Clinical Case Report

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Transhepatic-intrahepatic branches of the portal vein catheterization for ex vivo liver resection and autotransplantation

Two case reports of novel approach to perfuse the liver

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Abstract

Rationale: There has been increased use of ex vivo liver resection and autotransplantation (ERAT) for treatment of end-stage hepatic alveolar echinococcosis (HAE). Rapid perfusion of the autograft in bench resection is always required to reduce the warm ischemia time (WIT) and to protect the function of the remnant liver. Nevertheless, the severe invasion of the portal hepatis sometimes makes it impossible to find a usable inflow rapidly and the process of perfusion could be delayed.

Patient concerns: Two patients diagnosed with end-stage HAE combined with severe portal hepatis invasion were selected to undergo ERAT at our center.

Diagnosis: Besides the large HAE lesions, the CT imaging of patient 1 showed that part of the intra- and extrahepatic portal vein (PV) had disappeared. Patient 2 had severe invasion of both of the right and left branches of the PV.

Interventions: We introduced a new approach for perfusing the liver in ERAT using transhepatic-intrahepatic branches of the PV catheterization. Afterward, ERAT was successfully performed.

Outcomes: For patient 1, the WIT was 2 minutes and the cold ischemia time (CIT) was 296 minutes. For patient 2, the WIT was 2 minutes and the CIT was 374 minutes. Patient 1 suffered stenosis of the common bile duct on postoperative day 14, and patient 2 recovered uneventfully. Both of the 2 patients were discharged from the hospital with normal laboratory values on postoperative day 31 and 15, respectively. The laboratory values for both patients at recent follow-up were normal.

Lessons: Transhepatic-intrahepatic branches of the PV catheterization is useful for decreasing WIT and facilitating the management of ERAT. It is a useful technical variant that could be used in ERAT for treating patients with severe portal hepatis invasion.

Abbreviations: CTPV = cavernous transformation of the portal vein, ERAT = ex vivo liver resection and autotransplantation, GSV = great saphenous vein, HAE = hepatic alveolar echinococcosis, PTCD = percutaneous transhepatic cholangial drainage, PV = portal vein, RHVC = retrohepatic inferior vena cava, WIT = warm ischemia time.

Keywords: autotransplantation, ex vivo liver resection, hepatic alveolar echinococcosis, portal vein, warm ischemia time

1. Introduction

Ex vivo liver resection and autotransplantation (ERAT) is a newly-introduced technique to cure end-stage hepatic alveolar echinococcosis (HAE). Severe invasion of crucial intra- and extrahepatic conduits and adjacent structures make it a surgical challenge or even a contraindication to use of this technique.[1–3] The involvement of portal hepatis is common for end-stage HAE, sometimes leading to secondary cavernous transformation of the portal vein (CTPV), thereby substantially complicating the intraoperative procedures.[4] Worse still, after the procurement of the autograft, local compression, and inflammation around the intrahepatic portal vein (PV) could make it impossible for the surgeons to find a usable inflow and perfuse the liver rapidly in the bench resection. At this point, an increase of warm ischemia time (WIT, defined as the time interval between the blocking of total blood flow and liver flushing in the bench resection) of the autograft would happen and the function of remnant liver could be damaged.[5] Undoubtedly, this problem could influence the management and safety of ERAT.

