

# Utility of Intravascular US–Guided Portal Vein Access during Transjugular Intrahepatic Portosystemic Shunt Creation: Retrospective Comparison with Conventional Technique in 109 Patients

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## ABSTRACT

**Purpose:** To compare safety and effectiveness of intravascular ultrasound (US)–guided portal vein access during transjugular intrahepatic portosystemic shunt (TIPS) creation with conventional TIPS technique.

**Materials and Methods:** In this retrospective study, TIPS creation using intravascular US guidance in 55 patients was compared with conventional TIPS creation in 54 patients by 10 operators over a 3-year period. Operators were classified as experienced if they had performed  $\geq 20$  TIPS procedures at the beginning of the study period. Time to portal vein access, total radiation dose, and needle pass–related capsular perforation were recorded.

**Results:** Baseline demographic characteristics of patients were similar ( $P > .05$ ). Mean time to portal venous access was 46 minutes  $\pm 37$  for conventional TIPS and 31 minutes  $\pm 19$  for intravascular US–guided TIPS ( $P = .007$ ). Intravascular US guidance allowed significantly shorter times (48 min  $\pm 30$  vs 28 min  $\pm 16$ ;  $P = .01$ ) to portal vein access among operators ( $n = 5$ ) with limited experience but failed to achieve any significant time savings (44 min  $\pm 43$  vs 34 min  $\pm 22$ ;  $P = .89$ ) among experienced operators ( $n = 5$ ). Needle pass–related capsular perforation occurred in 17/54 (34%) patients with conventional TIPS and 5/55 (9%) patients with intravascular US–guided TIPS ( $P = .004$ ). Radiation dose was 2,376 mGy  $\pm 1,816$  for conventional TIPS and 1,592 mGy  $\pm 1,263$  for intravascular US–guided TIPS ( $P = .004$ ).

**Conclusions:** Intravascular US–guided portal vein access during TIPS creation is associated with shorter portal vein access times, decreased needle pass–related capsular perforations, and reduced radiation dose.

## ABBREVIATION

TIPS = transjugular intrahepatic shunt

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Transjugular intrahepatic shunt (TIPS) creation is one of the most complex and radiation-intensive procedures performed by the interventional radiologist (1,2). The unpredictable step in the creation of the shunt is accessing the portal vein (3). The most commonly performed technique involves wedge hepatic venography with carbon dioxide to visualize the portal vein followed by passing the needle under fluoroscopic guidance (4). Portal venous access may require multiple needle passes. Needle pass–related capsular perforation occurs in 5%–33% of cases, with significant intraperitoneal hemorrhage occurring in 1%–2% (5,6). Alternative image

guidance for portal venous access with cone-beam CT, transabdominal ultrasound (US), and intravascular US has been described (7,8). The use of intravascular US provides real-time US guidance to target specific segments of the portal vein (intrahepatic vs extrahepatic or segmental vs lobar). In this study, intravascular US–guided TIPS creation was compared with the conventional technique regarding the time required to access the portal vein, needle pass–related hepatic capsular perforation, and total radiation dose. The effect of operator experience on the time to portal venous access was also evaluated.

## MATERIALS AND METHODS

The institutional review board approved this retrospective chart review. Patient information was handled per Health Insurance Portability and Accountability Act protocols. This study included all TIPS procedures performed between January 2013 and October 2015 at 2 separate hospitals affiliated with the same academic center.

### Study Population

During the study period, 121 consecutive patients underwent a TIPS procedure. There were 12 patients excluded from the analysis because of crossover from conventional to intravascular US–guided TIPS ( $n = 7$ ), lack of standard imaging time stamps required for the analysis ( $n = 4$ ), and aborted procedures secondary to inability to access the portal vein by the conventional technique ( $n = 1$ ). In the remaining 109 patients, TIPS creation was performed using intravascular US guidance in 55 patients and the conventional technique in 54 patients.

### TIPS Procedure

In the intravascular US–guided TIPS group, a right femoral ( $n = 53$ ) or second right internal jugular access ( $n = 2$ ) was obtained. An 8-F, 5- to 10-MHz intravascular US catheter (ACUSON AcuNav; Siemens Medical Solutions, Mountain View, California) capable of producing 90° sector imaging was positioned in the retrohepatic inferior vena cava via the second access. The intravascular US images displayed the relationship of the hepatic veins to the portal vein branches (Fig 1). This information was used to select the most appropriate hepatic vein for TIPS creation based on proximity and angulation. The right hepatic vein was used in 37 patients, and the middle hepatic vein was used in 18 patients. Hepatic venography was performed to confirm the catheter position within the desired hepatic vein. Wedge hepatic venography to identify the portal vein was not performed. The catheter was exchanged for a Haskal Transjugular Intrahepatic Portal Access Set (Cook, Inc, Bloomington, Indiana). The needle tip was visualized under real-time intravascular US guidance as

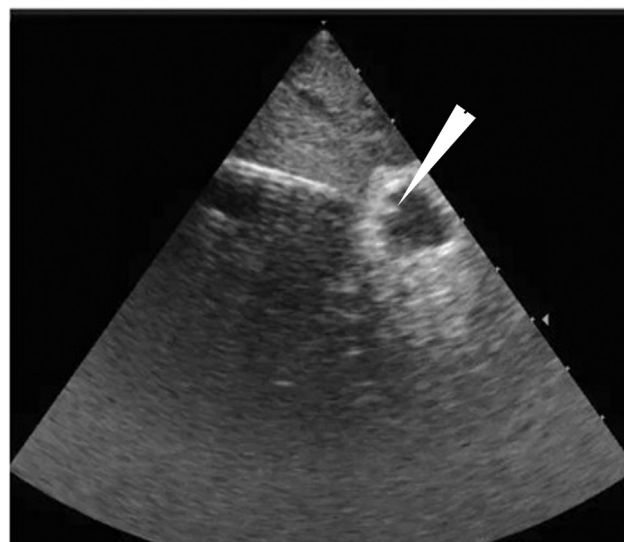
the needle was advanced in small increments toward the desired portal vein. The needle trajectory was adjusted as needed based on the position of the targeted portal vein. Portal venous access was confirmed by visualization of the needle tip within the portal vein (Fig 2). Standard established protocol was followed for the remainder of the TIPS procedure (9). The GORE VIATORR TIPS Endoprosthesis (W.L. Gore & Associates, Flagstaff, Arizona) was used in all cases.

### Data Review

Two interventional radiologists with 3 years and 9 years of clinical experience independently reviewed and recorded the time stamps on the angiographic images,



**Figure 1.** Intravascular US image showing the relationship between the middle hepatic vein (arrowheads) and the right portal vein (arrow).



**Figure 2.** Intravascular US image showing the needle tip within the targeted portal vein (arrow).

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