

# Urgent Revascularization of a Liver Allograft with a Saphenous Vein Interposition Graft Between the Hepatic Artery and the Recipient Splenic Artery After Late Hepatic Artery Thrombosis

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Hepatic artery thrombosis (HAT) after liver transplantation is a severe complication which may lead to graft infarction and subsequent graft loss. It complicates 2–12% of adult liver transplantations (1, 2) and subsequently leads to retransplantation in 50–75% of patients (3). Fortunately, innovations in Doppler ultrasonography and digital angiography technologies have provided an accurate and rapid method for detecting HAT before ischemic damage of the allograft (4). Revascularization procedures that can be performed once the diagnosis of HAT has been confirmed include thrombectomy alone, intrahepatic arterial thrombolysis with thrombolytic agents, creation of a new anastomosis between a more proximal part of the recipient artery and a more distal part of the donor hepatic artery, and introduction of an interposition graft (3). Early diagnosis is a prerequisite for these revascularization strategies.

We report here the case of a patient with previous orthotopic liver transplantation (OLT) and splenectomy in whom hepatic arterial reconstruction using saphenous vein graft between the splenic artery and the transplant hepatic artery following HAT was performed.

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## CASE REPORT

A 22-year-old male with a diagnosis of liver cirrhosis due to hepatitis B underwent OLT and splenectomy on October 7, 2002. OLT was performed using the piggyback technique (5). Arterial reconstruction consisted of end-to-end anastomosis of the donor celiac axis Carrel patch to a recipient pseudo-Carrel patch of the hepatic artery at the takeoff of the gastroduodenal artery. Portal anastomosis was performed in an end-to-end fashion, and biliary reconstruction with a stented duct-to-duct anastomosis in an end-to-end fashion. A splenectomy was performed at the time of transplantation for splenomegaly because the enlarged spleen was compressing the transplanted liver. At postoperative days 2 and 3, two relaparotomies were performed to control intraperitoneal bleeding. Adequate blood flow to the liver graft was verified during the operations by Doppler ultrasonography performed by an experienced radiologist. The arterial flow through the anastomosis was 800 ml/min. The platelet count was less than 50,000/mm<sup>3</sup> before the bleeding episodes, however, it later increased to 750,000/mm<sup>3</sup>, presumably because of the splenectomy. Antiaggregant therapy, including aspirin, 300 mg/day, and pentoxifyllin, 2 × 400 mg/day, for thrombocytosis, was added to the hepatitis B recurrence prophylaxis (HBIG and Lamivudine). The immunosuppressive regimen consisted of *Tacrolimus* and steroid. The patient was discharged on postoperative day 20. The arterial flow on Doppler ultrasonography performed on postoperative day 45 was normal (800 ml/min).

The patient, who had remained free of rejection, presented with acute abdominal pain and fever of 38.5°C on postoperative day 53. Elevation in liver function tests was observed (GOT, 639 U/L, GPT, 344 U/L,  $\gamma$ -GT, 132 U/L, bilirubin, 6.7 mg/dl, platelet count, 325,000/mm<sup>3</sup>). A liver biopsy performed at the time of admission showed a hepatocellular, canalicular cholestasis, neutrophilic infiltration in the portal areas, and cholangiolitis.

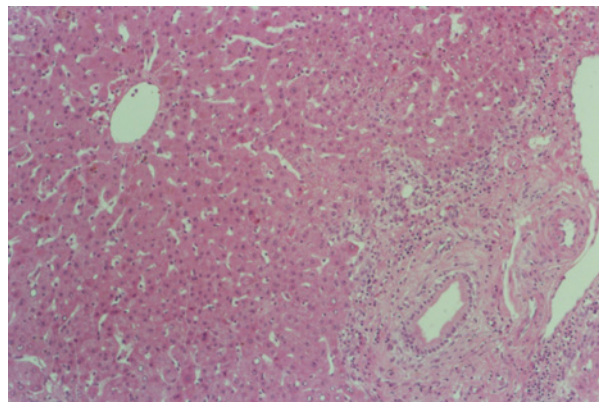


**Fig 1.** Selective angiogram of the celiac axis demonstrated thrombosis of the hepatic artery. Arrowhead, arteria gastrica sinistra; arrow, splenic artery.

