Direct Carotid-Cavernous Fistula Following Intracavernous Carotid Aneurysm Treatment with a Flow-Diverter Stent

A Case Report

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Summary

A 39-year-old woman presented with a right intra-cavernous carotid aneurysm measuring 1.76 cm×1.33 cm. The aneurysm was treated with a self-expandable flow-diverter stent. Follow-up MRI showed normal flow in the internal carotid artery with partial thrombosis of the aneurysmal sac. Two weeks later, the patient developed a right direct carotid-cavernous fistula. The fistula was treated by transvenous route. We concluded that rupture of a previously unruptured aneurysm can occur after treatment with a flow-diverter stent.

Introduction

Until very recently, the primary strategy for treating aneurysms endovascularly depended on filling the aneurysmal sac with embolic material (typically embolization coils) and excluding it from the parent artery circulation (i.e. endosaccular aneurysm occlusion). With the development of new adjunctive devices (e.g. intracranial stents and balloons) and improved embolization materials (e.g. three-dimensional coils and liquid embolics), the percentage of aneurysms amenable for treatment with endovascular techniques has broadened. However, the ability to achieve a durable and complete occlusion of aneurysms remains limited in

some cases. Large and wide-necked aneurysms remain challenging, with recurrence rates approximated at 50% for both of these anatomical subtypes¹.

Flow conditions within the parent artery and the aneurysm itself have long been thought to play an important role in growth and rupture of aneurysm². Yet, the early application of stent-assisted aneurysm therapy was primarily focused on geometric reconstruction of the parent artery through improved coil packing of the aneurysm. The presence of an intravascular stent construct provides several theoretical advantages in addition to physically supporting the introduction of coils into the aneurysm^{3,4}. We describe a case of direct carotid-cavernous fistula following treatment of intracavernous carotid aneurysm with a Silk flow-diverter stent alone.

Case Report

A 39-year-old woman complained of right hemifacial pain related to an aneurysm of the right intracavernous carotid artery revealed by MRI. Cerebral angiogram showed a large fusiform aneurysm of the C4 carotid siphon measuring 1.76 cm×1.33 cm (Figure 1). The aneurysm bombed over the cavernous sinus. We decided to cover the aneurysm neck with a 35 mm long, 4 mm diameter self-expandable stent

Figure 1 Pre-treatment cerebral angiogram of the right ICA (lateral view) showing a large fusiform aneurysm of the right carotid siphon measuring 1.76 cm x 1.33 cm.

Figure 2 Right carotid angiography (lateral view) 2 weeks later showing complete permeability of the aneurysm and the stent, and right direct carotid-cavernous fistula, draining through the superior ophthalmic vein and the inferior petrosal sinus.

flow-diverter type Silk stent. After giving the patient a loading dose of plavix (300 mg), the flow-diverter type Silk stent was delivered transfemorally via a 6F guiding catheter. Control angiogram after release of the stent showed a stenosis at the middle segment of the stent. Therefore, we achieved angioplasty-stent using a balloon type Hyperglide 4 mm x 10 cm. Angiographic controls at the end of the treatment showed satisfactory stent position, a good permeability of the right internal carotid and stagnation of contrast within aneurysm of the right carotid siphon. Follow-up MRI after 72 hours revealed normal flow in the carotid and side branches of the internal carotid artery with incomplete thrombosis of the aneurysmal sac. The patient was discharged on dual antiplatelet therapy, plavix and ASA (acetyl salicylic acid).

Two weeks later, the patient developed exophthalmos of the right eye with ptosis and limitation of mobility, without diplopia following minor trauma. Cerebral Computerized tomography angiography showed right carotid-cavernous fistula. Cerebral angiogram showed complete permeability of the aneurysm and the stent. There was also right direct carotid-cavernous fistula, draining through the superior ophthalmic vein and the inferior petrosal sinus (Figure 2). The patient did not show any external stigmata for a connective tissue disorder. It was decided to treat the arteriovenous fistula by transvenous route focusing on the anterior approach via the facial vein, angular vein and

the superior ophthalmic vein. The distal microcatheter was placed in the aneurysm sac. A total of five Guglielmi detachable coils were used for closure. Although clinical manifestations totally disappeared following treatment, immediate digital subtraction angiography (DSA) and MRI done after three weeks showed the persistence of a shunt at the cavernous sinus law apparently draining through the inferior petrosal sinus. Two months later, we stopped plavix and the patient refused follow-up DSA. Follow-up MRI was done revealing complete occlusion of the aneurysm of the right carotid siphon and carotid-cavernous fistula with good permeability of the stent.

Discussion

Recent strategies for endovascular treatment of cerebral aneurysms have rapidly developed since the introduction of the Guglielmi detachable coil system (Boston Scientific/Target, Fremont, CA, USA) in 1992⁴.

In 1997, Higashida et al.⁵ reported the application of an intravascular stent as an adjunctive device to support the endosaccular occlusion of a cerebral aneurysm. Other investigators began studying the impact of stents on flow dynamics in silicone aneurysm models and experimental animal sidewall aneurysms⁶. These sentinel events stimulated a shift in focus from endosaccular aneurysm occlusion alone

to strategies that incorporated intravascular stents, not only to support endosaccular occlusion, but also to achieve endoluminal remodeling of the diseased vascular segment⁷.

The presence of an intravascular stent construct provides several theoretical advantages in addition to physically supporting the introduction of coils into the aneurysm. The magnitude of the biological and, hemodynamic effects of the available intracranial stents on the aneurysm-parent vessel complex are somewhat mitigated by the limited metal surface area coverage provided by the available devices. Although this amount of coverage may be sufficient to improve the durability of aneurysm occlusion after coil embolization⁷, these stents do not represent a reliable stand-alone therapy for the majority of intracranial aneurysms which require dense coil packing of the aneurysm neck to provide a sufficient substrate for neointimal overgrowth of the aneurysm neck defect⁸.

During the past three years, a new generation of endovascular devices - the flow-diverters - has been developed to treat aneurysms through an exclusively endoluminal rather than endosaccular approach. These stent-like devices are designed to reconstruct the parent artery and divert blood flow along the normal anatomical course of the vessel and away from the aneurysm neck. Ideally, this hemodynamic uncoupling of the parent artery-aneurysm complex creates an intra-aneurysmal environment conducive to thrombosis and provides scaffolding over which neointima and endothelium can grow to ultimately seal off the neck of the aneurysm^{3,4}. The stents provide a mean by which

to achieve safe, technically straightforward, and definitive treatment of aneurysms that have either failed or are not amenable to conventional treatment strategies, but in some case stent alone is not sufficient to treat the aneurysm completely carrying risk of either recanalization or delayed rupture of the aneurysm.

These changes provoke the formation of mural thrombus inside the aneurysm which may play a key role in aneurysm rupture by both biochemical and mechanical effects. The biochemical effect could be related to protease enzymes secreted within the aneurysms from the aggregated platelets, leading to weakening of the aneurysm wall⁹. The mechanical effect could be related to swelling and increased volume of the aneurysm after occluding the parent vessel, provoking further stretching of the aneurysmal wall¹⁰.

Treatment of intracranial large and giant aneurysms with flow diverters stents is probably not recommended without coiling. However there is no proof that an aneurysm treated with coils and a flow-diverter may not also rupture.

Conclusion

Treatment of intracranial aneurysms with flow-divert stents as a monotherapy without coiling is not sufficient to prevent rupture. The use of flow-divert stent-assisted coiling in the treatment of wide-neck, large, giant, and circumferential fusiform intracranial aneurysms may offer an efficient method to preserve the patency of the vital vessel and suppress and prevent delayed rupture.

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