



Overview of transjugular intrahepatic portosystemic shunts (TIPS)

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INTRODUCTION

Portal hypertension often develops in patients with cirrhosis and may lead to complications such as variceal bleeding and ascites. Placement of a transjugular intrahepatic portosystemic shunt (TIPS) reduces elevated portal pressure by creating a low-resistance channel between the hepatic vein and an intrahepatic branch of the portal vein using angiographic techniques ([figure 1](#)). The tract is kept patent by deployment of an expandable stent across it, thereby allowing blood to return to the systemic circulation. An advantage of TIPS is that it functions like a surgical side-to-side portacaval shunt that is created by a minimally invasive procedure without the risks associated with major surgery.

An overview of TIPS including the indications, contraindications, and preprocedure testing will be discussed here.

Postprocedure patient care, complications, and long-term monitoring for patients with TIPS are discussed separately. (See "[Transjugular intrahepatic portosystemic shunts: Postprocedure care and complications](#)".)

The clinical manifestations and diagnosis of portal hypertension in adults are discussed separately. (See "[Portal hypertension in adults](#)".)

Management of patients with portal hypertension and acute variceal bleeding begins with hemodynamic resuscitation, airway protection, and antibiotic prophylaxis, and this is discussed separately. (See ["Overview of the management of patients with variceal bleeding"](#).)

Methods to achieve hemostasis in patients with variceal bleeding may focus on the bleeding site (eg, endoscopic variceal ligation, balloon tamponade) or may reduce the portal pressure directly (pharmacologic therapy, TIPS, surgically created shunts). In clinical practice, a combination of modalities is often used, and this is discussed in more detail separately. (See ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#).)

INDICATIONS

Bleeding related to portal hypertension

Esophageal varices

Active bleeding — TIPS may be used for patients with actively bleeding esophageal varices who fail first-line methods of hemostasis or who have initial hemostasis but then rebleed within 120 hours of initial hemorrhage (see ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#), section on 'Management if endoscopic therapy fails'):

- Patients with active bleeding who fail initial therapy – TIPS is used as rescue therapy for patients with active variceal bleeding despite endoscopic and pharmacologic treatment.

Multiple series have demonstrated efficacy of TIPS for active esophageal variceal bleeding despite endoscopic and pharmacologic treatment [1-3]. Rates of immediate hemostasis after TIPS in most series range from 90 to 100 percent, while the mortality rates (measured at 30 days or 6 weeks) range from 10 to 75 percent [1,3]. An illustrative report focused on 32 patients who were referred for TIPS after failing emergent endoscopic treatment [4]. Patients were stabilized initially with balloon tamponade and TIPS was placed semi-emergently within 12 hours. Balloon tamponade was discontinued within 12 to 24 hours after TIPS placement. The six-week survival was 60 percent in this patient cohort whose expected survival rate, based upon historical controls, was approximately 10 percent.

- Patients with active bleeding who had achieved initial hemostasis – Emerging data suggest that elective TIPS placement within 72 hours of initial endoscopic hemostasis (early TIPS) results in better outcomes for patients who are high risk for rebleeding (eg, Child-Pugh class C, hepatic venous pressure gradient of 20 mmHg) [5-10]. In a trial including 132

patients with cirrhosis with variceal bleeding who were treated with pharmacologic and endoscopic therapy resulting in hemostasis, patients with early TIPS placement had higher rates of transplant-free survival compared with patients without TIPS (79 versus 64 percent at two years; hazard ratio for death or liver transplant 0.50, 95% CI 0.25-0.98), while the rate of hepatic encephalopathy was not significantly different between groups [9]. While these results show promise, further trials are needed to verify the mortality benefit of early TIPS before it is routinely placed in patients with decompensated cirrhosis and high mortality risk. (See "[Cirrhosis in adults: Overview of complications, general management, and prognosis](#)", section on 'Child-Pugh classification'.)

Preventing recurrent bleeding — Options for preventing recurrent variceal bleeding (ie, >120 hours after initial hemorrhage) after successful treatment of variceal hemorrhage include pharmacologic therapy with a nonselective beta blocker and/or endoscopic variceal ligation with the goal of obliterating esophageal varices. However, some patients develop recurrent variceal hemorrhage despite these preventive strategies. The use and efficacy of TIPS as a long-term strategy for hemostasis for patients with a history of bleeding esophageal varices is discussed separately. (See "[Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis](#)".)

