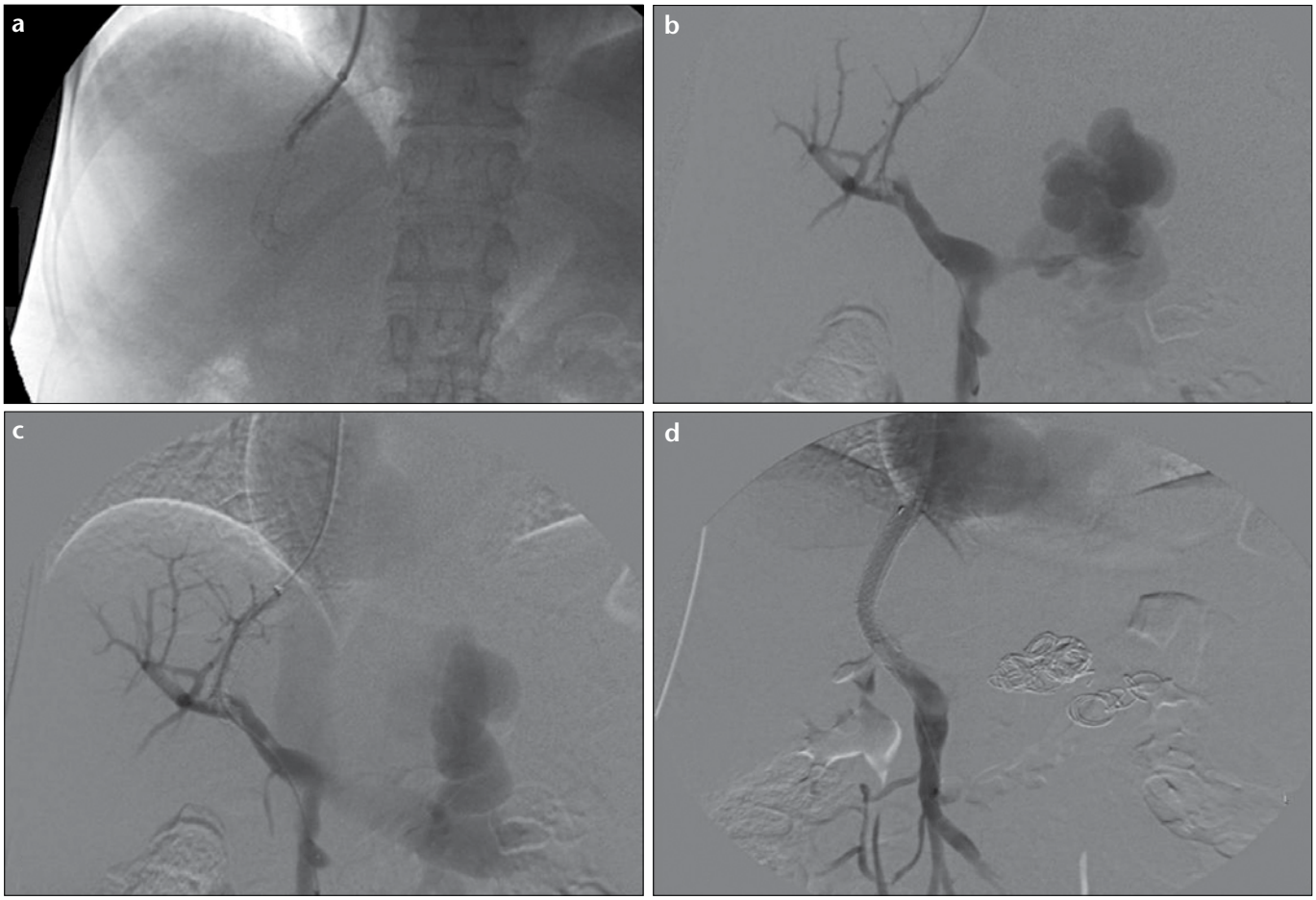

Figure 1. a–d. A 63-year-old patient who underwent covered TIPS two months earlier for recurrent variceal bleeding that was not responsive to endoscopic therapy. Doppler US showed TIPS occlusion and standard transvenous catheterization of the occluded stent was failed. The fluoroscopic image **(a)** shows that the Colapinto needle was advanced into the occluded stent under fluoroscopic control. A 5F angiographic catheter **(b)** was advanced over a hydrophilic guidewire into the superior mesenteric vein. The portography confirmed stent occlusion with filling of large perisplenic varices. Delayed phase of the portography **(c)** shows a patent spontaneous splenorenal shunt. The decreased flow through the TIPS due to the presence of the competitive spontaneous shunt was considered as a possible cause of stent occlusion. The portal pressure gradient was 7 mmHg. The low portal pressure gradient was due to the large patent splenorenal shunt. The final portography performed after perisplenic variceal coils embolization and new coaxial covered stent placement **(d)** shows good flow through the stent without filling of perisplenic varices. The final portal pressure gradient was 3 mmHg.

as liver transplantation. A bare stent was used in 118 patients and covered stents were used in 312 patients. Patients were followed up at one and three months after TIPS in the outpatient clinic, which included a clinical, biochemical, and Doppler US evaluation, and then received a follow-up every six months thereafter. In patients with thrombosis of the portal system before TIPS placement, multi-detector computed tomography and/or magnetic resonance