Cardiovasc Intervent Radiol (2012) 35:207–210
DOI 10.1007/s00270-011-0335-3

LETTER

Use of a Multilayered Stent for the Treatment of Hepatic Artery Pseudoaneurysm After Liver Transplantation

Ahmed M. Elsharkawy · Gourab Sen · Ralph Jackson · Robin Williams · John Rose · Mark Hudson · Steven Masson · Derek M. Manas

Published online: 28 December 2011

To the Editor:

We would like to use this opportunity to share with the wider clinical community our experience in managing a hepatic artery pseudoaneurysm (HAP) of a 59-year-old man after liver transplant using a multilayered stent. HAP is a rare but well-recognised complication occurring after orthotopic liver transplantation (OLT). The reported incidence is 0.3% to 2.6% [1, 2]. The majority of cases of HAP occurring after OLT arise in the context of endovascular intervention or secondary to diathermy injury to the artery during surgery [3]. They have also been reported to complicate other hepato-pancreatico-biliary surgical procedures [4]. With time, the natural history of HAP is of enlargement and an associated risk of rupture, which can be fatal [5]. Patients most commonly present with intraperitoneal bleeding or gastrointestinal haemorrhage secondary to haemobilia; however, incidental and asymptomatic HAP may be recognised [6]. Established management options include surgical ligation and endovascular coil embolisation; however, both of these methods are associated with a significant risk of hepatic ischaemia, which often requires retransplantation [5]. Coronary artery stent-grafts have also been used to treat HAP, often after failure of coil embolisation [7].

The introduction of the Multilayer Aneurysm Repair System (MARS) stent (Cardiatis SA, Belgium) is a recent development in endovascular aneurysm repair. This is an uncovered stent comprised of three-dimensional braided tubing that decreases blood flow velocity in the aneurysmal sac whilst improving laminar blood flow in the main artery and surrounding arterial tributaries [8]. Its use for the treatment of HAP occurring after OLT has not previously been reported.

Our case involves a 59 year-old man who underwent OLT for alcoholic cirrhosis in January 2011. The patient's main indication for OLT was recurrent ascites. A transjugular intrahepatic portosystemic shunt was inserted in November 2010 before emergency surgical repair of a ruptured umbilical hernia. He was transplanted in early January 2011. He received a whole liver from a 74-year-old brainstem-dead donor who was involved in a road-traffic accident. His hepatectomy was performed whilst he was on veno-venous bypass and was uncomplicated. The implantation included a cavocavostomy, end-to-end pulmonary vein anastomosis using 5.0 Prolene (Ethicon, UK) suture material, end-to-end arterial anastomosis to the common hepatic artery using 6.0 Prolene (Ethicon, UK) suture material, and duct-to-duct biliary anastomosis using 5.0 polydioxanone (Ethicon, UK) suture material. The cold ischaemic time was 12 h and 40 min. During surgery, he received 4 U of blood, 1 pool of platelets, and 6 U of fresh frozen plasma. His postoperative recovery was complicated by mild acute cellular rejection on day 10, which required augmentation with intravenous methylprednisolone. He was discharged home on day 16. His immunosuppression medication included tacrolimus, azathioprine, and prednisolone. Because he was a cytomegalovirus mismatch, vanganciclovir was given for 100 days.

At 3 months after OLT, the patient was admitted to our hospital for investigation of graft dysfunction. Liver histology showed evidence of perivenular haemorrhage and

A. M. Elsharkawy (✉) · G. Sen · M. Hudson · S. Masson · D. M. Manas
Liver Unit, Freeman Hospital, Freeman Road, Newcastle Upon Tyne NE7 7DN, UK
e-mail: ahmede@doctors.org.uk

