Endovascular repair of a celiac trunk aneurysm with a new multilayer stent

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Operative treatment of celiac trunk aneurysms has traditionally involved open repair using simple ligation, interposition graft, resection, and direct repair or antegrade bypass from the aorta; recently, endovascular techniques have been proposed in selected cases. We report a 60-year-old man presenting with a celiac trunk aneurysm that we treated with a new multilayer stent with the aim of preserving the parent vessels arising from the aneurysm. Computed tomography angiography at the 12-month follow-up visit confirmed the patency of the stents, the complete thrombosis of the sac without impairment of the main branches, and the regular perfusion of the liver and spleen. (J Vasc Surg 2011;54:1148-50.)

The type of treatment for visceral artery aneurysms (VAAs) generally has been related to the aneurysm location, the surgeon's experience, and whether the intervention was an emergency or elective procedure.[1] More recently, the increased detection of asymptomatic VAAs, coupled with the advancements in endovascular techniques, has influenced the review of the indications and treatment options for different types of these aneurysms.[2,3] Despite the intuitive advantages of endovascular procedures, the uncertainty about the durability and the need to perform secondary procedures to obtain a complete technical success have resulted in uncertainty about their effectiveness in the treatment of VAAs.[4]

In particular, the major technical difficulties of a conventional endovascular approach in celiac artery aneurysms (CAAs) has always been the inability to completely preserve the collateral vessels.[1,5] The recent advent of a new, self-expandable stent has extended the therapeutic possibilities for treatment of aneurysms involving the celiac trunk as collateral branches. We present the case of a CAA treated with this new multilayer self-expanding stent.

CASE REPORT

The patient is a 60-year-old man with an asymptomatic CAA that was discovered incidentally during a follow-up computed tomography (CT) scan of an uncomplicated pancreatic cyst. His medical history was notable for hypertension, dyslipidemia, ankylosing spondylitis, and diabetes. The contrast-enhanced CT scan (Aquilion 64, Toshiba Medical Systems, Tokyo, Japan) confirmed the presence of a 34- × 14-mm CAA involving the origin of the common hepatic artery and the splenic artery (Fig 1). The diameter ratio to the parent vessel was 2.5. No further aneurysm localization was identified.

The patient refused open surgical repair. Therefore, we used a new self-expanding multilayer FluidSmart 3D (Cardiatis, Isnes, Belgium) stent. The structure of this stent consists of multiple layers of cobalt that are interconnected to develop 3-dimensional (3D) geometric structures that control the vortex velocity into the sac and improve the laminar flow into the collaterals. The multilayer structure has the effect of slowing and reducing the power of the vortex. In addition, mathematical and in vitro studies have showed that the stent structure could align the trajectories of the vortices. The slowing of vortices and their alignment creates a filling that induces thrombosis.

The procedure was performed in the angiography suite. Local anesthesia was administered, and a selective celiac trunk angiography was performed through a standard percutaneous right transfemoral puncture. The celiac trunk was catheterized selectively with a 7F hockey-stick guiding catheter (Cordis, Johnson & Johnson, Warren, NJ) and then crossed with a 0.035-inch Radiofocus guidewire (Terumo, Somerset, NJ) into the splenic artery. The hydrophilic wire was changed with a 0.014-inch Stabilizer stiff guidewire (Cordis), and two FluidSmart 3D multilayer stents (8 mm × 6 cm and 7 mm × 6 cm) were deployed in the celiac trunk and in the splenic artery. The final angiography showed blood flow inside the aneurysm sac was reduced and that all collateral vessels were patent.

The patient's postoperative course was uneventful, and splanchnic enzyme levels did not change from basal levels. The patient was discharged on day 4 with lifelong clopidogrel (75 mg) therapy (Plavix-Bristol-Myers Squibb/Sanofi Pharmaceuticals, New York, NY). During the follow-up, contrast-enhanced CT scans were obtained at 3 and 12 months, when he was asymptomatic. The CT angiography (CTA) showed the patency of the stents without signs of restenosis or myointimal hyperplasia, the complete thrombosis of the sac, and direct perfusion of the liver and spleen (Fig 2). No endotension was observed.