imaging was also performed one month after TIPS placement and then every six months thereafter. TIPS revision was performed whenever clinical or imaging data suggested stent dysfunction (occlusion or stenosis). Stenosis was defined as an increase in the portal pressure gradient greater than 12 mmHg and/or significant narrowing of the lumen on venography.

Results

During the follow-up, a total of 125 TIPS revisions were performed. In 105 cases, portal vein catheterization was performed using a standard transvenous approach. Eighteen patients experienced a total of 20 occlusive events. For these patients, we were unable to bypass the TIPS occlusion using a hydrophilic guidewire. This cohort represented our study group. The mean age was 57 years (range, 26–72 years). Four patients were female. Eleven patients had cirrhosis related to hepatitis C infection, four had alcohol-related cirrhosis, two had Budd-Chiari syndrome, and one had cryptogenic cirrhosis. Two patients had two episodes of TIPS occlusion, while the remaining 16 patients had one episode each. Five cases had bare stents, and 15 had covered stents. Seventeen cases had a complete thrombosis of the stent lumen, while three cases had a distal occlusion. In all but one patient, the 16-gauge Colapinto puncture needle was fluoroscopically advanced over a 10F sheath from the transjugular approach through the stent (Fig. 1). The Colapinto needle was advanced at the mouth of the occluded TIPS (n=3) or within the thrombus in the middle-distal shunt (n=16) and provided support to advance the hydrophilic guidewire into the portal vein. In one patient, we were unable to advance the Colapinto needle at the mouth of the occluded