R. Jackson · R. Williams · J. Rose
Department of Interventional Radiology, Freeman Hospital, Newcastle Upon Tyne NE7 7DN, UK

congestion with atrophy of the liver cell plates, indicative of vascular compromise. There was no evidence of cellular rejection. Hepatic angiography showed a 1- to 2-cm pseudoaneurysm arising directly from the transplant artery just proximal to the bifurcation, and this was causing significant compression of the adjacent right and left hepatic artery origins (Fig. 1). The transplant artery itself was slightly tortuous between the aneurysm and the graft anastomosis. The lumen of the pseudoaneurysm measured 12 mm in maximum diameter on computed tomography angiography (CTA), which was performed to further characterise the arterial anatomy. Doppler ultrasound (US) confirmed the presence of a hepatic artery stenosis at the site of the HAP, and dampened arterial waveforms were evident (Fig. 2A).

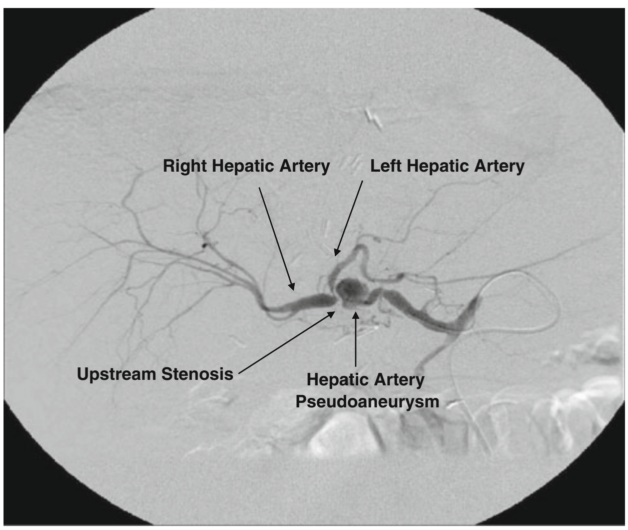

Fig. 1 Subtraction digital mesenteric angiogram through the coeliac axis shows the hepatic artery aneurysm with upstream stenosis of the common hepatic artery and subsequently decreased blood flow in the right and left hepatic artery branches

Given the proximity of the HAP to the liver hilum, surgical repair was believed not to be technically feasible. There was also concern that endovascular repair using a conventional covered stent would result in loss of blood flow into the left hepatic artery and risk hepatic ischaemia. Having recently become aware of the utility of the MARS stents in other cases of endovascular aneurysm repair, we believed this would provide an ideal solution. We planned to deploy a MARS stent across the HAP to try to maintain blood flow in both the left and right hepatic arteries whilst relieving compression of the common hepatic artery and preventing blood flow into the HAP.

At the time of endovascular intervention, the sheath was placed in the common hepatic artery, and the hepatic artery stenosis/HAP was crossed with a microcatheter. This was then exchanged for a 300-cm, 0.014″ wire, and the stenosis was predilated to 3 mm to allow a 30 × 6–mm MARS stent to be placed from the native hepatic artery into the transplant right hepatic artery. This treated the stenosis, maintained patency of the left hepatic artery, and excluded the false aneurysm (Fig. 3). Repeat Doppler US of the hepatic artery showed normal arterial waveforms after stent insertion (Fig. 2B). The patient was discharged the next day, and CTA performed 2 weeks after intervention demonstrated good arterial blood flow to both lobes of the liver as well as a thrombosed pseudoaneurysm (Fig. 4). After intervention, the patient's liver function improved to normal. Eight months later he remains clinically well.

