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## Case Report

# Pull-through technique for hepatic vein angioplasty after liver transplantation ☆,☆☆

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## ABSTRACT

Hepatic venous outflow complication is one of the crucial vascular complications after liver transplantation. We describe successful use of the pull-through technique for hepatic vein angioplasty in a patient with stenosis of the middle and left hepatic veins (MHV and LHV) after living-donor liver transplantation. It was difficult to select the stenotic MHV with a femoral approach. However, the guidewire was unexpectedly inserted into a small collateral vein and selective angiography showed the MHV through the collaterals. Because the guidewire proceeded to the MHV via the collateral and finally into the inferior vena cava, we advanced a catheter from the inferior vena cava to the MHV using the pull-through technique and performed balloon angioplasty.

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## Introduction

Liver transplantation has established and widely been accepted as a therapeutic option for endo-stage liver diseases. Hepatic venous outflow complication is one of the crucial vascular complications after liver transplantation, and occurs 2%–11% of liver transplantation, causing graft loss and mortality as high as 17%–24% [1–4]. The balloon angioplasty to the hepatic vein stenosis is recognized as a safe and useful treatment with minimum invasion, compared to a direct surgical approach to the stenotic site [5]. However, during the process of angioplasty to the hepatic vein stenosis, the direct catheterization of a catheter or a guidewire to the stenosed

hepatic vein is sometimes difficult. There is also no report about the hepatic vein angioplasty with pull-through technique. We present a case with successful balloon angioplasty with intrahepatic pull-through technique to the stenosed hepatic vein after living-donor liver transplantation.

## Case report

A 44-year-old female diagnosed with decompensated cirrhosis caused by nonalcoholic steatohepatitis was transferred to our hospital for living donor liver transplantation (LDLT). LDLT

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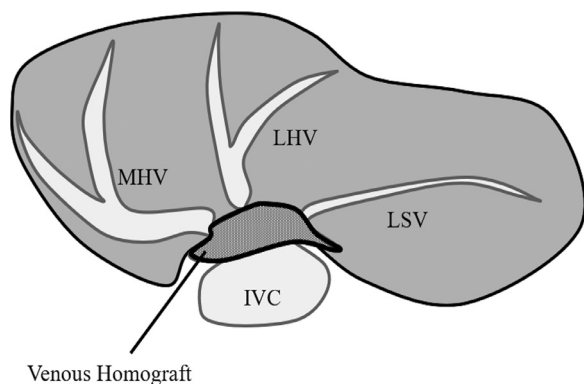
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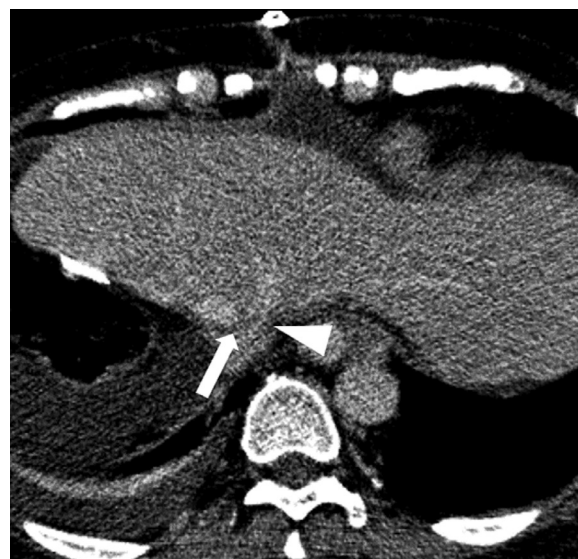
**Fig. 1** – Diagram showing reconstruction of the hepatic vein during LDLT. The anastomotic site between the graft-hepatic vein and the IVC was constructed using a cryopreserved venous homograft with 3 holes for connection to the MHV, the LHV and the LSV, and one large hole for connection to the IVC. IVC, inferior vena cava; MHV, middle hepatic vein; LHV, left hepatic vein; LSV, left superficial vein; LSV, left superficial vein.

was performed using a left liver graft from her brother. The anastomotic site between the graft-hepatic vein and the inferior vena cava (IVC) was constructed using a cryopreserved venous homograft with 3 holes for connection to the middle hepatic vein (MHV), the left hepatic vein (LHV), and the left superficial vein (LSV) each, and one large hole for connection to the IVC (Fig. 1). She was discharged 27 days after surgery. However, 3 months later, she returned to our hospital with massive ascites. Computed tomography (CT) showed severe stenosis of the reconstructed MHV and LHV (Figs. 2A and B). Because the ascites was considered to be caused by the stenotic hepatic vein, endovascular angioplasty was planned to resolve the stenosis of the MHV and LHV.

