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Rescue for rare complications of the hepatic artery in living donor liver transplantation using grafts of autologous inferior mesenteric artery

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Abstract This report describes two rescued cases with rare complications of the hepatic artery in living-donor liver transplantation (LDLT). In both cases a segment of the autologous inferior mesenteric artery (IMA) was successfully used as an arterial graft for re-vascularization under microsurgery. The first case was that of a pseudoaneurysm of the hepatic artery, which caused massive gastrointestinal bleeding. The hepatic arteries of the pre- and post-aneurysm were divided, and the arterial graft from the recipient's IMA was interposed for reconstruction. The second case was that of an intimal dissection of the recipient's

hepatic artery. Because the dissection extended to the root of the common hepatic artery, the autologous IMA was interposed between the donor's hepatic artery and the proximal stump of the recipient's splenic artery. Reconstruction using the arterial graft of the autologous IMA is feasible for re-vascularization of the hepatic artery in liver transplantation.

Keywords Living-donor liver transplantation · Hepatic artery · Pseudoaneurysm · Intimal dissection · Microsurgery · Autologous IMA

Introduction

As hepatic artery thrombosis (HAT) in the early stage after liver transplantation is frequently fatal, urgent treatment such as re-transplantation or re-vascularization is essential. Especially in countries where brain-dead donors are scarce, graft salvage and patient survival depend on early recognition and correction of HAT. Therefore, early postoperative and repeated Doppler ultrasound surveillance is, clearly, important. Angiography is recommended where necessary. Surgical thrombectomy or reconstruction of the artery should be considered immediately in the case of HAT, especially in the early postoperative period. In such cases, vascular grafts are sometimes required. In previous reports, the autologous radial artery, sigmoid artery or saphenous vein, as well as the donor's iliac artery, were used as graft vessels [1, 2, 3]. There is no report, however, regarding the autologous inferior mesenteric artery (IMA).

Though pseudoaneurysm or intimal dissection of the recipient's artery is rare among hepatic arterial complications following liver transplantation, both conditions are as serious, if not more so, than thrombosis. In this report, we present two cases of rare complications of the hepatic artery, in which the autologous IMA was successfully used as an interposed graft for hepatic re-vascularization in living-donor liver transplantation (LDLT).

Case report

Case 1

A 49-year-old man underwent LDLT for familial amyloid polyneuropathy (FAP), with the right lobe graft taken from his daughter. The recipient's right hepatic artery (3.5 mm in outer diameter) was sutured with the

donor's right hepatic artery (3.0 mm in diameter) in an end-to-end fashion by microsurgery. The interrupted suture was performed with 8-0 Prolene. There were no complications during operation, and postoperative Doppler ultrasound showed good arterial flow. The patient recovered without any complications such as abdominal bleeding or bile leakage in the early period after transplantation.

Nineteen days after transplantation, he developed acute rejection and steroid pulse therapy was performed. On postoperative day 31, he suddenly went into shock due to massive gastrointestinal bleeding. An urgent endoscopic examination revealed a duodenal ulcer with active arterial bleeding. The ulcer was 1.8 cm in diameter and located in the posterior wall of the duodenal bulb. Endoscopic hemostasis was not successful. An emergency laparotomy was therefore performed. Oversewing the ulcer through duodenotomy controlled the bleeding. However, re-bleeding occurred 10 days later. On this occasion, emergency angiography was performed and revealed massive bleeding from the pseudoaneurysm located near the anastomotic site of the hepatic artery. Coil embolization of the aneurysm was performed through the celiac artery, and bleeding was successfully controlled.

Though temporary hemostasis was attained, intestinal bleeding occurred again 11 days later, and coil embolization was performed again (Fig. 1). Once more, hemostasis was achieved, but re-bleeding was a serious concern. Surgical repair of the aneurysm was quickly decided upon and performed on day 56, 4 days after the third episode of gastrointestinal bleeding. Severe adhesion between the hepatic artery and the duodenal wall was observed. It was suggested that the pseudoaneurysm existed inside the granulation in the adhesion. Both the proximal and distal ends of the aneurysm were dissected as long as possible. The artery was transected on both sides without touching the pseudoaneurysm itself. The proximal stump was fragile and considered too inadequate for the new anastomotic site. Therefore, an arterial graft, 3 cm in length, which was taken from the recipient's IMA, was interposed between the graft side hepatic artery and the recipient's gastroduodenal artery (Fig. 2). A segment of IMA was dissected and resected from the root to the first branching. Arterial suturing was performed again by microsurgery. Since this repair was carried out, adequate flow in the hepatic artery has been maintained, and no further gastrointestinal bleeding has occurred. The patient continues to do well 2 years after the operation.