Gastric varices — Initial treatment for bleeding fundic gastric varices is pharmacologic (eg, [octreotide](#)) with balloon tamponade, which is a temporary measure. When initial therapy fails to achieve hemostasis, subsequent options include TIPS or endoscopic or surgical interventions. The approach to patients with bleeding gastric varices is discussed separately. (See "[Methods to achieve hemostasis in patients with acute variceal hemorrhage](#)", section on 'Management of gastric varices'.)

Ectopic varices — Varices may develop at sites other than the esophagus and/or stomach, and these are typically identified when patients develop bleeding. Examples of ectopic varices include duodenal, rectal, or peristomal varices (ie, varices that develop in patients with a stoma [typically following colectomy]). The use and efficacy of TIPS for achieving hemostasis in patients with bleeding ectopic varices is discussed separately. (See "[Methods to achieve hemostasis in patients with acute variceal hemorrhage](#)", section on 'Management of ectopic varices'.)

Portal hypertensive gastropathy — TIPS is a treatment option for patients with bleeding from portal hypertensive gastropathy who fail to respond to pharmacologic therapy (eg, nonselective beta blocker), and this is discussed separately. (See "[Portal hypertensive gastropathy](#)".)

Refractory ascites — The use of TIPS for the management of refractory ascites is discussed separately. (See ["Ascites in adults with cirrhosis: Diuretic-resistant ascites"](#).)

Other uses — Other conditions that have been managed with TIPS include:

- Budd Chiari Syndrome (see ["Budd-Chiari syndrome: Management"](#), section on ["Transjugular intrahepatic portosystemic shunt"](#)).
- Hepatic hydrothorax (see ["Hepatic hydrothorax"](#), section on ["Transjugular intrahepatic portosystemic shunt"](#)).
- Investigational uses – Small case series describe the use of TIPS for patients with hepatic sinusoidal obstruction syndrome (veno-occlusive disease), which is complication of bone marrow transplantation [11-14]. While some patients had improvement in ascites after TIPS placement, long-term survival was uncommon.

The pathophysiology of sinusoidal obstruction syndrome is related to increased sinusoidal pressures from occlusion of microscopic hepatic venules and central veins in the hepatic lobules, and this is discussed separately. (See ["Hepatic sinusoidal obstruction syndrome \(veno-occlusive disease\) in adults"](#).)

TIPS has been studied for treating patients with hepatorenal syndrome. (See ["Hepatorenal syndrome"](#), section on ["Transjugular intrahepatic portosystemic shunt"](#).)

CONTRAINDICATIONS

Absolute contraindications — Absolute contraindications to TIPS placement include [15]:

- Congestive heart failure – Cardiac decompensation and/or failure is a complication of TIPS and results from a large volume blood shift from the splanchnic to the systemic circulation, increasing venous return to the heart, cardiac output, and right heart pressures. (See ["Transjugular intrahepatic portosystemic shunts: Postprocedure care and complications"](#), section on ["Cardiac failure"](#).)
- Severe tricuspid regurgitation.
- Severe pulmonary hypertension (mean pulmonary pressure >45 mmHg).
- Polycystic liver disease.
- Active systemic infection or sepsis.

- Unrelieved biliary obstruction.

Relative contraindications — Relative contraindications to TIPS include:

- Hepatic tumors, especially if centrally located.
- Obstruction of all hepatic veins.
- Hepatic encephalopathy.
- Portal vein thrombosis (see "[Chronic portal vein thrombosis in adults: Clinical manifestations, diagnosis, and management](#)").
- Thrombocytopenia (<20,000/microL).
- Moderate pulmonary hypertension (see "[Pulmonary hypertension due to lung disease and/or hypoxemia \(group 3 pulmonary hypertension\): Epidemiology, pathogenesis, and diagnostic evaluation in adults](#)", section on 'Classification and definitions').

