How to reduce and manage hepatic arterial complications in living and deceased donor liver transplantations

Emrah Otan[^], Sami Akbulut[^], Sezai Yilmaz[^]

Department of Surgery and Liver Transplant Institute, Inonu University Faculty of Medicine, Malatya, Turkey

Correspondence to: Sami Akbulut, MD, PhD, FACS. Department of Surgery and Liver Transplant Institute, Inonu University Faculty of Medicine, Elazig Yolu 10. Km, Malatya 44280, Turkey. Email: akbulutsami@gmail.com.

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Hepatic arterial complications include hepatic artery thrombosis (HAT), stenosis, and aneurysm. HAT may occur in the early as well as the late period. Late HAT has typically been associated with less severe complications and may even be asymptomatic. This article, focuses on HAT, which is more likely to occur in the early period after liver transplantation (LT).

Development of HAT in the early period after LT is one among the most severe complications. Generally, HAT appearing on one month after LT is also referred to as early hepatic artery thrombosis (eHAT). There has been a confusion regarding eHAT, with its timing range varying from 2 weeks to 100 days after LT (1-3), but these time parameters are largely arbitrary. There is essentially no clear answer regarding the question of up to which day surgical revascularization can be performed in the early posttransplant period when HAT develops. Although surgical revascularization attempts have been performed until the second month after LT (3), the success rate beyond the initial 5 days is poor. In our institution, this time limit is usually considered to be 1 week after LT. The clinical picture may be variable following the development of eHAT. Although an asymptomatic course is observed in a minority of cases, acute hepatic necrosis and death are common outcomes. The incidence of eHAT is between 0 and 20% with a median of 4.4% (1). Appropriate treatment of eHAT requires prompt diagnosis without delay. Our surveillance protocol for detecting of eHAT includes Doppler sonography twice a day, in addition to the initial 3 days after LT is performed, and then once a day for

1 week, as well as computed tomography (CT) angiography between 10 and 12 days. In the case of an abnormal Doppler sonography finding, CT angiography is performed for verification.

The most crucial treatments for eHAT are revascularization and retransplantation. The success of urgent revascularization depends on early diagnosis. Half of the early diagnosed cases generally succeed. Retransplantation is required for the remaining half of the cases following eHAT. Transplant surgeons should not take risks of a delayed retransplantation due to organ shortage, as the results of urgent revascularization are similar to those of retransplantation. Biliary complications may occur in the late period after an episode of eHAT despite successful revascularization of the arterial flow to the liver. One point of view emphasizes that immediate revascularization is associated with better outcome for cases diagnosed as asymptomatic on routine Doppler examination. Based on this, for eHAT cases diagnosed following progression of elevated liver enzymes or biliary sepsis after LT, retransplantation rather than revascularization should be recommended. Furthermore, this approach highlights the importance of early diagnosis of eHAT (4).

What follows below is a brief description of the revascularization technique. In reoperation, the absence of intrahepatic arterial flow should be first confirmed by Doppler sonography. The anastomosis between the donor and recipient arteries is disconnected, and the thrombotic mass is evacuated from the vessels. Fogarty catheter is mostly recommended for this evacuation process. However,

[^] ORCID: Emrah Otan, 0000-0003-4834-813X; Sami Akbulut, 0000-0002-6864-7711; Sezai Yilmaz, 0000-0002-8044-0297.

Figure 1 Hepatic artery thrombosis after LT. LT, liver transplantation.

Figure 2 Thrombectomy procedure with Watson-Cheyne probe.

we have often experienced the graft hepatic artery endothelium being removed with the Fogarty catheter, rendering the remaining procedure infeasible in terms of reanastomosis. Therefore, our recommendation is to clean the thrombus mechanically by passing the spatula side of the Watson-Cheyne probe behind the thrombus in the graft artery (*Figures 1,2*), even if it is a living donor liver graft. Then, by washing the graft artery generously with saline, the small thrombus fragments that cannot be cleaned with Watson-Cheyne probe can be removed. If no adequate back-bleeding is obtained from the side of the liver graft, saline with heparin can be injected into the graft hepatic artery. Very rarely, intraoperative conventional angiography may be required, and a more distal point where the thrombus has occluded the graft hepatic artery may be revealed. In these circumstances, the Fogarty catheter can be very gently inserted, without being overinflated, to the intrahepatic arterial bed to clear the thrombus point. New arterial anastomosis is performed after the shortening of the 2 arteries. If the anastomosis is to be performed in a tense manner, the alternatives to native recipient hepatic artery for reanastomosis are, in order of preference, splenic artery, interposition cryopreserved artery in between the graft and recipient arteries, and left gastric artery (5,6). Similar to the primary anastomosis, a reanastomosis is constructed with 8.0 or 9.0 monofilament interrupted sutures (with surgical loops with 8–8.5 amplification). The use of an aortic conduit is considered when these options are not possible for the recipient hepatic artery. Our preference is to provide graft arterialization using a cryopreserved or synthetic vascular graft from the infrarenal aorta. If the interposition cryopreserved vascular graft is preferred, the regularity of the endothelium of the cryopreserved vascular

homografts is critical for the patency of the anastomosis. Aortic anastomosis is constructed with 6/0 monofilament interrupted sutures.

In order to prevent hepatic arterial anastomosis complications, especially in living donor LT, surgical criteria, such as optimal venous drainage of the graft, no tight or excessive redundancy of the hepatic artery anastomosis, and satisfactory recipient hepatic artery diameter and flow, are required. In our own experience, a one-third diameter difference between the graft and recipient hepatic arteries is easily tolerated with adaptive sutures. It is important to perform the anastomosis with microsurgical methods, whether it is performed with an operative microscope or large-magnification surgical loops. As the use of large-magnification surgical loops has become more widespread, the disadvantages of using the operative microscope have become more apparent, and its use has begun to decline (7). The nonsurgical risk factors of donors and recipients are beyond the scope of this discussion.

Angioplasty and stenting at the site of the hepatic arterial anastomosis, intra-arterial thrombolysis with thrombolytic agents, and an endovascular approach by mechanical thromboaspiration of the hepatic artery using neurovascular devices have been used for treatment of eHAT with unsatisfactory outcomes. These treatment methods should never preclude surgical revascularization. The low success rate of retransplantation after eHAT is definitely related to the inability to perform the operation at the optimal time. Failure to respond in a timely manner to emergency deceased donor organ calls or delayed living donors increases the likelihood of sepsis, resulting in high mortality rates (8).

In conclusion, early detection, thrombectomy and

reanastomosis should be the first choice of treatment of eHAT after LT. When this fails, retransplantation should be performed.

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