Case 2

A 30-year-old woman suffering from autoimmune hepatitis underwent LDLT with the left hepatic lobe from her father. Splenectomy was performed at the transplant

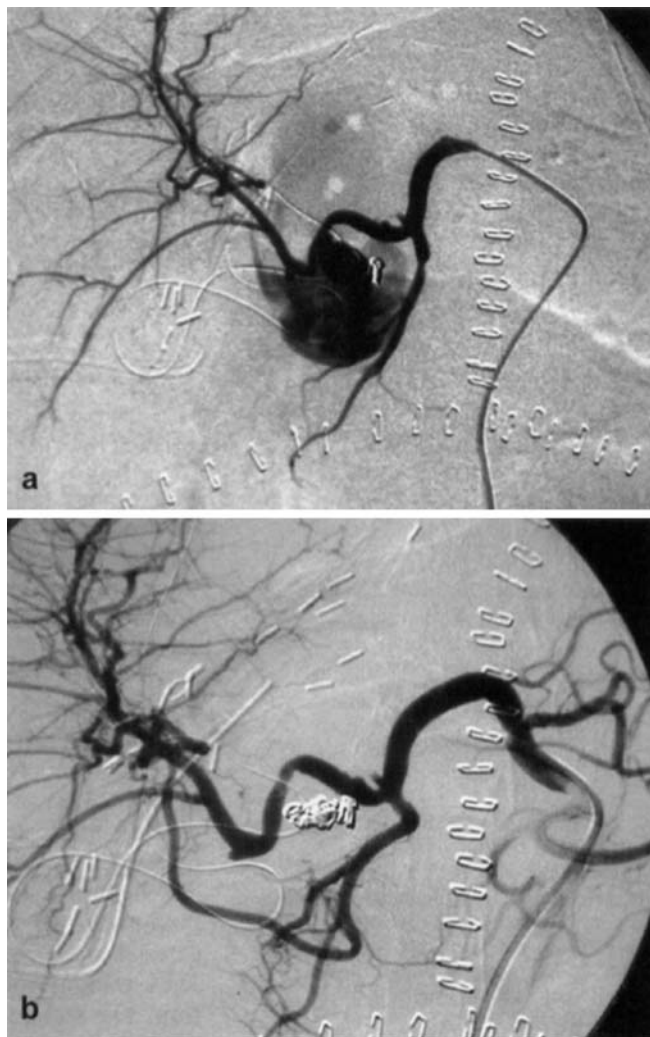
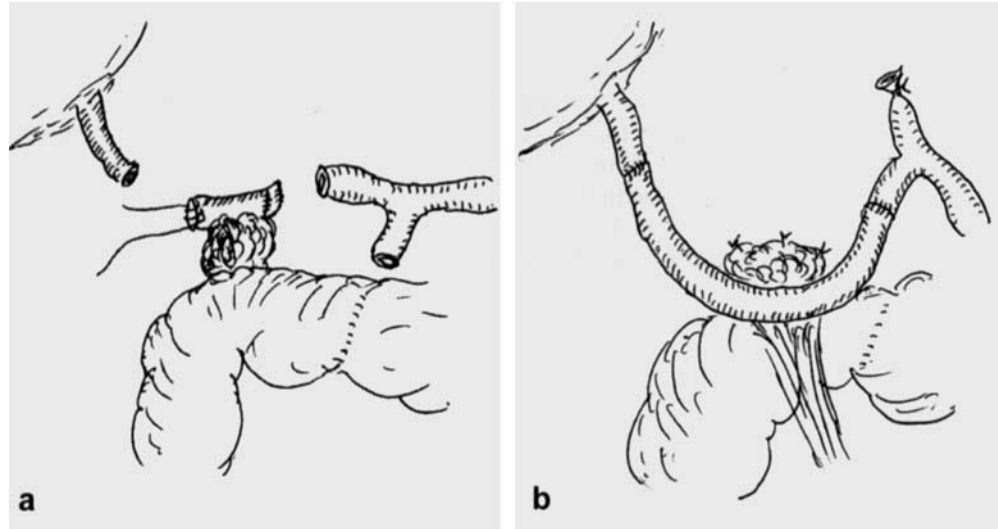


Fig. 1 Case 1: **a** celiac angiography on postoperative day 52. Bleeding from the pseudoaneurysm to the duodenal cavity is shown. **b** After coil embolization of the pseudoaneurysm

because the spleen was infected. The donor's left hepatic artery (3.0 mm in diameter) and the recipient's right hepatic artery (3.5 mm in diameter) were sutured in an end-to-end fashion. Though the intima of the stump of the recipient's right hepatic artery seemed to be partially peeled away from the wall, anastomosis was performed as usual after confirmation of a good outflow from the recipient side. However, the hepatic arterial signal suddenly disappeared on Doppler ultrasound 6 days after the transplantation. Emergency laparotomy was performed for reconstruction. Liver function tests were almost stable at the time, despite the inadequate flow in the hepatic artery. Intraoperative Doppler study demonstrated an arterial flow, but it was very unstable and depended on the position of the artery.