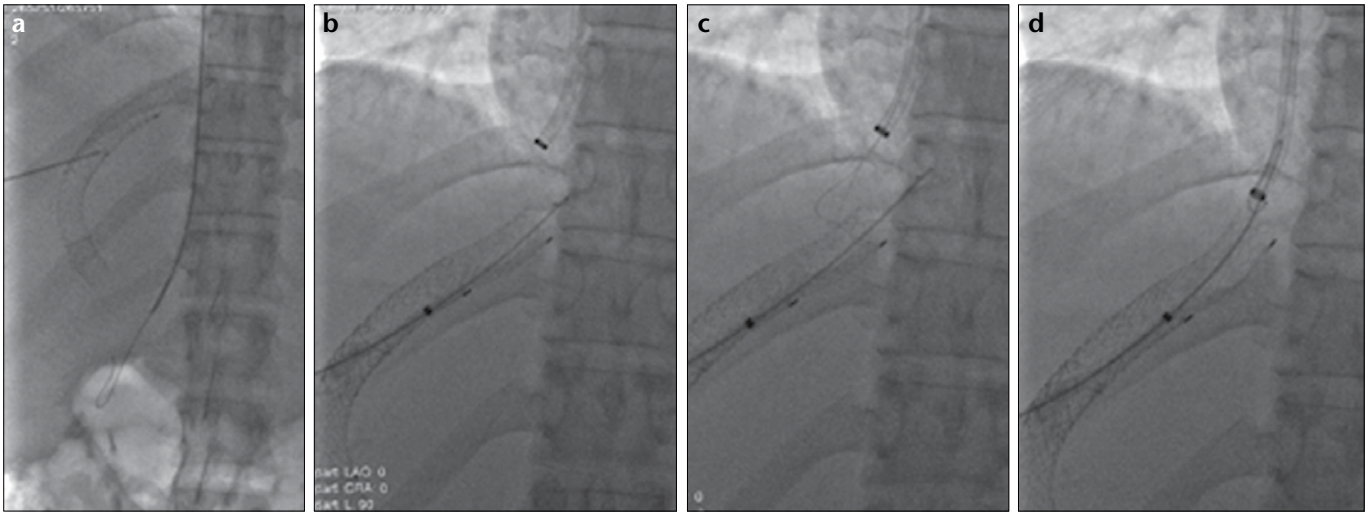

Figure 2. a–d. Fluoroscopic images of a 36-year-old patient with Budd-Chiari syndrome who received TIPS placement 14 months earlier for refractory ascites. Doppler US showed evidence of stent occlusion with subsequent, failure of standard transvenous catheterization of the occluded stent, and failure of catheterization of the mouth of the stent with the Colapinto needle, where a combined transhepatic and transvenous approach was used. Percutaneous puncture of the stent **(a)** was performed with a 20-gauge needle advanced under US and fluoroscopic guidance. Percutaneous catheterization of the stent, where a guidewire is advanced through the stent over a 6F sheath is seen **(b)**. A snare **(c)** is advanced from the jugular sheath. The guidewire **(d)** is captured with the snare.

