Endovascular treatment of embolization of aortic plaque with covered stents

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Spontaneous atheroembolization from aortic plaque can lead to organ dysfunction and limb loss. With discrete offending lesions, surgical treatment has been recommended. Although endovascular treatment with angioplasty or stenting has been reported, concerns about destabilizing atheromatous material with catheter manipulation are well founded. Covered stents may obviate this risk. We report herein two patients with embolizing infrarenal aortic plaque successfully treated with these devices. (J Vasc Surg 2002;36:727-31.)

Spontaneous atheroembolization from complex atherosclerotic plaque of the abdominal aorta can result in gangrene and major amputation. With localized offending plaque, surgical replacement has been advocated because endovascular manipulations are perceived to be risky in this setting.1-3 We report herein two cases of aortic atheroembolization syndrome successfully treated with covered stents.

CASE REPORTS

Case 1. An obese nonsmoking 67-year-old woman with hypercholesterolemia and a remote history of endometrial cancer, anticardiolipin antibody syndrome, and resolved left hemispheric stroke was seen with an 8-week history of the abrupt onset of painful cyanotic toes in both feet. Examination revealed normal pulses to the pedal level bilaterally. Mottling with digital cyanosis was present in all digits, with right worse than left. Frank dry gangrene to the proximal phalangeal level was noted in the right second through fourth toes.

Arteriography showed no proximal arterial occlusions; however, multifocal occlusions were noted at the inframalleolar level (Fig 1). Irregular plaque with ulceration was noted at the infrarenal aorta, which was small in caliber at 12 mm (Fig 2).

Because of the patient’s severe obesity and other comorbidities, aortic replacement was believed to carry substantial risk and endovascular treatment with a Wallgraft (Meditech, Boston Scientific, Natick, Mass) was elected. Aspirin therapy was initiated before the procedure and continued after surgery. An open approach was elected because of the small vessel size relative to the 9F sheath necessary. With regional anesthesia, a 14 mm by 4 cm Wallgraft was primarily deployed over a guidewire (Fig 3). Balloon angioplasty was performed after the stent graft was deployed. Completion aortography showed a smooth contour to the involved aortic segment (Fig 3, B).

The patient subsequently underwent interphalangeal amputations of the right second through fifth digits (Fig 4). The severe pedal pain resolved within 3 months, and the stent graft has remained patent through a follow-up period of 16 months with no subsequent embolic episodes.

Case 2. A 58-year-old woman who was a former smoker with diabetes mellitus and hypertension was seen with painful cyanosis involving multiple toes bilaterally that developed abruptly 4 weeks previously. Five months previously, the patient underwent cardiac catheterization and coronary bypass uneventfully, with no lower extremity symptoms. Examination revealed palpable pulses to the pedal level. Livedo reticularis with gangrenous changes were evident at the distal right first and second digits and the left fifth digit (Fig 5).

Arteriography revealed an ulcerated infrarenal plaque in the small-caliber aorta (Fig 6), with minimal other significant atherosclerotic changes. Inframalleolar arterial occlusions were also noted.

The patient underwent Wallgraft deployment with the same technique described in case 1. Prompt resolution of the pain and healing of the toe lesions followed, and the patient remains free of further embolic episodes through 10 months of follow-up. Patency and satisfactory positioning of the stent graft has been shown on color duplex scan.

DISCUSSION

Atheroembolization syndrome is a well-recognized entity. Characterized by the development of multifocal microinfarction of visceral organs and especially the lower extremities, the clinical process occurs from spontaneous or iatrogenic disruption of atherosclerotic plaque. This results in distal embolization of cholesterol crystals, platelet and fibrin thrombi, and other contents of complex atheromatous plaques.4-8 The pattern of ischemia induced is characteristic, with painful cyanotic or gangrenous changes in the toes (the “blue toe” syndrome), a livedo reticularis pattern of mottling of the skin of the lower extremities, and, when the offending plaque is in the proximal aorta, renal failure and intestinal infarction.