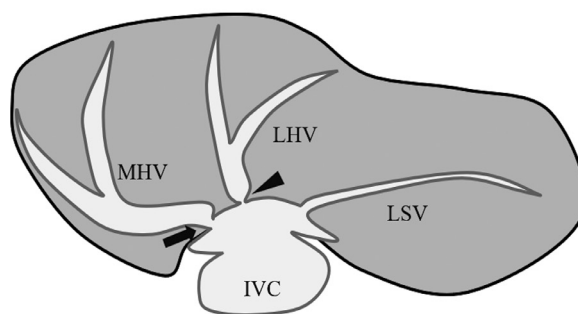
Angioplasty was performed through an 8 Fr sheath (Cobra type, Medikit, Tokyo, Japan) in the right femoral vein. First, the LHV was directly selected with a 4 Fr catheter and dilated with a 10 mm angioplasty balloon catheter (Admiral Xtreme PTA Balloon Catheter, Medtronic, Minneapolis, MN). The pressure difference between the IVC and the LHV was decreased from 13.2 to 4.3 mmHg.

Because of the severe stenosis and anatomical location, it was impossible to select the MHV using a 0.035 inch guidewire (Radifocus, Terumo, Tokyo, Japan) with a 4 Fr catheter system (straight type, Medikit). While trying to select the MHV, the guidewire was unexpectedly inserted into a small collateral vein. After advancing a 4 Fr catheter to the small collateral vein, selective angiography showed the MHV through the collateral vein (Fig. 3A). Because the guidewire was managed to be advanced to the MHV via the collateral vein and finally into the IVC, we planned to insert a catheter from the IVC to the MHV using the pull-through technique.

After placing an additional 8 Fr sheath in the right femoral vein, a snare wire (Goose neck snare, 10 mm diameter, Medtronic) was advanced to the IVC. The tip of the guidewire in the IVC was caught using the snare wire (Fig. 3B). After pulling the guidewire back into the sheath, a 4 Fr catheter



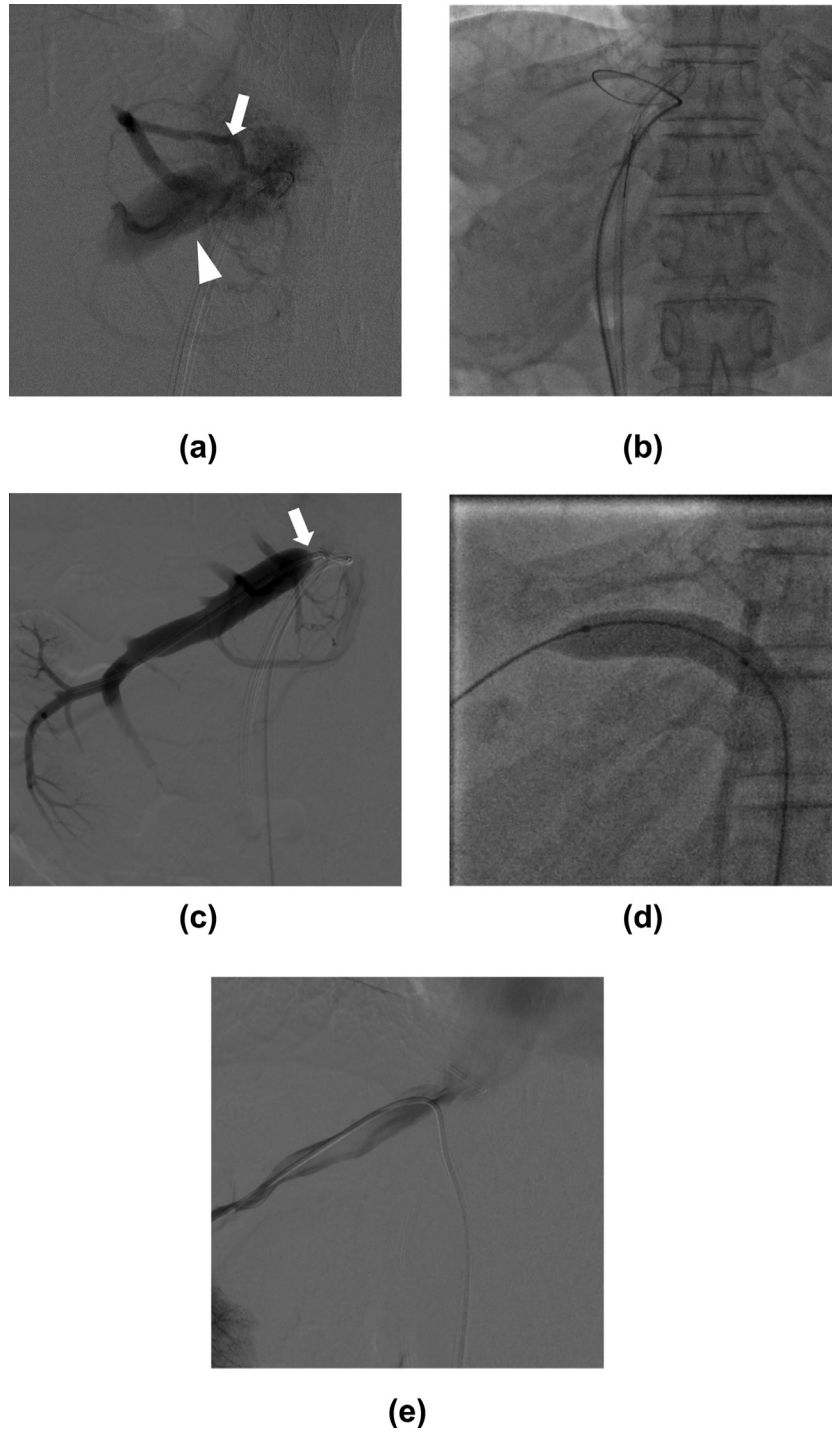
(a)