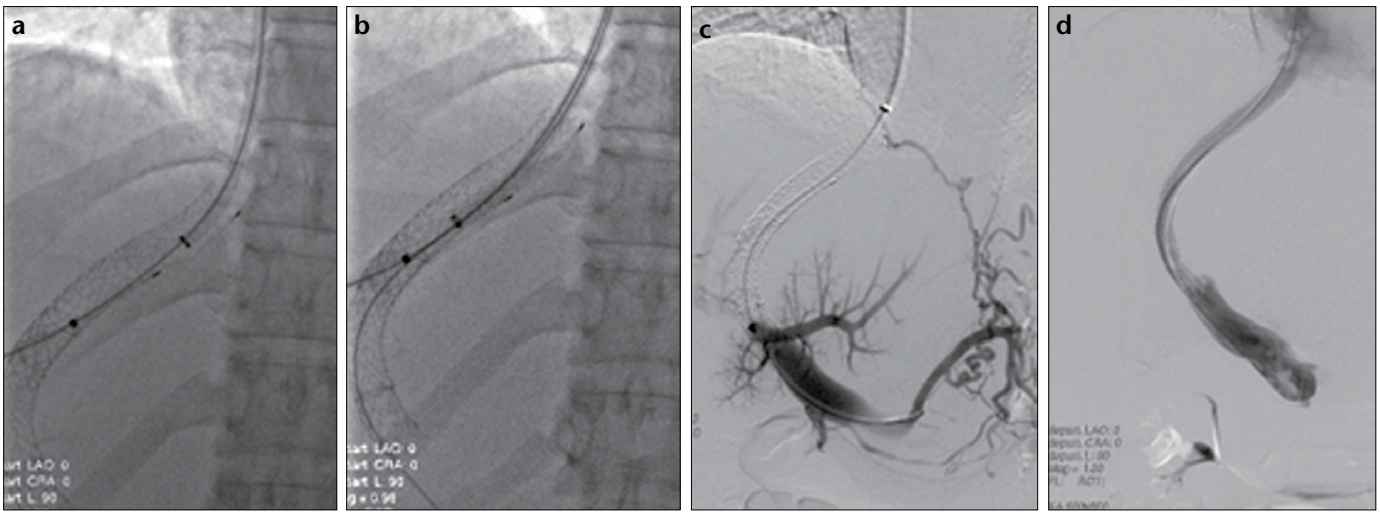

Figure 3. a–d. Fluoroscopic images of the same patient in Fig. 2. The guidewire **(a)** is pulled out from the sheath to the jugular entry site. The jugular sheath **(b)** is advanced over the wire in the stent, and a hydrophilic guidewire is advanced into the main portal vein. A portography **(c)** confirms the complete occlusion of the stent, and the hemodynamic measurement showed a portosystemic gradient of 14 mmHg. A final portography after coaxial stent placement **(d)** shows good flow in the stent. The portosystemic gradient was reduced to 7 mmHg.

TIPS and a combined transhepatic and transvenous approach was successfully used. A percutaneous puncture of the stent was performed with a 20-gauge needle advanced under sonographic and fluoroscopic guidance; the stent was catheterized and a guidewire was advanced over a 6F sheath. A snare was advanced from the jugular sheath to capture the guidewire advanced through the stent. The guidewire was then pulled out from the sheath to the jugular entry site. The jugular sheath was advanced over the wire in the stent and a hydrophilic guidewire was advanced in the main portal vein (Figs. 2, 3). After portal vein catheterization, these patients were treated with stent angioplasty (n=3) or placement of a new coaxial covered stent (n=17). In two cases, which occurred in a single patient with Budd-Chiari syndrome, after portal vein catheterization, pharmacological thrombolysis with infusion of tissue plasminogen activator was performed followed by angioplasty in the first case and coaxial stent placement in the second case (Table). The mean portosystemic gradient decreased from 16.5 mmHg (range, 10–21 mmHg) to 6.5 mmHg (range, 3–10 mmHg). At a mean follow-up of 34 months (range, 12–122 months), no other TIPS revisions were required for those patients.

The Colapinto needle technique provided sufficient support for advancement of a guidewire through the occluded lumen into the portal vein in all but one case (95%). In that case, after the Colapinto technique failed, a combined transhepatic and transvenous approach (pull-through technique)

was used. No major or minor procedure-related complications were reported. Of note, there was a possibility of thrombus migration from the occluded stent to the pulmonary artery during catheterization, but no cases of clinically evident pulmonary embolism occurred.

Discussion

Shunt dysfunction is a common problem after TIPS placement, arising in up to 50% of patients when bare metal stents are used (6, 7). It is less frequent if a covered stent graft is used, but may still occur in up to 13%–20% of patients. Shunt occlusion, unamenable with the standard transvenous and hydrophilic guidewire approach, may be caused by either acute or sub-acute thrombosis or an unusually thick pseudointimal hyperplasia in the tract of the hepatic vein that is not covered by the stent (8). Technical variables during TIPS creation, the presence of thrombofilic risk factors in the patients, or the presence of a large competitive spontaneous splenorenal shunt with flow reduction in the TIPS can be co-factors of stent occlusion. In bare stents, transected bile ducts have been associated with TIPS stenosis and occlusion. Transection of a bile duct creates a communication between the bile ducts and the TIPS lumen. Bile consists of bile acids, salts, cholesterol, and phospholipids, which make it thrombogenic and proinflammatory. Using the covered stent, the most common factor for TIPS occlusion is a short stent, because the presence of a tract of hepatic vein that is not completely covered will likely result in hepatic vein stenosis and a kinking of the stent due to a peripheral puncture of the portal vein.

Different techniques have been reported for the catheterization of TIPS in cases of an occluded stent, and a recent literature review of secondary interventional procedures for treating TIPS stenosis and occlusion has been published (3). To the best of our knowledge, no studies of occluded covered stent recanalization using the Colapinto technique have been reported. Our series clearly demonstrates that the Colapinto needle may be successfully utilized to recanalize occlusive TIPS stents that would otherwise be inaccessible through the standard transvenous approach for both bare and covered stents. This technique had been previously described in 11 patients with occlusive bare stents (5). Our experience confirms the optimal results previously reported for bare stents and supports the use of this technique with occlusive covered stents.