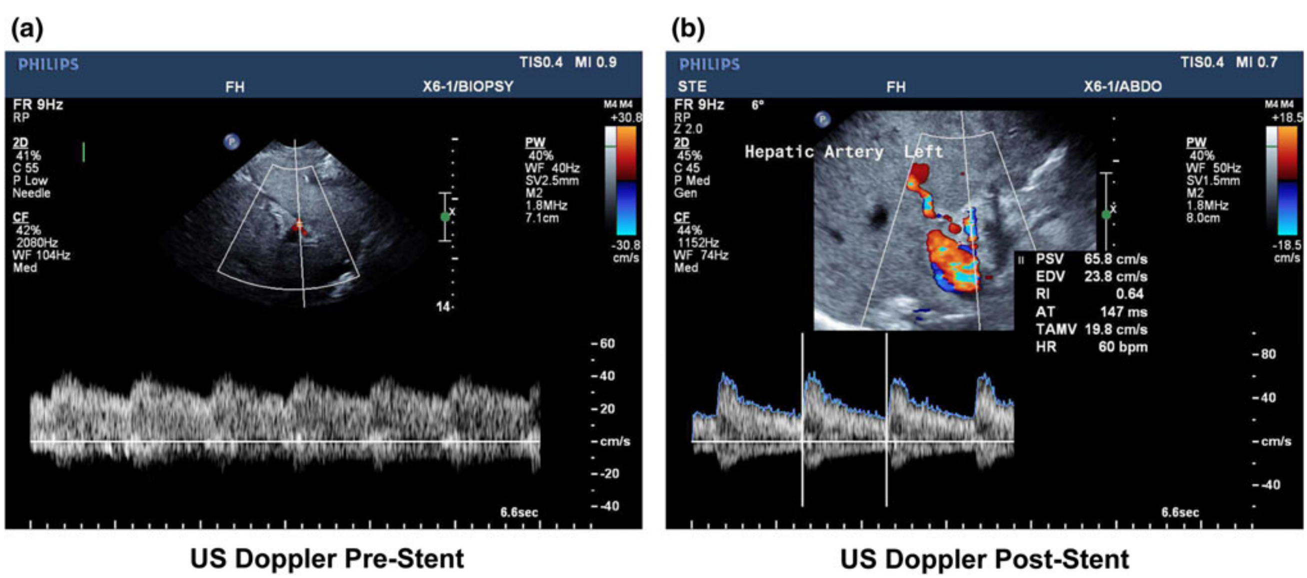

Fig. 2 **A** Doppler US of the HAP before stent insertion demonstrates dampened waveforms consistent with significant stenosis secondary to the HAP. **B** Doppler US after stent insertion demonstrates relief of the stenosis and normal arterial waveforms

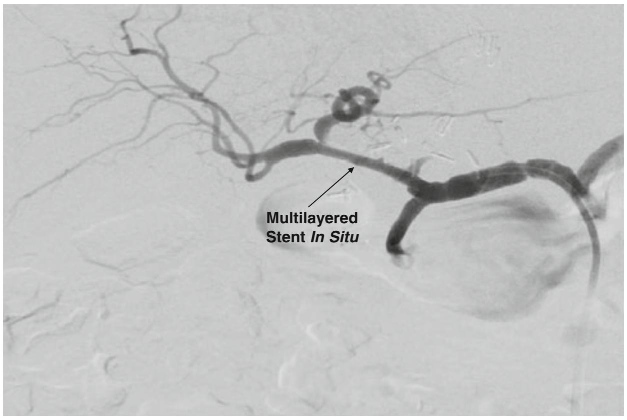

Fig. 3 Mesenteric angiogram immediately after insertion of the Cardiatis MARS stent. Note that the stenosis has resolved whilst blood flow to the right and left hepatic arteries is maintained. There is no longer any blood flow into the pseudoaneursymal sac

Fig. 4 CT angiogram of the Cardiatis MARS stent 2 weeks after insertion demonstrates blood flow through the stent with no filling of the hepatic artery pseudoaneurysm

HAPs are a relatively rare complication of OLT. In the largest reported series from Gothenburg in Sweden, 12 (1.34%) patients comprising a total of 825 transplants performed between 1995 and 2005 developed HAP [2]. In this series, 10 patients had positive microbiological cultures, suggesting that HAP may arise as a result of mycotic infiltration of the vascular wall; however, direct surgical trauma is also thought to be directly causative. Here, we described the management of HAP associated with stenosis of the upstream common hepatic artery resulting in relative ischaemia and graft dysfunction. This is a novel approach because we used an uncovered MARS stent to decrease blood flow into the HAP sac whilst also relieving the stenosis induced by the pseudoaneurysm. In addition, we managed to maintain blood flow into both branches of the hepatic artery. Deployment of a conventional covered stent in this area would, in our opinion, have led to compromise of the blood flow in the left hepatic artery with consequent ischaemia of the left liver and the potential requirement for retransplantation.

