

# Evaluation of Early Vascular Complications after Liver Transplantation : Usefulness of Power Doppler US with a Microbubble Contrast Agent

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## Introduction

Doppler ultrasonography (US) has been widely used for detection of vascular complications after Liver transplantation (LT) (1). US examinations are usually performed at the first, fourth, and seventh postoperative days and at three months and one year postoperatively. Hepatic artery thrombosis is most common vascular complication after LT (1). Reduced hepatic artery flow such as thrombosis or stenosis may lead to biliary complications, graft ischemia, and eventually graft failure (2). On Doppler US at the first day after LT, however, the hepatic artery cannot be easily detected due to postoperative hepatic edema and poor sonographic window (3). The absence of Doppler-detectable hepatic arterial flow as a diagnostic criterion for hepatic arterial thrombosis has produced false-positive interpretation. The purpose of this study was to evaluate the usefulness of PDUS with a microbubble contrast agent in assessing the early vascular complications after LT.

## Materials and Methods

Fifteen patients with orthotopic LT (n = 12) and living-related donor LT (n = 3) were referred for Doppler US at the first day after LT. There were ten men and five women ranging from 35 to 61 years in age (mean, 45.5 years). All patients were referred for LT because of liver cirrhosis. Two abdominal radiologists performed gray-scale US and PDUS, using 5-2-MHz convex array transducer (HDI 5000, Advanced Technology Laboratories, Bothell, WA, U.S.A.). PDUS examinations were performed before and after injection of a microbubble contrast agent (Levovist®; Schering AG, Berlin, Germany). The detection of hepatic arterial flow signal, thrombosis or stenosis of hepatic artery, portal vein, and inferior vena cava were evaluated. The diagnosis of hepatic artery stenosis was made when the hepatic arteries had tardus-parvus waveforms. Final decisions on the findings were reached by a consensus. The results of unenhanced PDUS were compared with those of contrast-enhanced PDUS in terms of depicting vascular complications and conspicuity of the lesions.

## Results

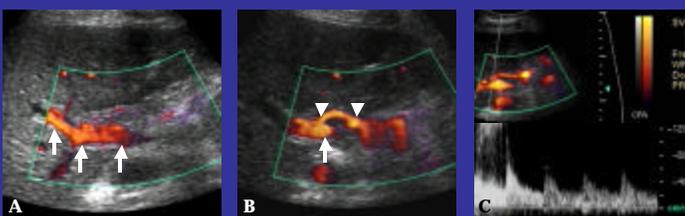


Fig. 1. — Proper hepatic artery at the first day after liver transplantation (LT) in 40-year-old woman. A. Unenhanced PDUS shows flow signal of main portal vein and right main portal vein (arrows). Some short segments of right main hepatic artery are noted. However, flow signal of proper hepatic artery is not detected. B. Contrast-enhanced PDUS shows flow signals through proper hepatic artery (arrowheads) and main portal vein (arrow). C. Contrast-enhanced spectral Doppler US shows arterial pulse waveform of proper hepatic artery.

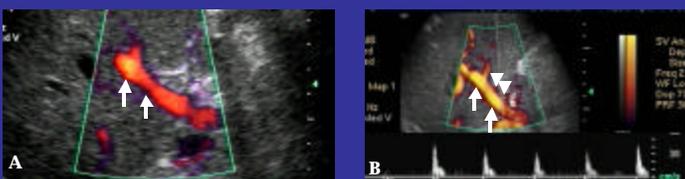


Fig. 2. — Right main hepatic artery at the first day after LT in 45-year-old man. A. Unenhanced PDUS shows flow signal of right main portal vein (arrows). However, flow signal of right hepatic artery is not detected. B. Contrast-enhanced PDUS shows flow signal of right main hepatic artery (arrowheads) and right main portal vein (arrows). Note arterial pulse waveform with high RI on spectral Doppler US.

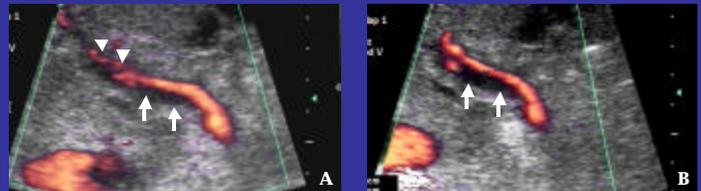


Fig. 3. — Main portal vein thrombosis at the first day after LT in 39-year-old man. A. Unenhanced PDUS shows flow signal of main portal vein and thrombosis (arrows). Note flow signal of right main hepatic artery (arrowheads). B. Contrast-enhanced PDUS again shows flow signal of main portal vein and thrombosis (arrows), but conspicuity of thrombosis was better appreciated.

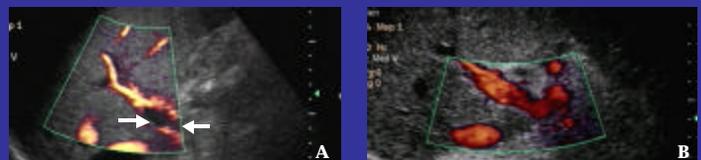


Fig. 4. — Main portal vein thrombosis at the first day after LT in 38-year-old man. A. Contrast-enhanced PDUS shows flow signal of main portal vein and thrombosis (arrows) with excellent conspicuity. B. Follow-up PDUS after thrombolectomy and reanastomosis shows no portal vein thrombosis.

In three (20%) of 15 patients, flow signal of hepatic artery was not detected on unenhanced PDUS, while contrast-enhanced PDUS showed flow signals of hepatic artery in all patients. Both unenhanced and contrast-enhanced PDUS showed portal vein thromboses in two (13%) of 15 patients, but conspicuity of portal vein thromboses was better appreciated on contrast-enhanced PDUS.

## Discussion

The thrombosis of the hepatic artery occurs with a reported frequency of 3-5% in adult patients and 9-15% in the pediatric population (2, 4, 5). According to a prior report, hepatic artery thromboses occurred from 1 day to 3.6 years after LT, and 59% of these occurred within 30 days (6). The clinical findings of vascular complications vary from mild elevation of hepatic function tests to fulminant hepatic failure (5). These findings overlap with other post-LT problems. Imaging studies can be essentially helpful in eliminating vascular complications from differential diagnosis. Several investigators proposed that Doppler US with a microbubble contrast agent increased flow signal when compared to the unenhanced Doppler US (7, 8). In our study, flow signal of hepatic artery was not detected in 20% on unenhanced PDUS at the first day after LT, but contrast-enhanced PDUS showed flow signals of proper hepatic artery and the both main hepatic arteries in all patients. These results suggest that contrast-enhanced PDUS may obviate unnecessary angiography which is an invasive technique.

Although we need more prospective, comparative studies with a large population of patients, compared with unenhanced PDUS, contrast-enhanced PDUS showed better detection of hepatic arterial flow and the increased conspicuity of portal vein thrombosis. Our preliminary data suggest that contrast-enhanced PDUS can be a promising noninvasive technique in assessing the early vascular complications after LT.

## References

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