Case Report

Successful stenting to superior mesenteric artery (SMA) after endovascular aneurysm repair (EVAR) of abdominal aorta

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Summary
A 70-year-old man complained of abdominal angina after endovascular aneurysm repair (EVAR). He had a history of successful treatment of abdominal aortic aneurysm with Zenith endovascular graft 12 months prior to the index abdominal symptoms. The endovascular graft had been placed with special attention for keeping blood flow of major abdominal branches to the intestine. However, both duplex sonographic study and enhanced computed tomography (CT) revealed a critical stenosis at the ostium of the superior mesenteric artery (SMA). The limited intestinal blood flow seemed to be a cause of his symptoms. Palmatz stent was selected to dilate the stenosis. A right trans-femoral artery approach was selected to avoid interaction with the Zenith stent graft because it was landed at the left external iliac artery. There was no difficulty in passing of the stent through the uncovered Z-stent area at the proximal end of the graft. Three-dimensional-CT image was useful for the precise ostial stenting. In treatment of SMA ostial stenosis after EVAR, percutaneous trans-catheter treatment with stent could be a feasible and effective strategy to be considered.

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Introduction

Of many etiologies involving the pathophysiology of abdominal pain, mesenteric ischemia, even if it is rare, should be carefully considered because of its serious clinical con-sequences. The cause of mesenteric ischemia has been classified as either mechanical or non-mechanical obstruction [1].

A surgical aneurysm repair is a mechanical solution to the problem of progressive expansion of abdominal aortic aneurysm and the risk of rupture. Recently, endovascular aneurysm repair (EVAR) was developed to reduce the risks associated with open surgery. However, in nearly 10% of procedures, ischemic complications due to mechanical obstruction, thrombosis and embolism have been reported [2].
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Figure 1  (a) The three-dimensional construction of computed tomography angiography demonstrated abdominal aortic aneurysm and aneurysm of the left common iliac artery. The abdominal aneurysm was 4.5 cm in diameter and increased 0.5 cm within the previous six months. The inferior mesenteric artery was occluded and collateral flow from the superior mesenteric artery was documented (A-P view). (b) Results of endovascular stent graft repair. Under general anesthesia, Zenith TFB30-88 type endograft was delivered. The molding balloon used to seal all anastomotic sites along the stent (A-P view). (c) Angiogram after the completion of the stent graft implantation. The long contra-lateral extension piece was landed at mid portion of the left external iliac artery after the coil embolization of left internal iliac artery. No leakage of blood into the aneurysm was observed (A-P view).

Figure 2  At pre-endovascular aneurysm repair image, there was 50% stenosis in the celiac axis (CA) and the superior mesenteric artery (SMA) (a). At the completion of stent graft implantation, the endograft was correctly placed and the aneurysm was excluded from the circulation. There was no significant change in the degree of stenosis in both the CA and the SMA (b). At 12-month follow-up, the stenosis of the SMA progressed to 99% (c).
In this report, we present a case of successful percutaneous trans-catheter treatment of chronic mesenteric ischemia induced by EVAR for the abdominal aorta.

Case report

A 70-year-old man presented himself to the division of cardiology of the Saiseikai Kumamoto Hospital Cardiovascular Center because of recurrent abdominal pain. He had a history of successful treatment of abdominal aortic aneurysm with Zenith endovascular graft 12 months prior to the index abdominal symptoms (Fig. 1). The endovascular graft had been placed with special attention for keeping blood flow of branches. The proximal end of the covered portion was placed just beneath the left renal artery. Both of the renal arteries and the superior mesenteric artery (SMA) were originated from the abdominal aorta at the uncovered Z-stent area of Zenith stent graft. A duplex sonographic study revealed an acceleration flow at the ostium of the SMA and the celiac axis (CA). An enhanced three-dimensional computed tomography (3D-CT) was performed and the severe stenoses of the SMA and the CA were clearly documented (Fig. 2). The CA stenosis was recognized immediately after EVAR, however, no significant progression was observed during 12 months. On the other hand, the SMA stenosis progressed significantly.

He was admitted to our ward and underwent an abdominal angiography. A 5.2-Fr. Judkins right 4.0 (Unite, JR4.0, Asahi Intec, Aichi, Japan) catheter was cannulated into the SMA selectively. The angiogram showed a 90% stenosis at the ostium of the SMA and the pressure gradient was not evaluated because the catheter was wedged at the stenosis site. These findings proved the stenosis to be severe enough.

Figure 3  Procedures of percutaneous transluminal angioplasty with a stent shown in left anterior oblique projection. Selective angiography revealed a 90% stenosis at the ostium of the superior mesenteric artery (SMA). The SMA arose at the level of the uncovered Z-stent area at its proximal end (a). A 5.0–20 mm balloon was used to treat the stenosis of the SMA (b). After the balloon angioplasty, a 6.0–10 mm Palmatz stent was placed at the lesion. The lesion was successfully dilated and residual stenosis was not observed. The pressure gradient between the SMA and abdominal aorta was completely eliminated (c).
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for inducing the abdominal angina. His symptoms seemed to become apparent because of the reduced collateral flow due to the co-existing CA stenosis. Thus, we planned to perform angioplasty of the SMA to relieve his abdominal angina.