In addition, while TIPS is indicated for treating active variceal bleeding, resuscitation measures and pharmacologic therapy are initiated in an effort to stabilize patients with active bleeding prior to transporting them to interventional radiology for the procedure. (See "[Overview of the management of patients with variceal bleeding](#)", section on 'Initial measures'.)

PRE-TIPS EVALUATION AND PLANNING

Preprocedure testing — Prior to TIPS placement, we typically obtain the following tests; however, there is no consensus on preprocedure testing in this setting:

- Laboratory testing:
 - Complete blood count
 - Total bilirubin
 - International normalized ratio
 - Serum creatinine
- Model for End-stage Liver disease (MELD) score – The MELD score is calculated based on the patient's creatinine, bilirubin, and international normalized ratio (INR), and has proven to be superior to the Child–Pugh score for predicting post-TIPS mortality ([MELD score](#)).

Patients with a MELD score >18 have a higher risk of mortality at three months after TIPS than those with a MELD score of ≤18 [16].

- **Imaging** – Liver imaging is performed to assess for patency of the portal and hepatic veins, spleen size, ascites, and presence and extent of portosystemic collaterals [17]. Contrast enhanced imaging (ie, computed tomography or magnetic resonance imaging) is typically performed prior to TIPS placement; however, a noncontrast abdominal ultrasound with Doppler study is a reasonable alternative for some patients (ie, those with renal impairment or active variceal bleeding) [18]. Patient evaluation prior to administration of intravenous contrast agents is discussed separately. (See "[Patient evaluation prior to oral or iodinated intravenous contrast for computed tomography](#)" and "[Patient evaluation before gadolinium contrast administration for magnetic resonance imaging](#)".)

A chest radiograph is obtained to evaluate for abnormalities such as fluid overload and cardiomegaly.

- **Additional testing** – A cardiac evaluation should be performed prior to TIPS placement in patients with signs, symptoms, or a history of heart failure, tricuspid regurgitation, cardiomyopathy, or pulmonary hypertension. The evaluation often includes an echocardiogram and specialty consultation (eg, cardiology, pulmonary). (See "[Transjugular intrahepatic portosystemic shunts: Postprocedure care and complications](#)", section on '[Cardiac failure](#)'.)

The evaluation of patients with suspected heart failure or pulmonary hypertension is discussed separately. (See "[Heart failure: Clinical manifestations and diagnosis in adults](#)" and "[Clinical features and diagnosis of pulmonary hypertension of unclear etiology in adults](#)".)

Preprocedure preparation — Antibiotic prophylaxis is routinely given to patients at the time of TIPS insertion. An antibiotic with broad coverage against Gram-negative bacteria is selected, and we typically use [ceftriaxone](#) 1 g intravenously once [19,20]. Transient bacteremia during the creation of the TIPS shunt is common (up to 35 percent of patients), as enteric bacteria within the static portal system can enter the systemic circulation [21].

PROCEDURE

Positioning and anesthesia — For TIPS placement, the patient typically lies in a supine position, and either general anesthesia or monitored anesthesia care (MAC) is used. Anesthesia

for TIPS and other interventional radiology procedures is discussed separately. (See ["Considerations for non-operating room anesthesia \(NORA\)"](#) and ["Anesthesia for the patient with liver disease"](#), section on 'Anesthesia for transhepatic portosystemic shunt'.)

Technique — The general steps for performing TIPS placement include:

- Obtain vascular access through the right internal jugular vein.
- Advance the catheter into the right or middle hepatic veins and perform hepatic venogram.
- Advance the TIPS sheath and cannula into the proximal hepatic vein and perform carbon dioxide (CO₂) portovenogram to localize and target the intrahepatic segment of the portal vein.
- Use the TIPS needle and catheter to obtain access into the portal venous system.
- Perform portal venogram ([image 1](#)) and obtain direct portal venous pressures to calculate pre-TIPS portosystemic venous pressure gradient.
- Perform balloon dilation of the intrahepatic tract between the hepatic and portal veins.
- Create the shunt by deploying a covered stent ([image 2](#)).
- Obtain post-TIPS portosystemic gradient.
- If esophageal or gastric varices require intervention, perform embolization of varices using coils, plugs, and/or sclerosing agents ([image 3](#)) (see ["Methods to achieve hemostasis in patients with acute variceal hemorrhage"](#), section on 'Alternative treatments').