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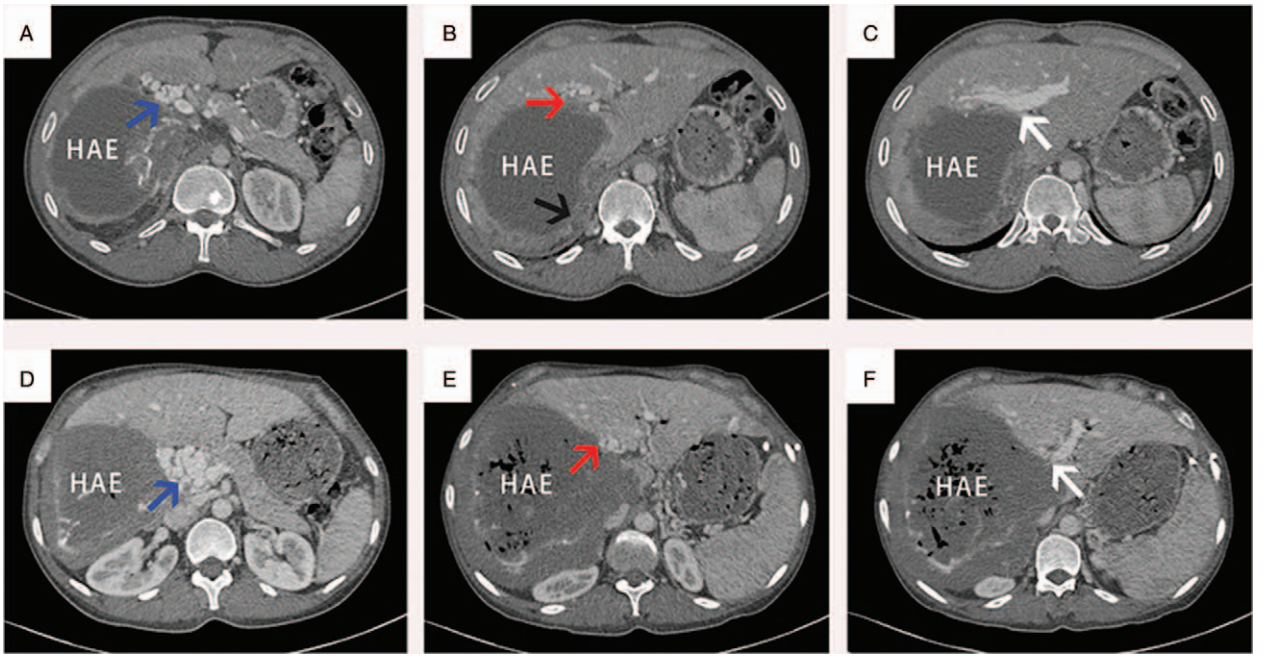

Figure 1. The severe invasion of the portal hepatis revealed on preoperative CT of the 2 patients who underwent ex vivo liver resection and autotransplantation. Note: (A, B, and C) For patient 1, preoperative CT revealed a large lesion (hepatic alveolar echinococcosis, HAE) in the right lobe, severely invading the right branch. Bifurcation of the portal vein (PV) and the retrohepatic inferior vena cava (RHVC) caused part of the intra- and extrahepatic PV to disappear and led to secondary cavernous transformation of portal vein (CTPV). (D, E, and F) For patient 2, the large HAE lesion severely invaded the right and left branches of the PV and the RHVC, causing part of the intra- and extrahepatic PV to disappear and leading to a secondary CTPV.

We present here a novel approach for perfusing the liver during ERAT that was used by our team in 2 patients diagnosed with end-stage HAE combined with severe portal hepatis invasion and secondary CTPV. We believe our suggested approach could substantially shorten the WIT of the liver and facilitate the use of ERAT.

2. Case reports

2.1. Case presentation

Case 1 was a 41-year-old male who was admitted to our hospital in April 2018 for treatment of end-stage HAE. He was diagnosed with HAE 1 year prior and had undergone 3-months of albendazole therapy (the treatment stopped because of poor compliance). CT imaging revealed one large lesion measuring 11.3 × 8.6 cm located in the right lobe of the liver, a CTPV was found around the portal hepatis and a stenosis of the retrohepatic inferior vena cava (RHVC) was identified. On further analysis of the CT image, part of the intra- and extrahepatic PV had disappeared, suggesting severe invasion of the PV and predicting difficulty in dissecting a usable inflow to perfuse the liver intraoperatively (Fig. 1A–C).

Case 2 was a 37-year-old female who was diagnosed with HAE 5 years prior. She did not receive any regular treatment. Recently, she had symptoms of right abdominal pain combined with jaundice. Following ultrasonography-guided percutaneous transhepatic cholangial drainage (PTCD) to reduce the bilirubin level and relieve the biliary obstruction, the total bilirubin decreased to 23.1 μmol/L and she was admitted to our hospital in May 2018 for further treatment. CT revealed one large lesion located in the right lobe of the liver, invading both the right and left branches of the PV and severe secondary CTPV occurred because of the chronic obstruction (Fig. 1D–F).

The preoperative preparation details were similar to our previous experience.[2] The study was approved by the Ethics Committee of West China Hospital of Sichuan University (No. 2017-38) and was performed in accordance with the Declaration of Helsinki. Informed written consent was obtained from the patient for publication of this case report and accompanying images.

