Percutaneous Transarterial Stent Placement in a Transplant Liver Hepatic Artery Complicated by Angioplasty Balloon Rupture and Fragmentation

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Abstract

The incidence of posttransplant hepatic arterial stenosis (HAS) has been reported in 5 to 10% of orthotopic liver transplants and, left untreated, can lead to hepatic arterial thrombosis. Most vascular complications develop less than 3 months after initial transplant, with thrombosis representing over half of all complications. There has been a trend toward minimally invasive, endovascular techniques for treating HAS with angioplasty and stenting. In one review of endovascular therapies for HAS, primary technical success was achieved in 95% of the interventions. Complication rates following endovascular repair of HAS have been reported to be between 0 and 23% in the literature. The main risk factors for complications include tortuosity of the hepatic artery and history of a second liver transplant. Other associated risk factors include female gender, age greater than 60 years, prior history of transarterial chemoembolization, and multiple arterial graft anastomoses. The case presented here is representative of a complication of balloon rupture and fragmentation in a patient undergoing hepatic arterial stent placement post–liver transplant.

Keywords

- liver transplant
- arterial stent
- interventional radiology

A 61-year-old male with alcohol and hepatitis C–related cirrhosis suffered episodes of recurrent esophageal variceal bleeding and hepatic encephalopathy. The patient met UNOS transplant criteria and received a deceased donor liver transplant. The transplantation surgery was technically challenging and complicated, due to the patient's severe portal hypertension with multiple large varices requiring intraoperative ligation.

On postoperative day 1, the interventional radiology service was consulted regarding an abnormal posttransplant ultrasound which demonstrated *tardus parvus* waveforms and low resistive indices distal to the arterial anastomosis concerning for arterial stenosis. Due to a challenging transplant surgery, surgical revision was not offered and the patient was brought for diagnostic arteriography with possible angioplasty and stenting.

The initial angiograms demonstrated focal stenoses at the anastomosis of the recipient proper hepatic artery and donor

common hepatic artery, as well as distally within the donor proper hepatic artery (► **Fig. 1**). Stable access was achieved by placing an 8-Fr Flexor Raabe sheath (Cook Medical, Bloomington, IN) into the recipient common hepatic artery. The stenoses were then traversed with a Renegade microcatheter (Boston Scientific, Natick, MA) and Transcend microwire (Stryker, Kalamazoo, MI). Papaverine was administered intra-arterially and the patient was systemically heparinized throughout the procedure.

Angioplasty with a 4 mm × 2 cm Sterling monorail balloon (Boston Scientific) was performed across both stenoses resulting in restored patency to the proximal, anastomotic stenosis, but persistent narrowing at the distal stenosis (► **Fig. 2**). Following discussion with the transplant surgical team, a decision was made to deploy an endovascular stent across the recurrent distal stenosis. A 4 mm × 2 cm Rebel coronary stent on a monorail catheter (Boston Scientific) was deployed

Fig. 1 Initial proper hepatic angiography demonstrating a tortuous hepatic artery and focal stenoses at the anastomosis of the recipient proper hepatic artery and donor common hepatic artery (*solid arrow*) as well as within the donor proper hepatic artery (*dashed arrow*) just distal to the ligated donor gastroduodenal artery (*arrowhead*).

across the distal stenosis and dilated with a 4-mm angioplasty balloon using a 3-mL syringe (**Fig. 3**). Due to recoil of the stenosis in the midportion of the stent, the angioplasty balloon was reinflated. However, the angioplasty balloon ruptured, as evidenced by blood return on deflation. There was substantial resistance noted while attempting to retract the angioplasty

Fig. 3 A 4 mm $\times$ 2 cm Rebel coronary bare metal stent placed across the distal stenosis (*arrow*).

balloon catheter. The proximal two-thirds of the balloon were removed with the catheter; however, the distal third of the balloon was retained in the recipient proper hepatic artery just proximal to the anastomosis (**Fig. 4**).

Multiple attempts were made at retrieving the ruptured angioplasty balloon fragment with a 4-mm Amplatz right angle snare (Medtronic, Minneapolis, MN), which were unsuccessful. During one attempt, the snare device became entangled on a stent strut along its proximal portion. All attempts to free the snare were also unsuccessful including

Fig. 2 Following angioplasty with a 4 mm $\times$ 2 cm balloon, there is restored patency at the anastomosis between the recipient proper hepatic artery and the donor common hepatic artery (*solid arrow*) but refractory stenosis in the donor proper hepatic artery (*dashed arrow*).