MARS stents are low-profile, uncovered, self-expandable stents with interconnected layers [8]. These layers are formed from interconnected cobalt alloy wires. They work in principle by controlling the vortex blood flow through an aneurysm whilst maintaining laminar blood flow in collaterals arising from the aneurysm and maintaining blood flow in side branches. This decrease in vortex blood flow in the aneurysm initiates thrombus formation (as in our case) with a subsequently decreased risk of bleeding.

Two reports in the literature have described use of the MARS stent for the treatment of hepatic artery aneurysm. The first, from Balderi et al., described the treatment of a 74-year-old man with an incidental 85-mm hepatic artery aneurysm that was detected on US for bladder symptoms [9]. The investigators deployed an 8 × 60–mm MARS stent across the aneurysm as well as the splenic, gastroduodenal, and left hepatic arteries. Subsequent angiography demonstrated decreased blood flow in the aneurysmal sac whilst blood flow to the aforementioned arteries was preserved. The second report, by Ruffino and Rabbia, describes use of the MARS stent in five patients with hepatic artery aneurysms [10]. To our knowledge, ours is the first report of the use of this stent to treat pseudoaneurysms of the hepatic artery and the first report in the setting of a liver transplant. We believe this stent provides an important addition to the interventional radiology armamentarium for dealing with vascular complications occurring after OLT.

References

1. Marshall MM, Muiesan P, Srinivasan P et al (2001) Hepatic artery pseudoaneurysms following liver transplantation: Incidence, presenting features and management. Clin Radiol 56(7): 579–587
2. Fistouris J, Herlenius G, Backman L et al (2006) Pseudoaneurysm of the hepatic artery following liver transplantation. Transplant Proc 38(8):2679–2682
3. Turrion VS, Alvira LG, Jimenez M et al (2002) Incidence and results of arterial complications in liver transplantation: Experience in a series of 400 transplants. Transplant Proc 34(1):292–293
4. Christensen T, Matsuoka L, Heestand G et al (2006) Iatrogenic pseudoaneurysms of the extrahepatic arterial vasculature: Management and outcome. HPB (Oxford) 8(6):458–464
5. Tulsyan N, Kashyap VS, Greenberg RK et al (2007) The endovascular management of visceral artery aneurysms and pseudoaneurysms. J Vasc Surg 45(2):276–283
6. Maleux G, Pirenne J, Aerts R et al (2005) Case report: Hepatic artery pseudoaneurysm after liver transplantation: Definitive treatment with a stent-graft after failed coil embolisation. Br J Radiol 78(929):453–456

7. Millonig G, Graziadei IW, Waldenberger P et al (2004) Percutaneous management of a hepatic artery aneurysm: Bleeding after liver transplantation. Cardiovasc Intervent Radiol 27(5):525–528
8. Meyer C, Verrel F, Weyer G et al (2011) Endovascular management of complex renal artery aneurysms using the multilayer stent. Cardiovasc Intervent Radiol 34(3):637–641
9. Balderi A, Antonietti A, Pedrazzini F et al (2010) Treatment of a hepatic artery aneurysm by endovascular exclusion using the multilayer cardiatis stent. Cardiovasc Intervent Radiol 33(6): 1282–1286
10. Ruffino M, Rabbia C (2011) Endovascular treatment of visceral artery aneurysms with Cardiatis multilayer flow modulator: Preliminary results at six-month follow-up. J Cardiovasc Surg (Torino) 52(3):311–321