Intraprocedure complications

Anesthesia-related issues — TIPS is typically performed with monitored anesthesia care or general anesthesia, and choice of anesthetic technique and effect of anesthesia on the liver are discussed separately. (See ["Anesthesia for the patient with liver disease"](#), section on 'Anesthesia for transhepatic portosystemic shunt'.)

Cardiac arrhythmias — As the TIPS catheter is passed through the heart before accessing the hepatic vein, cardiac arrhythmias may develop. This is most likely to occur if the catheter bulges within the right atrium and rubs against the atrial wall or prolapses into the right ventricle;

however, use of a relatively stiff introducer for venous access may help maintain a straight catheter [22].

Although premature atrial complex (also referred to as premature atrial beat, premature supraventricular complex, or premature supraventricular beat) have little clinical significance, more serious arrhythmias, such as atrial fibrillation, conduction defects (nodal or infranodal), and ventricular tachycardia, can occur [23]. Potential contributing factors that may lead to cardiac arrhythmias (eg, electrolyte and acid-base abnormalities) should be identified and corrected, prior to the procedure; this is discussed separately. (See '[Pre-TIPS evaluation and planning](#)' above.)

Liver capsule puncture — A potentially serious complication of creating an intrahepatic tract is traversal of the liver capsule during attempts to enter the portal vein. The reported incidence of capsule traversal is approximately 33 percent [22]; however, the development of clinically significant hemoperitoneum (eg, hemodynamic instability) is uncommon [24]. This complication is most likely to occur in two settings: when the liver is small, hard, and displaced upward by ascites, thereby making the angle necessary to enter the portal vein from the hepatic vein very acute; or when the portal vein is thrombosed and replaced by collaterals. Management of liver capsule rupture and/or laceration includes balloon tamponade and coil embolization of the bleeding vessel [25].

To minimize the risk of puncturing the liver capsule, portal vein patency is routinely assessed with imaging (eg, ultrasound with doppler imaging, portal venography) prior to TIPS insertion [26]. In addition, the interventional radiologist may remove ascites prior to the procedure because this may help to stabilize the liver during transparenchymal puncture. (See '[Pre-TIPS evaluation and planning](#)' above.)

Other complications — Other complications of TIPS insertion include [25]:

- Portal vein rupture – A rare but potentially fatal complication of TIPS insertion is extrahepatic puncture of the portal vein with severe bleeding after attempts to dilate the site of portal vein puncture [22]. The portal vein should ideally be accessed in an intrahepatic location to avoid hemorrhagic complications; however, there are reports of achieving hemostasis by placing a covered TIPS across the site of injury [26,27].
- Injury to the biliary tree – The creation of biliary fistula during TIPS insertion is uncommon [22]. While isolated injury to the bile ducts may be well tolerated, biliary or vascular fistulas may lead to hemobilia, cholangitis, and infection [28]. In addition, communication between TIPS and the biliary system has been associated with stenosis and shunt occlusion ([picture 1](#)) [29,30].

POSTPROCEDURE CARE

Postprocedure care and long-term monitoring for patients with TIPS are discussed separately. (See "[Transjugular intrahepatic portosystemic shunts: Postprocedure care and complications](#)".)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "[Society guideline links: Gastrointestinal bleeding in adults](#)" and "[Society guideline links: Portal hypertension and ascites](#)".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Beyond the Basics topics (see "[Patient education: Esophageal varices \(Beyond the Basics\)](#)")

SUMMARY AND RECOMMENDATIONS

- **Background** – Portal hypertension often develops in patients with cirrhosis and may lead to complications such as variceal bleeding and ascites. Placement of a TIPS reduces elevated portal pressure by creating a low-resistance channel between the hepatic vein and an intrahepatic branch of the portal vein ([figure 1](#)). The tract is kept patent by deployment of an expandable stent across it, thereby allowing blood to return to the systemic circulation. (See '[Introduction](#)' above.)