We cut the recipient's side of the anastomosis and found intermittent and poor flow from the stump.

Fig. 2a,b Case 1: schema of the reconstruction for hepatic artery pseudoaneurysm. **a** Arteries of pre- and post-aneurysm were cut and closed by continuous suturing. The gastroduodenal artery was dissected and divided for the anastomosis. **b** Autologous IMA was interposed between the donor's hepatic artery and the recipient's gastroduodenal artery. The aneurysm was covered by the omentum



Further examination revealed that continuous intimal dissection had developed in the arterial wall and extended to the root of the common hepatic artery. Therefore, we looked for the stump of the splenic artery and confirmed that its intima was intact and had sufficient arterial outflow. The previous anastomotic portion of the hepatic artery, in which no thrombosis was detected, was resected. An arterial graft of autologous IMA was retrieved as in the first case and interposed between the donor's hepatic artery and the recipient's splenic artery. The hepatic arterial flow recovered completely after surgery and was maintained until the patient died of sudden massive bleeding from an esophageal ulcer 11 months after transplantation.

Discussion

Pseudoaneurysm of the hepatic artery is a rare but life-threatening complication in liver transplantation. It has an incidence of less than 1%, and major clinical signs are gastrointestinal or abdominal bleeding [4]. The main cause of the pseudoaneurysm is a bacterial infection due to bile leaks, pancreatitis or other infections such as fungal infections. In case 1, no sign of infection was detected and the cause was unknown, though it might have been due to a technical problem in arterial anastomosis. Another possibility is that the deep duodenal ulcer that first developed could have injured the arterial wall and might have promoted the aneurysm. It has been proposed that the most appropriate treatment for pseudoaneurysm is embolization by angiography or ligation of the hepatic artery [5, 6]. However, ligation carries the prospect of extremely high morbidity and mortality, especially early after transplantation. Therefore, treatment by excision and immediate re-vascularization has been recommended by Bonham et al [7]. In

the present case, it was not very difficult to approach the hepatic artery near the aneurysm because there were no findings of infection. The pre- and post-aneurysm artery was dissected successfully, and the arterial graft of autologous IMA was interposed. In this case, because there was no infection, reconstruction of the artery seemed to be better than intervention therapy, even if the pseudoaneurysm itself could not be taken out.

Intimal dissection of the hepatic artery is also a rare complication in LDLT, and has seldom been reported [8]. This author personally experienced two cases, among 300 cases of LDLT (data were not published), in which the intimal dissection of the donor's hepatic artery occurred immediately after the anastomosis of the hepatic artery from an unknown cause. Once it occurred, it was almost impossible to restore the flow by any means, as the dissection continued to the artery branches inside the liver graft. In contrast, we have sometimes encountered an intimal deformity of the recipient's hepatic artery like a honeycomb in chronic liver disease. In such cases, the recipient's artery was repeatedly cut towards the root of celiac trunk until the normal wall appeared. In case 2, the anastomosis in the first operation might have been dealt with in another way if the orifice of the recipient's artery and the outflow had been observed more carefully or if pre-transplantation angiography had been performed to detect splanchnic artery stenosis [9].

Several arterial grafts for reconstruction of the hepatic artery in liver transplantation have been proposed. In the present study, the main branch of the IMA was dissected, and approximately 3.0 cm of the artery from the root to the first branch was retrieved. The blood flow in the descending colon was not compromised after retrieval of the IMA branch, and no complications related to this procedure were observed. This procedure is recommended because the approach is very easy and the

diameter of the IMA graft is similar to the hepatic artery.

All of the arterial anastomoses in the present study were performed by microsurgical techniques. Microsurgery in LDLT was introduced for small artery anastomosis, such as left lateral lobe transplantation in pediatric cases, and, as a consequence, the incidence of hepatic artery thrombosis has become very low [10]. Recently, anastomosis using a surgical loupe has been

revived in LDLT of right lobe grafts because of the relatively larger size of the arteries involved. It might have been possible to suture the arteries in the present cases using a surgical loupe. However, we still believe that anastomosis of the hepatic artery can be performed quickly and safely by experts using microsurgery, and that it is extremely beneficial to avoid critical complications of the hepatic artery in LDLT.

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