(b)

**Fig. 2** – (A) CT image and (B) diagram showing anastomotic stenosis of the middle (arrow) and the left (arrowhead) hepatic veins. CT, computed tomography.

was advanced along the guidewire to the MHV through the stenotic lesion. Angiography via the catheter revealed that the MHV was wedged by the catheter through the site of stenosis (Fig. 3C). The pressure difference between the MHV and the IVC was 8.4 mmHg. After changing the guidewire to a 0.035 inch stiff guidewire (Amplatz super stiff, Cook, IN, USA), the 10 mm angioplasty balloon catheter was advanced to the stenotic lesion in the MHV and successfully dilated 3 times at 6 atm for 1 minute each (Fig. 3D). After balloon angioplasty, angiography showed a slight constriction at the anastomotic site in the MHV; the pressure difference between the MHV and the IVC was decreased from 8.4 to 4.8 mmHg (Fig. 3E). After endovascular treatment, her ascites improved, and no further interventions were necessary during a year follow-up.



**Fig. 3 – Balloon angioplasty using the pull-through technique. (A) Angiography of the selected collateral hepatic vein (arrow) depicted the MHV (arrowhead). (B) A guidewire was advanced to the MHV and into the IVC through a collateral, and was caught with a snare wire. (C) A catheter was advanced to the MHV along the guidewire that passed through the stenosis (arrow). (D) The stenosis was dilated with a 10 mm angioplasty balloon catheter. (E) The stenosis improved after angioplasty. MHV, middle hepatic vein.**

## Discussion

Stenosis of the hepatic vasculature, such as the hepatic artery, portal vein, or hepatic vein, is one of the most common com-

plications after liver transplantation [6]. Balloon angioplasty is widely accepted as a safe and effective treatment for hepatic vein stenosis after liver transplantation, and sometimes stents are used to treat stenosis [5,7]. During hepatic vein angioplasty, catheterization of the stenotic hepatic vein is a key

step, followed by balloon dilatation or stent placement. The femoral vein approach or the jugular vein approach are usually used for hepatic vein angioplasty. At our institution, we usually use the femoral approach for hepatic vein angioplasty after LDLT because the homograft between the IVC and graft-hepatic vein is reconstructed and shaped as a pouch to prevent hepatic venous outflow obstruction. We consider that the femoral approach is easier than the jugular approach for selecting the hepatic vein through a reconstructed homograft. However, we sometimes experience difficulty in advancing the guidewire to the stenosed hepatic vein.

If direct catheterization to the stenotic hepatic vein is difficult, there are several possible options: (1) switching from a femoral approach to a jugular approach, or using a percutaneous transhepatic approach with direct puncture of the distal hepatic vein; (2) changing the sheath or catheter to a device with another shape or by shaping the catheter manually; (3) selecting a small system with microcatheters and microballoon catheters; and (4) using a pull-through technique via intrahepatic venous collaterals. In this case, we decided to use the pull-through technique. Because the guidewire was able to advance to the MHV via the collateral vein and finally into the IVC, we planned to advance a catheter from the IVC to the MHV using the pull-through technique.

The pull-through technique is widely performed in interventional radiology since it was first described for recanalization of the occluded common iliac artery in 1988 [8–10]. To our knowledge, there are no reports describing the pull-through technique for angioplasty of a stenotic hepatic vein after LDLT.

In our patient, we considered that there was a possibility of advancing a balloon catheter to the stenotic region of the MHV using the pull-through technique, when angiography from a small collateral vein revealed the MHV. This method of angioplasty is apparently less invasive than using a direct percutaneous transhepatic approach to reach the distal MHV, although an additional sheath is needed for the snare wire. Furthermore, an additional femoral approach is more feasible for inserting a snare wire compared with switching to a jugular approach because it is not necessary to prepare another clean surgical field.

There are several limitations of performing hepatic vein angioplasty using the pull-through technique after LDLT. First, the pull-through technique is impossible if collaterals to the stenosed hepatic vein are not visualized by angiography from a selected small collateral vein or if a guidewire is not able to pass through the stenotic lesion of the hepatic vein. Second, an additional sheath is needed to insert the snare wire for grabbing the guidewire in the IVC. Third, there is the additional cost of the snare wire required for the pull-through technique.

## Conclusion

The pull-through technique is a feasible procedure for hepatic vein angioplasty after LDLT. To our knowledge, this is the

first report in which the pull-through technique was used for hepatic vein angioplasty after liver transplantation. The pull-through technique is a useful option for hepatic vein angioplasty if direct catheterization of the stenotic hepatic vein is difficult.

## Patient consent

Written informed consent for publication was obtained from the patient.

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