- **Indications:**

- For patients with actively bleeding esophageal varices who either fail first-line methods of hemostasis or who have initial hemostasis but then rebleed within five days, TIPS is an option for achieving both short- and long-term hemostasis. (See "[Methods to achieve hemostasis in patients with acute variceal hemorrhage](#)" and '[Esophageal varices](#)' above.)
- For patients who develop recurrent variceal bleeding despite use of a preventive strategy (nonselective beta blocker and/or endoscopic variceal ligation), TIPS is an option for achieving long-term hemostasis, and the efficacy of TIPS in this setting is discussed separately. (See "[Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis](#)".)
- The use of TIPS for the management of refractory ascites is discussed separately. (See "[Ascites in adults with cirrhosis: Diuretic-resistant ascites](#)".)
- **Contraindications** – Absolute contraindications to TIPS placement include (see '[Absolute contraindications](#)' above):
 - Congestive heart failure
 - Severe tricuspid regurgitation
 - Severe pulmonary hypertension (mean pulmonary pressure >45 mmHg)
 - Polycystic liver disease
 - Active systemic infection or sepsis
 - Unrelieved biliary obstruction
- **Pre-TIPS evaluation and planning** – Prior to placement of TIPS, we typically obtain the following studies (see '[Pre-TIPS evaluation and planning](#)' above):
 - Laboratory testing – Complete blood count, total bilirubin, international normalized ratio, and serum creatinine. The [MELD score](#) is calculated.
 - Imaging – Liver imaging (contrast-enhanced liver imaging [ie, computed tomography or magnetic resonance imaging] or noncontrast abdominal ultrasound with Doppler study) and chest radiograph.

- Additional evaluation is performed for selected patients (eg, echocardiography and cardiology consultation for patients with signs or symptoms of heart failure).
- **Postprocedure care** – Postprocedure care and adverse events related to TIPS are discussed separately. (See "Transjugular intrahepatic portosystemic shunts: Postprocedure care and complications".)

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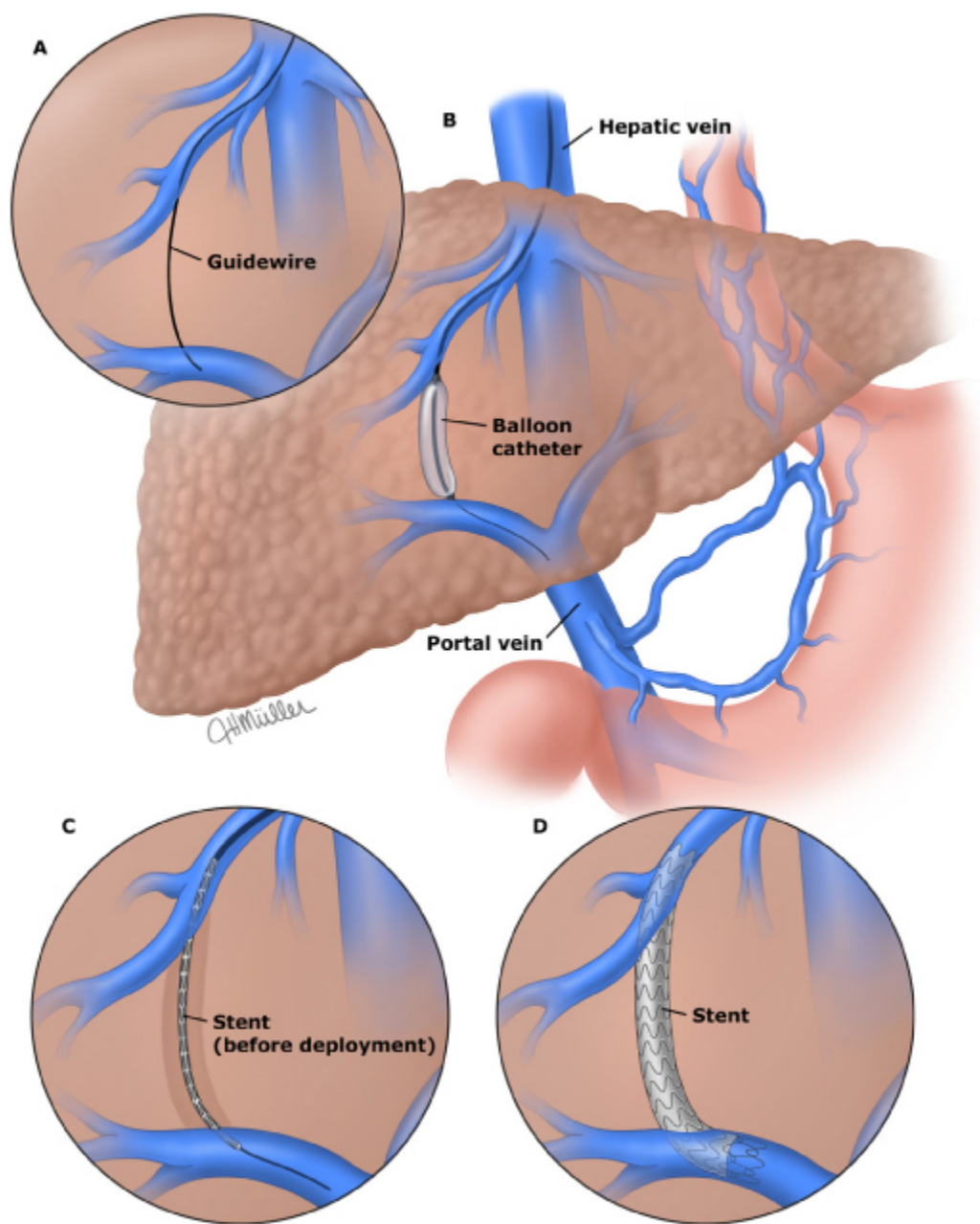
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GRAPHICS

