MR Evaluation of Portal Hypertensive Collateral Shunting Vessels for Prediction of Outcomes after Transjugular Intrahepatic Portosystemic Shunt

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INTRODUCTION: The transjugular intrahepatic portosystemic shunt (TIPS) leads to portal decompression by creation of a communication between a central hepatic vein and an intrahepatic branch of the portal vein using interventional radiologic minimal invasive procedures (1-4). However, selection of patients is still a controversial issue because of high early mortality rate (5). In addition, various complications after TIPS creation, such as shunt dysfunction, onset or worsening of hepatic encephalopathy (1-4) can worsen patients' quality of life (QOL). Also, technical difficulty in TIPS procedure differs from patient to patient. Previously reported parameters and criteria are used mainly for predicting long-term survival rather than to predict therapeutic effectiveness and complications of TIPS. The purpose of this study was to access the usefulness of MR evaluation of portosystemic collateral shunts in prediction of therapeutic effectiveness and complications after TIPS creation.
MATERIALS AND METHODS: Thirty-two patients (27 men, 5 women; mean, 56.4 years) who underwent TIPS creation and gadolinium-enhanced MR examination before TIPS were retrospectively reviewed. Outcome was reviewed on the charts. Initial technical failure, which resulted in re-interventions to complete TIPS creation, was recorded. Therapeutic success was defined as immediate homeostasis for variceal or gastrointestinal mucosal bleeding or reduced frequency of paracentesis for ascites or hydrothorax. Early mortality was evaluated by patient's death within the 30 days after TIPS. Onset or worsening of hepatic encephalopathy after TIPS was recorded. TIPS dysfunction was diagnosed by follow-up image findings and clinical symptoms.
The delayed-phase gadolinium-enhanced MR images were obtained in the axial plane with the use of efgre3d sequence (section thickness, 5 mm; TR/TE, 4-7/1.4-1.8; FA, 12; signal acquired, 0.6 with half-Fourier technique; and 23-sec breath-hold acquisition time). A frequency selective fat inversion nulling technique was used. All images were obtained in relaxed end-expiratory phase with breath-hold technique in each patient. Two experienced abdominal radiologists reviewed the images at a PACS workstation and evaluated PV and pre-existing portosystemic shunting collaterals caused by portal hypertension such as left gastric vein, paraumbilical vein, gastrorenal shunt, splenorenal shunt, or mesenteric varices. The measurements of the short-axis diameters of main stem of PV and portosystemic shunting collaterals were conducted by the same radiologist on the axial MR images. The shunting collaterals were measured at the sites, which indicated maximum diameters. Each portosystemic shunting collateral was graded by a scoring system shown in Table 1 by agreement of the two radiologists. Severity of portosystemic shunting collaterals was evaluated using a sum of the scores and referred to as shunting collateral score. Left gastric and paraumbilical veins, gastrorenal and splenorenal shunts, and mesenteric varices were selected for measurement to avoid overestimation of the same shunting vessels such as left gastric vein and esophageal varices, or posterior or short gastric veins and gastrorenal shunt. Finally, the patients were divided into two groups according to their shunting collateral scores. Patients with the score equal to or more than 3 were assigned as pre-existing large portosystemic shunting collateral group and the others were assigned as small shunting collateral group (Table 2). Therapeutic effectiveness and complications of TIPS, and portal venous (PV) pressure, PV-inferior vena cava (IVC) pressure gradient, and PV diameter were compared between the groups.
RESULTS: TIPS procedure was successfully completed in all patients. The mean shunting collateral score was 2.8 (range, 0 - 9). The patients with pre-existing large portosystemic shunt showed non-significant trends toward higher early mortality, initial technical failure, and tract stenosis rates. In these patients, onset or worsening of hepatic encephalopathy was less frequent (Table 2). There was no significant difference between the two groups in terms of PV pressure, PV-IVC pressure gradient, post-TIPS pressure gradient, PV diameter, or therapeutic success rate.
DISCUSSION: Shunt dysfunction and onset or worsening of hepatic encephalopathy occur in 10 – 78 and 10 – 44 % of the cases, respectively (1). Technical difficulty in TIPS procedure differs from patient to patient and is possibly caused by narrowing of the access or target vessels (i.e. hepatic or portal veins) or distortion of the liver due to cirrhosis. Prediction of complications during or after TIPS would potentially reduce medical costs and improve patients' QOL. We found that patients with pre-existing large portosystemic shunt showed non-significant trends toward higher initial technical failure and tract stenosis rates, and toward lower onset or worsening rates of hepatic encephalopathy, possibly caused by decreased hepatopetal portal blood flow. Even though diameters of the portal branches or hepatic veins were not evaluated in this study, diameters of these vessels may be smaller in patients with large shunt due to decreased portal blood flow, thereby complicating the TIPS procedure and perhaps jeopardizing tract patency. Lower onset or worsening rates of hepatic encephalopathy might occur as a result of tolerance for causative agents due to pre-existing shunts. As for higher early mortality rate in patients with large shunt, higher percentage of emergent cases in the large shunt group was a possible reason. Our results suggested development of collateral shunts cannot be used to predict PV pressure, PV-IVC pressure gradient, or therapeutic success rate of TIPS.
CONCLUSION: Gadolinium-enhanced MRI has the potential to predict therapeutic effectiveness and complications after TIPS.

