Case Report

Hepatic Vein Flow Reversal at Duplex Sonography: A Sign of Transjugular Intrahepatic Portosystemic Shunt Dysfunction

Vickie A. Feldstein[1] and Jeanne M. LaBerge

Sonography is an important diagnostic tool in the noninvasive evaluation of hepatic parenchymal disease and of hepatic vasculature. With the use of duplex and color Doppler sonography, functional hemodynamic information regarding vascular patency, flow direction, and flow patterns can be obtained [1, 2]. Recently, these techniques have been used to assess transjugular intrahepatic portosystemic shunts (TIPS), a relatively new, nonsurgical therapy for the management of uncontrollable variceal bleeding associated with portal hypertension. Preliminary observations indicate that Doppler sonography is accurate for detecting TIPS occlusion and may be useful for predicting alterations in shunt function on the basis of calculated flow velocities and changes in direction of portal venous flow [3, 4]. We report here a case of abnormal TIPS function revealed by the sonographic observation of reversal in the direction of flow within the right hepatic vein.

Case Report

A 27-year-old woman with Child's C cirrhosis due to autoimmune hepatitis was admitted for acute variceal bleeding. She had experienced four previous bleeding episodes that had been controlled by endoscopic sclerotherapy. Endoscopic evaluation on admission disclosed bleeding distal esophageal varices; however, the bleeding could not be controlled endoscopically. A TIPS was placed. A 10-mm shunt was constructed from the right hepatic vein to the right portal vein using a 68-mm Wallstent endoprosthesis (Schneider, Minneapolis, MN). The portosystemic gradient was reduced from 30 mm Hg to 10 mm Hg, and the direction of portal flow was reversed (hepatopetal before TIPS to hepatofugal after TIPS).

The patient stopped bleeding after TIPS placement and was discharged 3 days later. She has experienced no further bleeding. Routine follow-up sonographic examinations were done before discharge and at 3-month intervals since discharge.

The baseline discharge sonogram and the 3-month follow-up sonographic study showed the TIPS to be patent. Additional relevant observations included the presence of monophasic high-velocity flow within the TIPS, with maximal peak velocity measured at 1.2 m/sec. Hepatofugal flow was identified within the intraparenchymal portal veins. Also, the right hepatic vein was shown to have normal phasic venous flow directed toward the inferior vena cava (Fig. 1A).

A follow-up sonographic examination 6 months after TIPS insertion revealed significant alterations in shunt flow and hemodynamics. The TIPS remained patent, as shown by spectral and color Doppler techniques. However, the maximal peak velocity of blood flowing within the shunt was dramatically reduced, measuring only 0.24 m/sec. The intraparenchymal portal veins showed an interval change to hepatopetal flow. The most striking and unusual observation was the change in direction and character of flow within the right hepatic vein (Figs. 1B and 1C). Doppler imaging now revealed monophasic flow within the right hepatic vein directed away from the inferior vena cava, toward the periphery of the liver.

These sonographic findings, and an interval change in hemodynamic observations, suggested the development of significant stenosis of the right hepatic vein central to the site of TIPS insertion. Although the patient remained asymptomatic, these suggestive findings warranted further evaluation of the TIPS. Portal venography was, therefore, performed on an outpatient basis, 7 months after TIPS insertion. A transjugular approach was used so that shunt revision could be performed, if necessary.

Catheterization of the right hepatic vein was performed without difficulty by using a 5-French catheter (Cook Inc., Bloomington, IN). Injection of contrast material revealed brisk retrograde flow in the right hepatic vein toward the liver capsule. The TIPS was easily

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[1]Both authors: Department of Radiology, Box 0628, University of California, San Francisco, San Francisco, CA 94143-0628. Address correspondence to V. A. Feldstein.

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catheterized. Portal venography revealed a widely patent shunt and a high-grade stenosis of the right hepatic vein 1 cm above the shunt (Fig. 1D). Blood flowing through the shunt exited via the peripheral right hepatic vein and drained toward the liver capsule. Pressure measurements revealed a 27-mm portosystemic gradient between the right portal vein and the inferior vena cava.

A 68-mm Wallstent was deployed across the stenosis in the right hepatic vein and the stent was dilated with a 10-mm angioplasty balloon. The portosystemic gradient after shunt revision was 10 mm Hg. After the procedure, a limited sonographic examination showed a widely patent shunt with return of flow within the right hepatic vein to the normal direction (Fig. 1E).