Transjugular intrahepatic portosystemic shunt



A transjugular intrahepatic portosystemic shunt (TIPS) is created by passing a needle catheter via the transjugular route into the hepatic vein and wedging it there. The needle is then extruded and advanced through the liver parenchyma to the intrahepatic portion of the portal vein and a stent is placed between the portal and hepatic veins. A TIPS functions like side-to-side surgical portacaval shunt, but does not require general anesthesia or major surgery for placement. (A) Passage of a guidewire between the hepatic vein and the portal vein. (B) Inflation of a balloon catheter within the liver to dilate the tract between the

hepatic vein and the portal vein. (C) Deployment of the stent. (D) Stent in its final position.

Graphic 72311 Version 2.0

Portal venogram

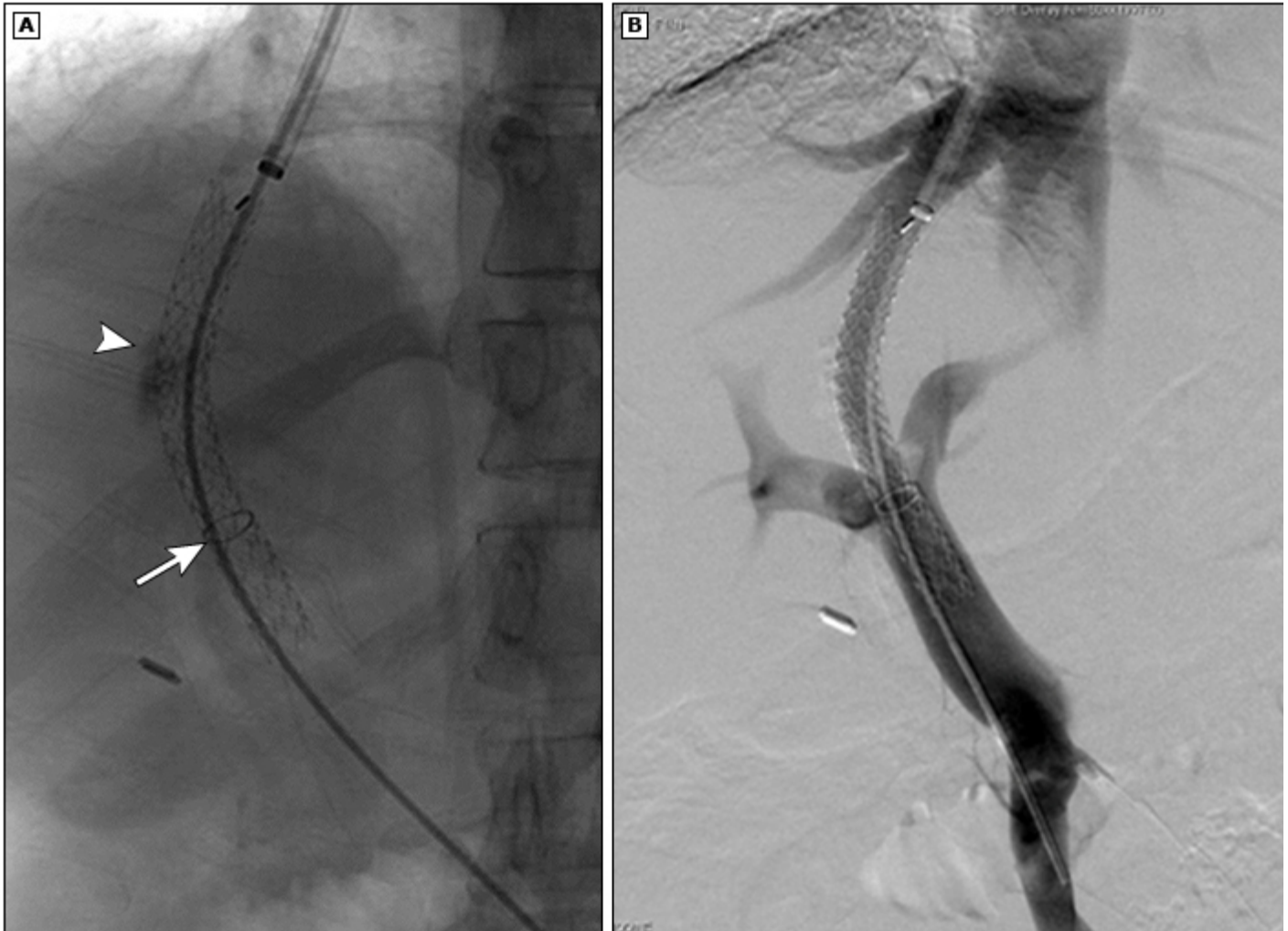


This portal venogram demonstrates the tip of the catheter in the superior mesenteric vein (arrow) and the distal end of the TIPS sheath in the intrahepatic segment of the right portal vein (arrowhead). The venogram shows patent portal circulation.

TIPS: transjugular intrahepatic portosystemic shunts.