The Doppler hepatic artery signal was absent and subsequent celiac angiography revealed that there was no arterial flow into the grafted liver. The appearance of the celiac axis, arteria gastrica sinistra, and arteria lienalis was normal (Figure 1).

The patient was prepared for urgent laparotomy. Although the liver looked normal, intraoperative Doppler ultrasonography did not detect intrahepatic arterial flow and the hepatic artery was found to be thrombosed without any specific etiology. The anastomosis was taken down and a clot was identified that extended into the recipient hepatic artery but not into the liver. Back-bleeding from the graft hepatic artery was obtained. Consideration was given to retransplantation, but no allografts were immediately available. We opted for a revascularization procedure because of the presence of back-bleeding from the graft hepatic artery and the normal appearance of the liver. The splenic artery was used because the recipient hepatic artery was thrombosed. Although splenectomy had been performed during the liver transplantation, the patient still had a large patent splenic artery. The splenic artery was not fully mobilized as would be needed for a primary anastomosis in order to reduce the risk of ischemic pancreatitis and pancreatic necrosis (6). Instead, we used a saphenous vein graft between the recipient splenic artery and the graft hepatic artery. The anastomoses were performed in end-to-end fashion on the graft side and an end-to-side fashion on the splenic artery side. A liver biopsy obtained after revascularization during the operation showed mild sentrilobular hepatocyte degeneration and nonspecific lymphocytic infiltration in the portal areas, indicating reperfusion to the liver. The liver histology was still preserved (Figure 2). Doppler ultrasonography performed intraoperatively to measure flow in the new graft showed normal flow (650 ml/min). Postoperatively the liver function tests normalized over 4 days.

The patient was treated with intravenous heparin and low molecular weight dextran for 7 days, followed by long-term low-dose aspirin. The heparin dosage was designed to achieve a partial thromboplastin time between 1.5 and 2.0 times baseline. Serum amylase levels were assayed daily during the first postoperative week and remained normal. Hepatic artery blood flow through the graft was confirmed daily for the first 7 days and later



**Fig 2.** A liver biopsy obtained after revascularization during the operation showed mild sentrilobular hepatocyte degeneration and nonspecific lymphocytic infiltration in the portal areas, indicating reperfusion to the liver. The liver histology was still preserved. (H&E; original magnification,  $\times 100$ .)

once a week for the first month by Doppler ultrasonography. The patient was discharged on postoperative day 25.

Fifteen days postrevascularization, the patient had pruritis, with an elevated alkaline phosphatase, GGT, and bilirubin. A liver biopsy showed canalicular cholestasis. These symptoms and laboratory findings resolved spontaneously within 2 weeks but recurred after 3 months. At this time MRCP and biliary scintigraphy revealed an extrahepatic biliary stricture. After three unsuccessful attempts of ERCP, a stented Roux-en-Y hepaticojejunostomy was performed 271 days from the revascularization.

The patient is alive 13.5 months after the revascularization operation performed for HAT. Patency of the hepatic artery was confirmed by selective splenic artery angiogram done on postoperative day 397 (Figure 3). There were no complications related



**Fig 3.** Selective angiogram of the splenic artery showing a well-functioning saphenous vein graft (between the two thin white arrows) between the recipient splenic artery (thick white arrow) and donor celiac axis (white arrowhead).

to the technique used for revascularization, and particularly, there was no pancreatic necrosis, chronic pancreatitis, chylous ascites, or re-HAT.