REFERRENCES

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Table 1. Shunting Collateral Scoring

Diameter	Score
< 2 mm	0
≥ 2 mm, ≤ 7 mm	1
≥ 8 mm, ≤ 10 mm	2
≥ 11 mm, ≤ 12 mm	3
≥13 mm, ≤ 14 mm	4
15 mm	5
≥ 16 mm, ≤ 17 mm	6
18 mm	7
≥ 19 mm, ≤ 20 mm	8

Table 2. Patient Characteristics, Image Findings, Measurements Results during TIPS, and Outcomes after TIPS in Each Group

	With large pre-existing portosystemic shunt (n = 14)	None or with small pre-existing portosystemic shunt (n = 18)	P value
Age	53.0 ± 12.8	59.0 ± 10.2	0.151
Sex	13 men and 1 woman	14 men and 4 women	0.419
Cause of portal hypertension	Alcoholic: 10, hepatitis C: 6, hepatitis B: 1, PBC: 1, cystinosis: 1, cryptogenic: 1	Alcoholic: 11, hepatitis C: 4, PBC: 1, AIH: 1, cryptogenic: 3	
Child-Pugh score	8.86 ± 4.90 (n = 14)	9.00 ± 2.75 (n = 17)	0.839
Reason for TIPS	AS: 4, EV:7, GV: 2, PHG: 2	AS: 8, EV:4, GV: 2, GEV: 1, MV: 1, HH: 1, SB: 1	
Emergent cases	5/14	2/18	0.195
PV pressure (mmHg)	34.0 ± 10.1 (n = 7)	34.9 ± 9.5 (n = 10)	0.853
PV-IVC pressure gradients (mmHg)	21.8 ± 7.5 (n = 7)	22.1 ± 9.9 (n = 14)	0.926
Post TIPS pressure gradients (mmHg)	6.93 ± 2.37 (n = 14)	7.94 ± 2.62 (n = 18)	0.266
PV diameter (mm)	14.0 ± 3.4	14.8 ± 3.1	0.506
Therapeutic success	9/14 (64.3 %)	11/18 (61.1 %)	> 0.999
Early mortality	4/14 (28.6 %)	3/18 (16.7 %)	0.669
Onset or worsening of hepatic encephalopathy	4/14 (28.6 %)	7/18 (38.9 %)	0.712
Initial technical failure	4/14 (28.6 %)	2/18 (11.1 %)	0.365
TIPS dysfunction	7/14 (50.0 %)	6/18 (33.3 %)	0.473