Graphic 130103 Version 1.0

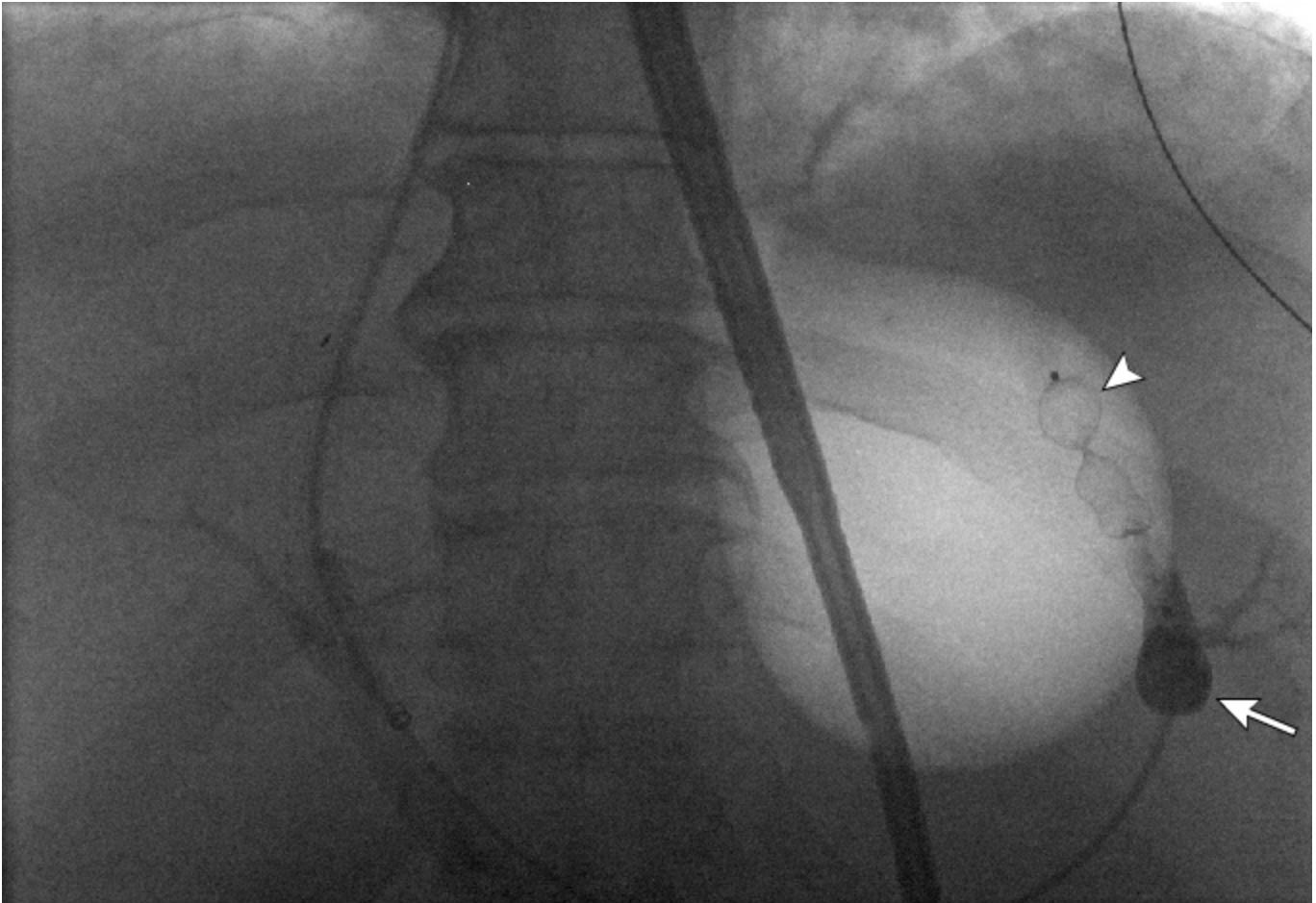
Intrahepatic portosystemic shunt using a Viatorr stent



Radiographic image (panel A) demonstrates the creation of an intrahepatic portosystemic shunt using a Viatorr stent. The metallic ring (arrow) shows the transition between the covered portion of the stent located in the intrahepatic segment of the shunt (arrowhead) and the bare portion of the stent located intravascularly in the right portal vein. Portal venogram with digital subtraction (panel B) demonstrates opacification of the porta hepatic veins and of the patent shunt.

Graphic 130104 Version 1.0

Embolization of gastric varices

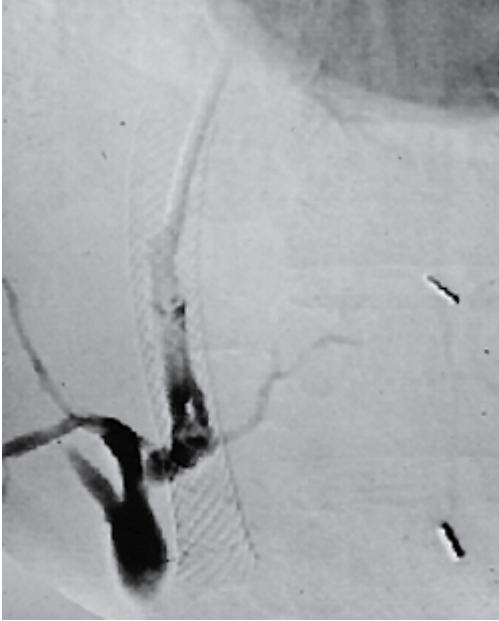


This radiographic image was obtained following embolization of gastric varices using a combination of a metallic plug (arrowhead) and sclerotherapy delivered through a balloon occlusion catheter (arrow). The embolization has resulted in occlusion of flow through the varices.

Courtesy of Felipe Collares, MD.

Graphic 130106 Version 1.0

Occluded TIPS



Occlusion of a transjugular intrahepatic portosystemic shunt (TIPS) with a fistula between the stent and the biliary ducts.

Courtesy of Arun Sanyal, MD.

Graphic 77747 Version 2.0

Contributor Disclosures

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Conflict of interest policy

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