## DISCUSSION

HAT remains one of the most dreaded complications after OLT. Several series reported HAT in less than 10% of recipients, with higher rates for children (1, 2, 7). Conventionally described late HAT occurs at least 30 days following OLT and is a rare complication, with a rate of 1.7–4% (8, 9). In our case HAT was diagnosed on postoperative day 53 and is therefore considered late HAT.

In the incipient days of liver transplantation as many as 50% of HAT patients died without retransplantation (10). Those who did survive with HAT suffered significant morbidity, primarily related to problems of hepatic sepsis and biliary tree complications. Although retransplantation has been credited with reducing the mortality of HAT, the inadequate supply of donor organs has limited this option. While the feasibility of using urgent revascularization to avoid the need for retransplantation has been reported, this alternative strategy depends on early diagnosis. Urgent revascularization includes thrombectomy, intrahepatic thrombolysis with thrombolytic agents, and reestablishment of both the inflow and the arterial outflow (3).

In urgent revascularization, the recipient hepatic artery should not be reused because inadequate flow or other problems in this vessel often can contribute to re-HAT. The first choice is generally to base an interposition graft on the infrarenal or, occasionally, supraceliac recipient aorta (3). However, in urgent revascularization, dissection of the supraceliac aorta tends to be more difficult than that of the splenic artery due to previous surgical dissection and the depth of the field (6). Also, donor iliac artery graft may not be available in cases of late HAT, and the orientation of the aorta–iliac conduit when anastomosed to the infrarenal aorta together with the use of reconstructions involving multiple anastomoses significantly increases the risk of re-HAT (6, 11).

The use of the splenic artery for the arterial inflow in HAT has been previously described (12–14) and there have been several reports of transplant arterial reconstruction using a saphenous vein interposition graft (15, 16). A primary anastomosis between a donor celiac axis and the recipient splenic artery in an end-to-side fashion in a first OLT has been reported (17), however, in cases of urgent revascularization it is not possible to make the celiac axis of the donor reach the splenic artery of the recipient's without an interposition graft or turning of the splenic artery to the right. This is the first report of hepatic artery recon-

struction with interposition saphenous vein graft between the graft artery and the recipient splenic artery. Pathological studies have shown arterialization of the vein wall during the first month (18). The present report confirms the reliability of the saphenous vein for arterial reconstruction even in late HAT in liver transplantation.

One advantage of this technique is that isolation of the splenic artery requires minimal dissection. End-to-end anastomosis of the graft artery and recipient splenic artery without interposition graft could cause pancreatitis, pancreatic necrosis, and chylous ascites (6, 14, 18). For this reason end-to-side anastomosis between the splenic artery and the interposition saphenous vein was performed in the reported case to avoid the ligature of the splenic artery.

In our patient, the approach to the splenic artery did not pose any technical difficulty, but care was taken to avoid injury to the pancreas. The dissection and subsequent anastomosis are not difficult to perform in patients with the large splenic arteries that are frequently seen in posthepatitis cirrhosis. Contrary to the opinion of Ikegami *et al.* (19), the splenectomy that was performed previously did not make use of the splenic artery impossible. Also, thrombocytosis caused by splenectomy was probably not responsible for this late HAT because the platelet count was 325,000 /mm<sup>3</sup> when the HAT was diagnosed.

## CONCLUSION

To decide to reperfuse the liver instead of relisting the patient for retransplantation based on the fact that the liver histology was still preserved as in our case is the most important point regarding the patient's life because of the inadequate supply of donor organs. The technique of hepatic graft rearterialization for HAT reported here is an alternative to the use of an aortic interposition graft in patients with an inadequate native hepatic artery and may be useful in (1) patients with previous upper abdominal surgery, (2) patients with an anomalous native arterial supply, and (3) patients with disease of the abdominal aorta. In conclusion, we believe that anastomosis using the interposition saphenous vein between the graft artery and the splenic artery is a simplified alternative technique for arterial revascularization in cases of late HAT. The reported revascularization technique should be among the options for transplant surgeons performing urgent revascularization in patients with late HAT.

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