Fig. 4 Hepatic arteriogram showing a filling defect (*arrow*), corresponding to the partially inflated retained distal third of the angioplasty balloon including its distal marker band in the recipient proper hepatic artery.

Fig. 5 Spot fluoroscopic image demonstrating the entangled snare and deformed stent (arrow).

upsizing the snare catheter, exchanging for a directional catheter, inflating a second balloon alongside, and pulling the snare among others. After these failed maneuvers, entanglement and gross deformity of the stent were noted (**► Fig. 5**). After additional discussion with the transplant surgery service, the decision was made to remove the balloon, stent, and entangled snare operatively the following day. At the conclusion of the case, there was preserved arterial flow into the liver in spite of the retained balloon fragment, entangled snare, and deformed stent (**► Fig. 6**). The snare was left in place inside the vascular sheath.

Intraoperatively the following day, an arteriotomy was made in the donor hepatic artery; the wire portion of the

Fig. 6 Hepatic arteriogram at the conclusion of the procedure with preserved arterial flow into the liver in spite of the retained balloon catheter fragment, retained entangled snare, and deformed stent.

snare was cut and removed from the groin; and the deformed stent, balloon catheter fragment, and snare were removed from the donor hepatic artery (**► Fig. 7**). The intima of the hepatic artery was noted to be severely damaged and a revision anastomosis was performed, excluding the redundant loop of hepatic artery containing both of the areas of narrowing. Ultrasound performed 1 day later demonstrated improved waveforms and resistive indices in the common, proper, and right hepatic arteries. A repeat ultrasound performed two and a half weeks later showed normal posttransplant arterial velocities and resistive indices. At 25 months posttransplant, the patient maintains normal liver function.

Discussion

The incidence of posttransplant hepatic arterial stenosis (HAS) has been reported in 5 to 10% of orthotopic liver transplants and, left untreated, can lead to hepatic arterial thrombosis.¹⁻³ Hepatic arterial thrombosis has been associated with early allograft failure and a 30 to 50% incidence of

Fig. 7 Intraoperative photographs. (a) Operative images demonstrating the entangled snare (white arrow) and deformed stent (white arrowhead). (b) The deformed stent (black arrow), fragmented balloon (black curved arrow), and entangled snare (black arrowhead) were successfully removed as a unit prior to revision of the arterial anastomosis.

eventual liver failure.⁴ Most vascular complications develop less than 3 months after initial transplant, with thrombosis representing over half of all complications.⁵

There has been a trend toward minimally invasive, endovascular techniques for treating HAS with angioplasty and stenting.^{2,6,7} In one review of endovascular therapies for HAS,¹ primary technical success was achieved in 95% of the interventions. Furthermore, the primary patency rate was 78% and overall primary assisted patency was 93% at 24 months postintervention.

Complication rates following endovascular repair of HAS have been reported to be between 0 and 23% in the literature.^{2,8–10} However, these comparisons are limited by the sample size of each study, the majority ranging between 20 and 40 patients. In the largest study to date, Goldsmith et al⁷ reported a reintervention rate of 27% in a total number of 99 patients. This included 22% of patients who initially received stent placement and 38% of patients who received angioplasty alone. Additionally, there were eight cases of major complications, five of which involved hepatic artery dissection and three involving rupture. Although none of these cases required surgical intervention, 50% of these patients developed arterial thrombosis and one patient required retransplantation. The main risk factors for complications included tortuosity of the hepatic artery as seen in this case and history of a second liver transplant. Other associated risk factors include female gender, age greater than 60 years, prior history of transarterial chemoembolization, and multiple arterial graft anastomoses.⁶

This case highlights the complexity and risks inherent to posttransplant intervention where attention to detail is truly paramount and underscores the importance of open communication with the surgical colleagues. Stenoses that become clinically evident in the very early posttransplant period are likely structural in etiology, and may require surgical revision. In this case, the surgical revision of the anastomosis was not possible due to the difficulty of the initial transplant procedure. While the first complication of the retained balloon catheter fragment was unfortunate in its own right, the problem quickly became much more complex when the snare became entangled in the stent,

demonstrating how further intervention can exacerbate the initial problem. Ultimately, there are times when minimally invasive methods and techniques cannot salvage a complication safely, and open and ongoing dialogue with the surgeons, as in this case, can result in the best outcome for the patient.

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