2.2. Technique

The Mercedes incision was selected for both patients. After mobilization of the liver, ultrasonography was used to evaluate the lesion and the portal hepatis. For patient 1, further dissection of the portal hepatis was first performed (Fig. 2C, see Video, Supplemental Digital Content 1, http://links.lww.com/MD/C872). Subsequently, ultrasonography was performed again to identify the route for puncture. This also showed there was no blood flow in the left branch of PV (Fig. 2A). An 8-Fr radifocus introducer (Radifocus Introducer II Standard Kit - Introducer sheath, RS+A80K10SQ, TERUMO, Japan) was punctured into the right branch of the PV and was then placed into the left branch under ultrasound guidance (Fig. 2B and E, see Video, Supplemental Digital Content 2, http://links.lww.com/MD/C873).

For patient 2, catheterization was performed first. An introducer with the same specifications used for patient 1 was directly placed in the left branch of the PV. The dissection of portal hepatis then began (Fig. 2D and F).

In both cases, after the introducer was successfully placed into the intrahepatic branches of the PV, heparin saline was injected into the vessels to identify the effect of the catheterization and to prevent coagulation of blood. Finally, the liver was procured combined with the RHVC for bench resection.

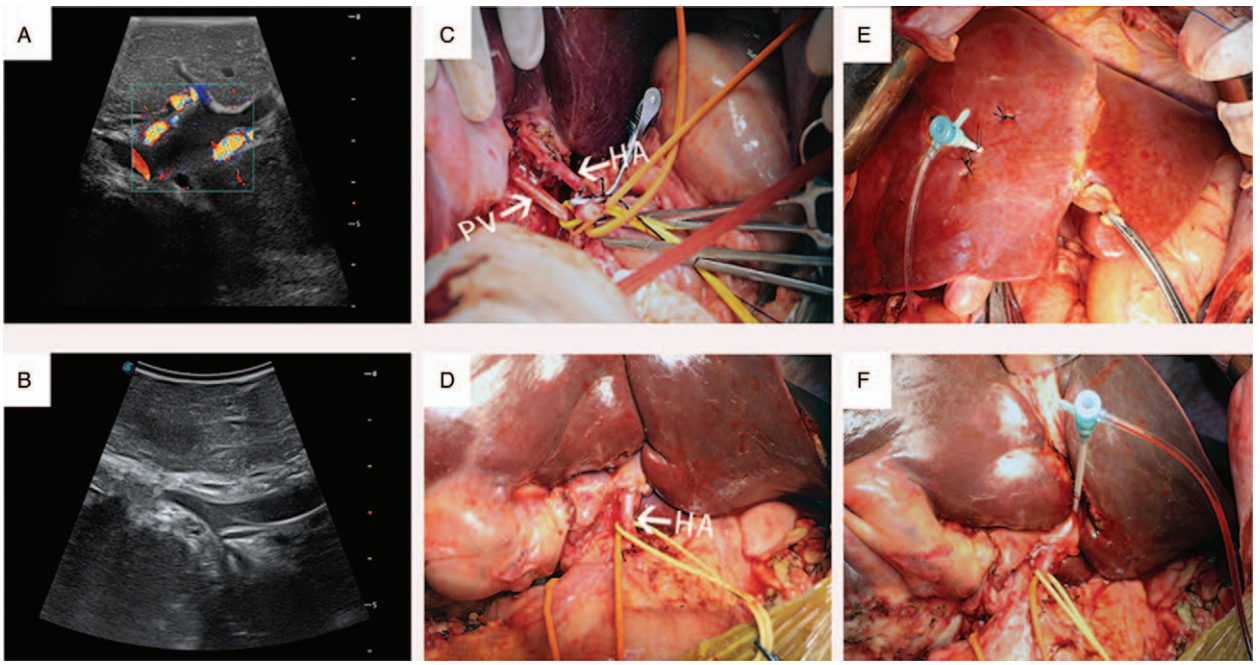

Figure 2. The procedures of catheterization and management of portal hepatis. Note: (A) For patient 1, intraoperative ultrasonography revealing no blood flow in the left branch of the portal vein. (B) Ultrasonography showing that the introducer was placed into the left branch of the portal vein. (C and D) The common hepatic artery was dissected and protected during the operation. (E and F) In both cases, the introducers were successfully placed into the left branches of the portal vein and were fastened to the liver.