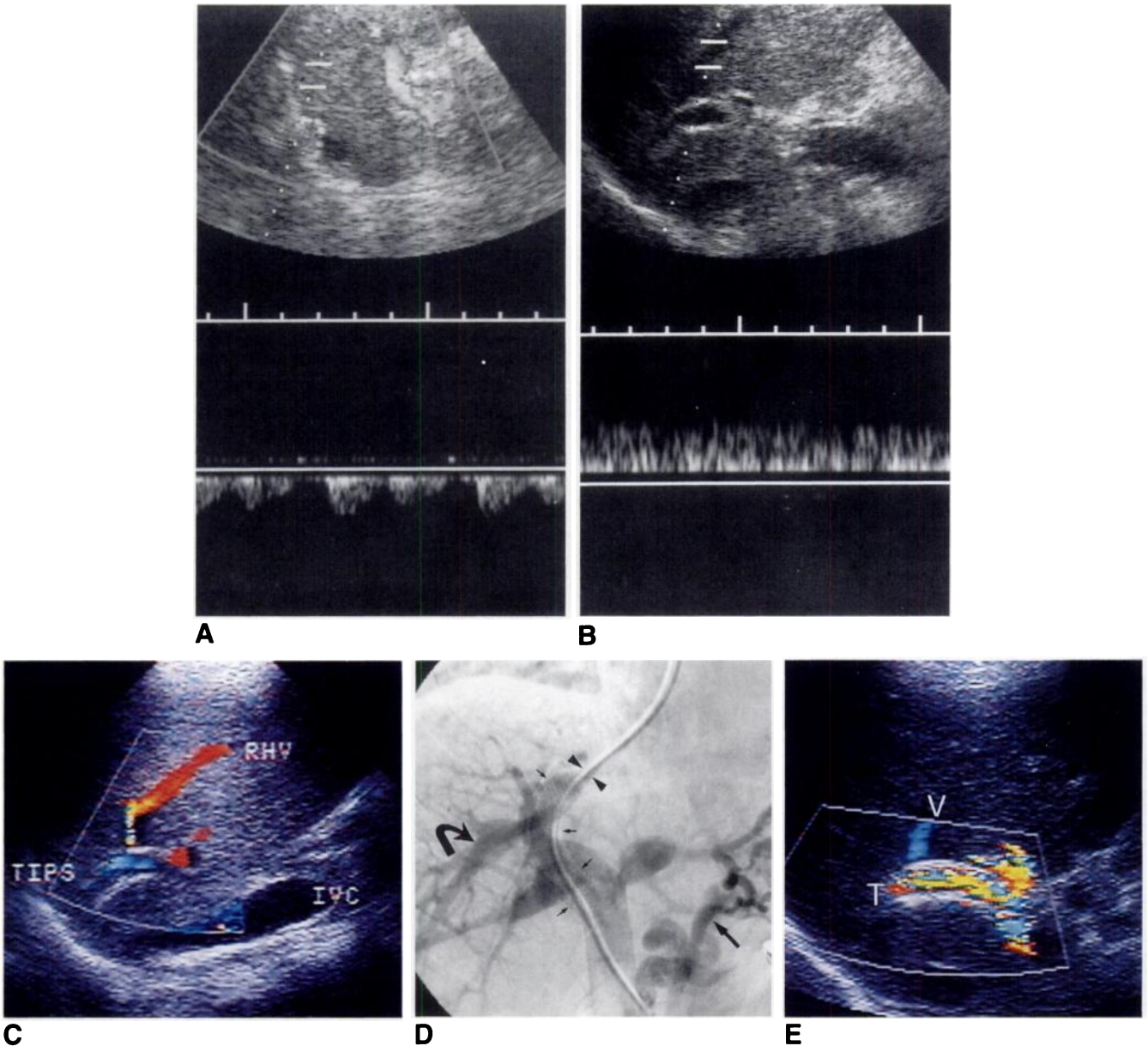

Fig. 1.—*A*, Doppler sonogram obtained 3 months after insertion of transjugular intrahepatic portosystemic shunt (TIPS) shows phasic blood flow in right hepatic vein (RHV). Doppler waveform is below baseline, indicating normal direction of venous flow away from transducer, toward inferior vena cava (IVC).

***B*, Sagittal sonogram obtained 6 months after insertion of TIPS shows monophasic flow within RHV. Doppler waveform is above baseline, indicating that flow in RHV has reversed and is now directed toward transducer, away from IVC.**

***C*, Color Doppler sonogram obtained 6 months after insertion of TIPS shows abnormal direction of flow in RHV. Venous flow, directed toward periphery of liver, is coded red.**

***D*, Transjugular portal venogram shows evidence of recurrent portal hypertension with filling of coronary vein (*large straight arrow*). Contrast material flows through TIPS (*small arrows*) with tight stenosis of RHV above shunt (*arrowheads*) and retrograde filling of peripheral part of RHV (*curved arrow*). Central hepatic vein is not opacified.**

***E*, Color Doppler sonogram obtained immediately after TIPS (T) was revised. Hepatofugal flow within RHV (V) is coded blue, confirming return of normal direction of venous flow.**

Discussion

The TIPS procedure is known to be an effective nonsurgical means of lowering portal venous pressure and has been proved useful in the management of variceal bleeding [5]. Preliminary data suggest that recurrent variceal bleeding after TIPS insertion is directly related to shunt patency. In a series of 48 patients followed after TIPS creation, recurrent variceal bleeding developed in 10, all of whom had shunt occlusion or stenosis [5]. Recurrent variceal bleeding did not occur in any patient with a patent functioning shunt. The exact prevalence of TIPS stenoses is not yet known, but the development of TIPS stenosis is increasingly recognized as a cause of shunt failure. Early detection of alterations in shunt function and prompt intervention are important to maintain patency and prevent recurrent bleeding. Percutaneous revision of TIPS stenoses is significantly easier and more successful than revision of TIPS occlusions.

Sonographic examinations, including duplex Doppler studies, are currently advocated as a routine, noninvasive means of evaluation after TIPS placement. Sonography can confirm stent patency and show stent thrombosis. Changes in hepatic hemodynamics, observed on serial sonographic studies, are useful in the early detection of stent complications. Diminished flow velocity within a TIPS or interval change in direction of intrahepatic portal venous flow, from hepatofugal to hepatopetal, are considered suggestive, indirect signs of stent malfunction or hepatic vein stenosis [4]. The findings in the case presented here indicate that the sonographic observation of reversed direction of flow in the hepatic vein should be considered another clue to impaired TIPS function. This observation should prompt further examination, by means of transjugular portal venography, so that TIPS stenoses can be recognized and revisions performed expeditiously, in an effort to maintain TIPS patency and preclude recurrent symptoms.

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