The progression of the Colapinto needle can be easily manipulated under fluoroscopic guidance within the occluded stent until the portal vein side of the stent is reached; this provides a more rigid scaffold to advance the hydrophilic guidewire into the portal vein. The results presented here demonstrate that recatheterization of an occluded stent is feasible in 95% of

Table. Procedural data of TIPS recanalization in 18 patients

Patient number	Age (years)	Disease	Stent type	Occlusion type	Recanalization technique	Treatment
1[a]	30	Budd-Chiari	Bare	Complete thrombosis	Colapinto technique	Angioplasty + pharmacological thrombolysis (coaxial stent placement in the second episode)
2	36	Budd-Chiari	Covered	Complete thrombosis	Pull-through technique	Coaxial stent placement
3	55	HCV-related cirrhosis	Bare	Distal occlusion	Colapinto technique	Coaxial stent placement
4	72	HCV-related cirrhosis	Bare	Complete thrombosis	Colapinto technique	Coaxial stent placement
5	59	HCV-related cirrhosis	Bare	Distal occlusion	Colapinto technique	Coaxial stent placement
6	64	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
7	59	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
8	63	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
9[a]	68	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement (angioplasty in the second episode)
10	66	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
11	57	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
12	65	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
13	52	HCV-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
14	66	Alcohol-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
15	71	Alcohol-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
16	47	Alcohol-related cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement
17	55	Alcohol-related cirrhosis	Covered	Distal occlusion	Colapinto technique	Angioplasty
18	26	Cryptogenic cirrhosis	Covered	Complete thrombosis	Colapinto technique	Coaxial stent placement

[a]Two episodes of TIPS occlusion.
HCV, hepatitis C virus; TIPS, transjugular intrahepatic portosystemic shunts.

cases without the need of more invasive procedures requiring percutaneous liver puncture and/or creation of a new parallel shunt. This is particularly important in patients with ascites and/or coagulopathy.

In conclusion, our results delineate a safe and effective approach for bare or covered occluded TIPS that are not suitable for recanalization through the standard transvenous approach. The Colapinto technique should be attempted as a first approach. The combined percutaneous transhepatic and transvenous approach (2), which was originally described for bare stents, has also been successfully described in patients with covered stents and should be used as an alternative method if the Colapinto needle technique fails (3).

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Ferral H, Banks B, Wholey M, Nazarian GK, Bjarnason H, Castañeda-Zuñiga WR. Techniques for transjugular intrahepatic portosystemic shunt revision. AJR Am J Roentgenol 1998; 171:1041–1047.
2. Haskal ZJ, Cope C. Combined transhepatic and transvenous approach to hepatic vein stenosis after transjugular intrahepatic portosystemic shunt (TIPS). Cardiovasc Intervent Radiol 1994; 17:173–175.
3. Tanaka T, Günther RW, Isfort P, Kichikawa K, Mahnken AH. Pull-through technique for recanalization of occluded portosystemic shunts (TIPS): technical note and review of the literature. Cardiovasc Intervent Radiol 2011; 34:406–412.
4. Chan CY, Liang PC. Recanalization of an occluded intrahepatic portosystemic covered stent via the percutaneous transhepatic approach. Korean J Radiol 2010; 11:469–471.
5. Gordon RL, LaBerge JM, Ring EJ, Doherty MM. Recanalization of occluded intrahepatic portosystemic shunts: use of the Colapinto needle. J Vasc Interv Radiol 1993; 4:441–443.
6. Sterling KM, Darcy MD. Stenosis of transjugular intrahepatic portosystemic shunts: presentation and management. AJR Am J Roentgenol 1997; 168:239–244.
7. Haskal ZJ, Pentecost MJ, Soulen MC, Shlansky-Goldberg RD, Baum RA, Cope C. Transjugular intrahepatic portosystemic shunt stenosis and revision: early and midterm results. AJR Am J Roentgenol 1994; 163:439–444.
8. Cura M, Cura A, Suri R, El-Merhi F, Lopera J, Kroma G. Causes of TIPS dysfunction. AJR Am J Roentgenol 2008; 191:1751–1757.