2.3. Perfusion and dissection of the liver in bench resection

After procurement of the autograft, the liver was first perfused with 0 to 4°C HTK solution (histidine-tryptophan-ketoglutarate, Custodiol, Dr. Franz Kohler Chemie, Germany) through the introducer. Meticulous dissection of the portal hepatis was then performed. For both cases, the branches of PV were severely invaded and absolutely obstructed because of compression, inflammation, and thrombosis. The usable branches of the PV for reconstruction were located after long and meticulous dissection (Fig. 3).

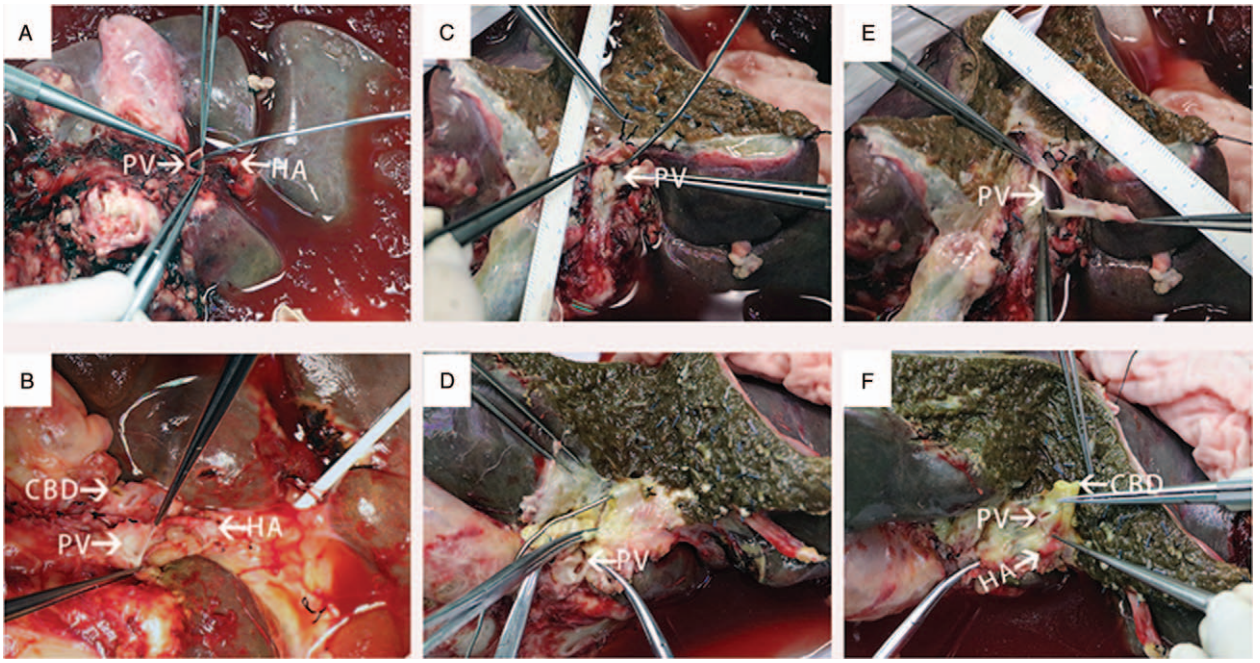

Figure 3. The intraoperative exploration of the portal hepatis of the 2 patients who underwent ex vivo liver resection and autotransplantation. Note: (A and B) For both cases, the portal hepatis was severely invaded and normal structure could not be identified because of the local compression and inflammation. Perfusing the liver directly was impossible. (C and D) Further dissection of the portal hepatis of both patients, revealing that the intrahepatic parts of the portal veins were severely obstructed. (E and F) Usable inflows were finally located after meticulous dissection of the portal hepatis.