A right trans-femoral artery approach was selected to avoid interaction with the Zenith stent graft because it was landed at the left external iliac artery (Fig. 3). At first, a 0.035 in. guide wire (Radifocus, angled 300 cm, Terumo, Tokyo, Japan) was inserted into the SMA through 5.2-Fr size Judkins right 4.0 diagnostic catheter. Then, a 8-Fr size RDC1 type guiding catheter (Mach1, Boston Scientific, Natick, MA, USA) was gently placed at the SMA with a support of the diagnostic catheter as a daughter catheter because of the following two reasons. First, as the ostial stenosis of the SMA might be a result of serial atherosclerotic change like abdominal aorta, avoiding the ostial injury with a down-sized catheter seemed to be important. Second, the proximal end of the endograft has barbs or hooks to achieve appropriate fixation and prevent device migration. A direct maneuver with a large guiding catheter might cause a vascular injury due to migration of endograft, and therefore, we thought a 5.2-Fr daughter catheter was necessary. A 5.0 mm diameter balloon catheter (Fox Plus PTA balloon, Abbott Vascular, Dublin, Ireland) was inflated at the stenotic site of the SMA. Then a 6.0—10 mm balloon expandable stent (Palmatz stent, Cordis Endovascular Systems, Miami Lakes, FL, USA) was carefully implanted at the ostium of the SMA. There was no difficulty in passing of the stent (the uncovered Z-stent area) at the proximal end of the stent graft system. The balloon expandable stent was selected because it enabled us to make precise placement of the stent at the ostium of the SMA. The lesion was successfully dilated and the pathological constriction was completely eliminated. During the procedure, no abdominal pain was documented, and no SMA flow disturbance was observed. The clinical course after SMA stenting was favorable and his abdominal angina was completely relieved. Dual antiplatelet therapy of ticlopidine 200 mg daily and aspirin 100 mg daily had been started 2 weeks prior to the stenting and was planned to be continued indefinitely after the procedure.

Discussion

Chronic mesenteric ischemia has been referred to as intestinal angina. Patients usually complain of postprandial gastric pain within the first hour postprandial phase. Clinical manifestations are due to insufficient visceral blood flow during the periods of heightened intestinal demands [1]. However, the presence of mesenteric artery stenosis, per se, does not mean mesenteric ischemia. Wilson et al. reported that up to 18% of people over 65 years old in the general population have significant stenosis of the celiac artery or SMA without symptoms [3], since the CA and SMA communicate principally through the junction of the superior and inferior pancreaticoduodenal arteries. Like this major collateral system, the visceral circulation is characterized by a vast network of collateral blood vessels, resulting in substantial protection from ischemia in the setting of segmental vascular occlusion.

In our case, the stenoses of both CA and SMA were documented. In addition, the inferior mesenteric artery (IMA) was occluded by abdominal aortic aneurysm, and filled with the collateral artery from the SMA. The maximum diameter of abdominal aorta at the SMA level showed no significant change between pre-EVAR (26.4 mm), immediately after EVAR (26.4 mm), and at 12-month follow-up (26.8 mm). The mesenteric ischemic complication was thought to result from two factors, mechanical compression or plaque shift at the SMA ostium, and rapid progressive atherosclerotic change at the Z-stent area of the EVAR system. Under the condition of CA stenosis and IMA occlusion, the progression of SMA stenosis was a critical problem. So the treatment for the SMA stenosis seems to be crucial to relieve his symptoms.

Therapeutic options include surgical reconstruction and percutaneous transluminal angioplasty (PTA) with or without placement of a stent [4]. Recently, PTA has become an alternative to surgery for many patients who have poor surgical indications. It has been reported that the procedural and clinical success rates are greater than 80% and 75%, respectively [5—7]. In PTA without stenting, however, restenosis of the dilated artery and recurrent symptoms occur in 17—50% of patients within the first year [5—7]. This reduces the efficacy and durability of this procedure.

There have been no randomized control studies comparing PTA without stenting, PTA with stenting, and surgical revascularization. Matsumoto et al. reported 12 PTA cases with and 21 cases without stent for the treatment of chronic mesenteric ischemia [8]. The overall long-term clinical success rate was 83% among 29 patients who achieved initial clinical success [8]. In their series, PTA to the SMA with a stent was related to low incidence of complications and high technical and clinical success rate. However, we need a prospective randomized trial to determine the best strategy to restore the SMA flow deterioration.

In our case, PTA with Palmaz stent was useful to dilate the ostial stenosis of the SMA after EVAR with Zenith endovascular graft. We did not perform simultaneous treatment of the CA and the SMA. Longer term durability of stenting for mesenteric ischemia has not been definitively established, and therefore, we planned the treatment of SMA stenosis first, by which his abdominal angina was mainly caused. If we had failed the stent deployment for SMA by interaction of uncovered Z-stent, a treatment of the CA or an open surgical repair might be considered. Zenith graft has an uncovered Z-stent at its proximal end. Fortunately, the Palmaz stent could be placed precisely at the origin of the SMA via this uncovered area of the stent graft. Ischemic complications after EVAR have decreased significantly with the advent of lower profile devices with easier delivery systems and supported limbs [9]. However, like this case with multiple vascular disease, we have to pay special attention for the placement of endograft in the procedure of EVAR to keep the branches’ flow as much as possible. When several abdominal branches have moderate to severe stenosis at the ostium, ischemic complications are highly predicted. In such cases, an open surgical repair with treatment of side branches rather than an endovascular repair would be chosen. However, rapid progress in devices, such as fenestrated endovascular graft, may provide some breakthrough for the treatment of branches adjacent to abdominal aortic aneurysm [10].

In conclusion, we reported a case of successful PTA with Palmaz stent to the SMA stenosis after EVAR with
Zenith stent. Percutaneous trans-catheter treatment with stent could be a feasible and effective strategy to be considered for the treatment of EVAR related branch-vessel stenosis.

References