When atheroembolization syndrome occurs after manipulation of diseased arteries, such as with vascular surgery or intraarterial catheterization procedures, supportive treatment is often sufficient and repeat embolic episodes are uncommon in the absence of further arterial trauma.5 However, when spontaneous atheroembolization occurs, which is less common than the iatrogenic type, recurrent
embolic episodes and progressive tissue loss are likely.\textsuperscript{9-11} Anticoagulation therapy with heparin and warfarin has generally not been effective and may in fact be harmful because it may destabilize the fibrinous cap of complex atherosclerotic ulcers.\textsuperscript{4,12} Antiplatelet therapy has been advocated but is of unproven efficacy.\textsuperscript{13} When the source of the embolization is focal and amenable to treatment, it should be addressed to prevent further embolic episodes.\textsuperscript{1,4,14}

The most common source for peripheral atheroembolization is the aorta, and when bilateral lower extremity involvement occurs without renal and visceral involvement, the infrarenal aorta can be presumed to be the source.\textsuperscript{15} Arteriographic findings are not always impressive, and detailed imaging is critical. The goal of therapy is to safely remove the offending atherosclerotic plaque from the arterial bloodstream. Given the frequent instability of these lesions, surgical treatment has been perceived as safer than endovascular approaches because the surgeon can clamp the artery proximal or distal to the lesion to arrest antegrade flow while manipulating the diseased vessel. Endarterectomy or graft replacement has been the approach most used.\textsuperscript{1,16} In patients who are at high risk for major surgery, a fairly common scenario in this population, extraanatomic bypass with ligation of the external iliac arteries has been advocated.\textsuperscript{1,2}

Anecdotal experience and a few small published series have shown that transluminal angioplasty can sometimes be used to sufficiently treat embolizing lesions.\textsuperscript{14,17} The remodeling process that occurs with balloon injury theoretically results in stabilization of the ulcerated atherosclerotic plaque. Stent placement may provide a protective scaffold to help secure these lesions. In their report on stent placement for blue toe syndrome in 15 patients, Matchett et al\textsuperscript{18} reported no procedure-related embolization and only one patient had recurrent emboli in follow-up. However, as vascular surgeons attest, the atheromatous paste sometimes encountered within these plaques can be expected to disrupt with transluminal pressure and extrude through stent interstices. The risk of peri-procedural reembolization is a serious concern and has limited the application of these techniques.

The commercial availability of the Wallgraft covered stent has led to its off-label use within the vascular system with generally favorable results.\textsuperscript{19-22} This self-expanding device can be primarily deployed rapidly over a guidewire. Balloon angioplasty can then be performed with the stent graft in place. Although available devices for endovascular aortic aneurysm repair have large delivery systems and necessitate multistep deployment, immediate exclusion and

**Fig 1.** Occlusions of pedal vasculature by small emboli (arrows).

**Fig 2.** Complex atherosclerotic plaque in infrarenal aorta.
stabilization of atheromatous material can be accomplished with minimal arterial manipulation with this low-profile delivery system. Significant length changes occur with the Wallgraft with varying vessel diameter, so precise measurement and adjustment during deployment are critical, especially when landing near the aortic bifurcation as in the cases reported. The largest diameter Wallgraft currently available is only 14 mm. This limits its applicability to patients with small aortic caliber, such as the two female patients who comprise this case report, or to iliac and femoral arteries. With rapid evolution and improvement of endovascular technologies, larger devices with smaller delivery systems, such as the Aneurex extension cuff (Medtronic, Minneapolis, Minn), are becoming available.

Although long-term durability of covered stents in the aortic position is not yet proven, the risks of late failure seem intuitively to be considerably less than for endografts for aneurysmal disease. Migration has been infrequent with stents in general, and late stenosis has been uncommon in larger caliber, high-flow arteries treated with stents. In nonaneurysmal vessels, there is no issue of endoleaks.

More diffuse atherosclerotic disease associated with recurrent microembolization remains a major challenge for
Fig 5. Blue toe syndrome with digital gangrene.

Fig 6. A, Aortic plaque with shallow ulcer. B, Exclusion with Wallgraft.
which current therapies are suboptimal. Progressive loss of renal function, need for amputation, and poor survival are the rule. In this scenario, the mortality rate approaches 80%. The concept of extensive exclusion of diseased aortic segments with covered stents is attractive. Our current approach is to consider this strategy when anatomy is suitable for both patients at good and at poor risk.

REFERENCES


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