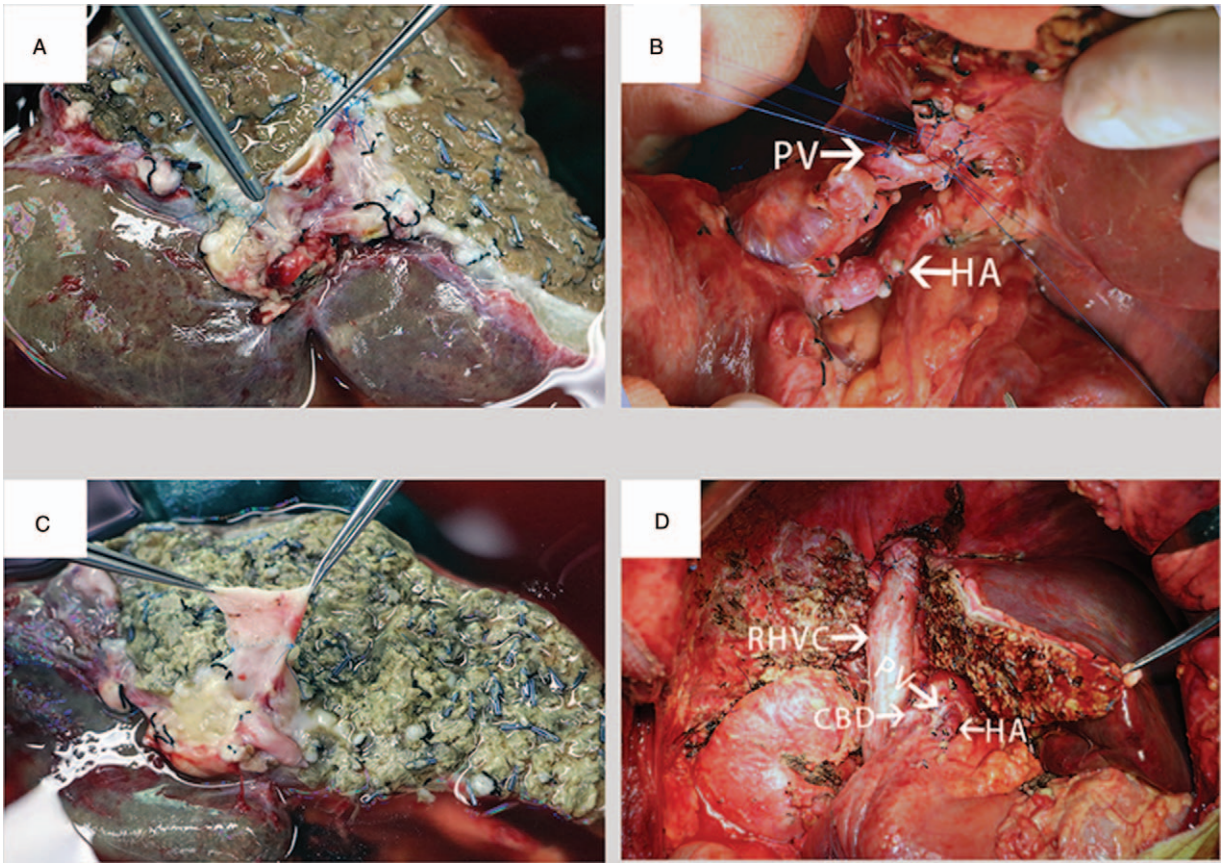

Figure 4. Reconstruction of the portal vein and other crucial conduits. Note: (A and B) For both patients, autografts were used to prolong the left branch of the PV, made using parts of the portal vein and great saphenous vein (GSV), respectively. (C) For patient 1, the portal vein and hepatic artery were reconstructed successfully. (D) For patient 2, the portal vein and other crucial conduits were reconstructed.

2.4. Reconstruction of crucial conduits

The details of approaches for reconstructing conduits were discussed in our previous study.[2] For both patients, autografts were used for prolonging the left branch of the PV that were made from the patients' parts of the PV and great saphenous vein (GSV) (Fig. 4A and B, see Video, Supplemental Digital Content 3, http://links.lww.com/MD/C874). An end-to-end anastomosis between the autografts and the trunk of the PV was then performed. Patient 1 received an artificial graft (InterGard grafts, IGW0020-15, InterVascular SAS, Inc., La Ciotat, France) for reconstruction of the RHVC, while patient 2 received an autograft made by her GSV. The reconstruction of the artery and bile duct was uneventful, and end-to-end procedures were performed (Fig. 4C and D).

3. Results

For patient 1, the WIT was 2 minutes and the cold ischemia time (CIT) was 296 minutes. He suffered stenosis of the common bile duct on postoperative day 14. Endoscopic retrograde cholangiopancreatography and endoscopic nasobiliary drainage therapy were performed, and a plastic stent was placed in the stenosis. For patient 2, the WIT was 2 minutes and the CIT was 374 minutes.

Both patients required admission to the intensive care unit after surgery. Liver and kidney function assessments, complete blood count and four coagulation tests were routinely performed. Ultrasonography was commonly carried out on the first three days as well as on the seventh and fourteenth day after surgery, and CT was performed at least once more before discharge. After the verification of hemostasis 2 days after surgery, low-molecular-weight heparin sodium was administered to prevent thrombotic complications.