DISCUSSION

Recent reports have documented results of the operative management of VAAs; however, CAAs have been

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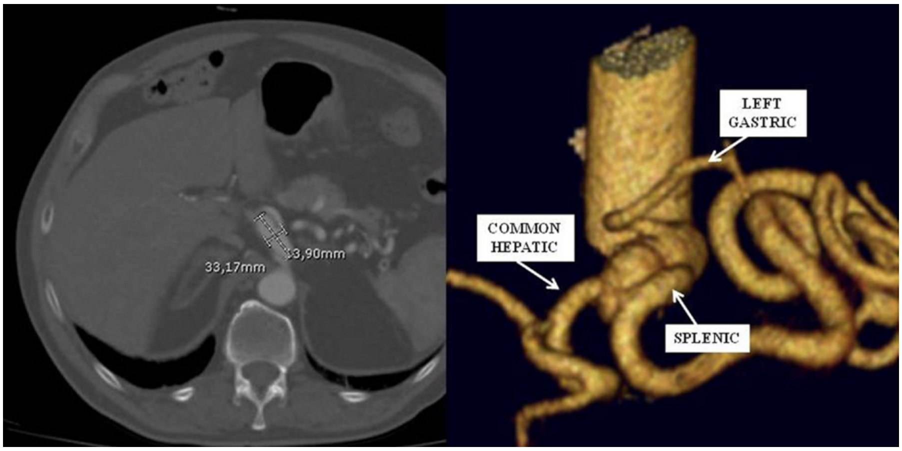

Fig 1. Computed tomography angiography of the celiac aneurysm with 3-dimensional reconstruction shows **(Left)** the fusiform shape of the sac with its relative sizing and **(Right)** the origin of the parent vessels directly from the aneurysm.

Fig 2. Left, Computed tomography angiography image 12 months after the procedure shows the patency of the stents and of the parent vessels (*arrows* show the common hepatic artery). **Middle and Right,** Volume-rendered reconstructions highlight the patency of the hepatic artery.

described more rarely, and therefore, agreement on their management is far from definitive.[1,2,6] The expert consensus suggests that asymptomatic CAAs should be repaired if the diameter is >20 mm or the diameter ratio to the parent vessels is >2 mm to avoid the high morbidity and mortality rates reported for ruptured aneurysms.[1,4,6-8] The type of treatment should be determined by the aneurysm location, the surgeon's experience, and whether the clinical situation is urgent or an emergency. Conventional interventions include aneurysmectomy, aneurysmorrhaphy, graft interposition, or simple ligation, but these operations carry a mortality rate of up to 5% for elective repair.[2,9] More recently, advancements of the endovascular techniques have led to a review of the indications for the operative repair of these aneurysms, as well as the treatment options.[2]

Nevertheless, long-term durability and the frequent need for secondary interventions are still major drawbacks of these procedures. In particular, considering CAAs, traditional endovascular exclusion has been troubled by the potential risk of ischemic complication due to the difficulties in saving collateral vessels. In fact, most of the endovascular reports have described embolization techniques, whereas few articles have described stent graft implantation to try to preserve direct organ perfusion.[10-13] However, these two types of intervention do not guarantee the perfusion preservation of collateral vessels; hence, endovascular treatment of a wide-necked large aneurysm involving major arterial branches might seem risky.

We note that a recent report from Waldenberger et al[14] mitigated these concerns. They reported 10 cases of direct overstenting or coil embolization of the CAA during thoracic endografting, without major technique-related complications. They concluded that the many side collaterals, especially from the gastric and pancreaticoduodenal arteries, could support the celiac artery territory and that portal vein or superior mesenteric artery occlusions are the only exclusion criteria that need to be taken into account.[14-16]

The recent advent of a new type of stent has offered a potential endovascular alternative to manage CAAs involving one or more collateral vessels, thus potentially avoiding these concerns. The Cardiatis stent has been available in Europe since 2006, and the first successful use in humans was reported for a popliteal aneurysm in 2007. The main advantage of the 3D multilayer stent is that it reduces flow velocity and vortex into the sac, while improving laminar flow in the main artery and the surrounding vital branches. All of these characteristics may help to reduce the shear stresses on the diseased arterial wall and increase the formation of an organized thrombus.[14,15]

In a previous report,[16] we described a "reversed" version of the technique initially reported by Basile et al.[15] We decided to implant the stents into the celiac-splenic artery, exploiting the patency of the portal vein and the superior mesenteric artery. The liver can well bear a potential occlusion of the hepatic artery, provided that the portal vein is open and no arterial obstructive disease synchronously has affected the superior mesenteric artery, as was observed in this patient. Moreover in that situation, a thrombosis at the origin of the splenic artery could be less well tolerated and could have had the potential to cause pancreatic ischemic damage in combination with a massive splenic infarction.

CONCLUSIONS

To date, only two cases of VAAs treated with this new stent have been reported. Henry et al[17] first reported the successful exclusion of a large renal aneurysm and also suggested its application for peripheral aneurysms, and Balderi et al[18] excluded a huge hepatic aneurysm. Our experience also supports the promising performance of this new device for the visceral vessels. The only weakness in the procedure we encountered was related to the important shortening of the stent during the deployment—nearly 50% of its original length—which is why we were forced to use two stents to optimize the sealing of the aneurysm. We believe this new technology could be a very useful and attractive alternative technology to surgery or other endovascular techniques for those CAAs involving or very close to major branch vessels.

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