Patient 1 was discharged from the hospital on postoperative day 31 with normal laboratory values. Patient 2 recovered uneventfully and was discharged from the hospital on postoperative day 15. The laboratory values for both patients at recent follow-up were normal.

4. Discussion

ERAT is an effective technique for treating unresectable but not metastatic HAE lesions. It can overcome the limitations of liver transplantation, including the mandatory use of immunosuppressive agents, the shortage of organ donations and the high costs.[6,7] Our center has also been exploring the feasibility and indications of this technique recently and has obtained satisfactory results.[2] Nevertheless, the complexity of the technique and the HAE disease demands that further technical details be explored to guarantee safety and facilitate the application of ERAT.

Portal hepatis invasion is common for end-stage HAE. Large lesions invade the branches and trunk of the PV, often causing local compression and inflammation and resulting in reactionary

thrombus formation in the intra- and extrahepatic PV. The result is a reduction of diameter or even obstruction of the PV.[8] In some patients, a secondary CTPV is formed because of the chronic obstruction.[4] In addition, local compression and inflammation often make it difficult to locate normal structures in the portal hepatis, and the dissection of crucial conduits could be time-consuming or even impossible. Consequently, after procurement of autograft, finding a usable inflow and perfusing the liver rapidly were substantial problems. Without timely perfusion, long WIT ensues, possibly leading to irreversible damage of the remnant liver.[5] One of our previous patients had similar conditions, and it required about 15 minutes to find a usable inflow to perfuse the autograft successfully. Although the operation was successfully managed, the patient had dysfunction of the liver and kidney postoperatively, and she was discharged to the local hospital for further treatment. We subsequently discovered that the patient had died.

PV catheterization was first reported by Bayly and Gonzales in 1964, used to measure portal pressure.[9] Since that time, this technique was used in portography, chemotherapy, PV decompression, and assessment of liver cirrhosis.[10,11] Urahashi el al[12] also used this method for perfusion of the explanted graft and measurement of the portal venous pressure during living donor liver transplantation. Nevertheless, these operations all used the umbilical vein or splenic vein and required an uninvaded trunk or left branch of the PV.

Transhepatic-intrahepatic branches of the PV catheterization is a relatively easy minimally invasive method that is not limited by the invaded portion of the PV. Preoperative CT imaging and intraoperative ultrasonography were used to identify the optimum puncture route, requiring an experienced surgeon who was familiar with the anatomy of the liver. The 8-Fr Radifocus introducer is currently the best introducer for the puncture of branches of the PV. Undoubtedly, with the successful catheterization of the PV, the surgeon can perfuse the liver rapidly and unhurriedly after the procurement of the autograft.

Because the 2 patients had CTPV, attention to PV catheterization was required, and the process was performed before and after the dissection of the portal hepatis. The laboratory values showed that postoperative recovery for both patients was uneventful. Nevertheless, we propose that the process of catheterization should be performed before the dissection of the portal hepatis. For patient 1, after dissection of the portal hepatis and ligation of the collateral veins, there was no blood in the intrahepatic PV, making it difficult to puncture the introducer into the PV. Furthermore, the absence of blood flood in the intrahepatic PV was a risk for remnant liver function. At this point, the common hepatic artery must be intact and unobstructed such that part of the blood and oxygen supply the liver could be maintained.

Conditions required for use this technique in ERAT include severe invasion of the portal hepatis. Preoperative CT and intraoperative ultrasonography indicated that it was difficult or impossible to locate usable inflow to perfuse the liver rapidly. The umbilical vein could be an alternative route to perform the catheterization; however, when the left branch of the PV is invaded, the route of the umbilical vein to PV is not patent and this method is therefore not feasible. Furthermore, because portal hypertension in both patients was not severe, there was no patent umbilical vein available and the procedure of catheterization could be complicated. Consequently, we believe that our method is more minimally invasive, less time-consuming and easier to perform, encouraging us to do more exploration of this technique.

Transhepatic-intrahepatic branches of the PV catheterization in ERAT with patients with severe portal hepatis invasion is a useful technique with potential to rapidly perfuse the liver and decrease the WIT in bench resection with minimal invasion. Furthermore, it could improve the safety and feasibility of ERAT in certain patients and facilitate the treatment of end-stage HAE.

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