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CASE REPORT
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Treatment of High-Flow Carotid Cavernous Fistula Using a Graft Stent: Case Report

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Currently, endovascular treatment of carotid cavernous fistula (CCF) is widely accepted and performed. However, a graft stent is rarely used for the treatment of high-flow CCF. Here we describe our experience using a graft stent to treat CCF and discuss the indications for its use. (Korean J Neurotrauma 2012;8:51-54)

KEY WORDS: Carotid cavernous fistula · Graft stent.

Introduction

Direct high-flow carotid cavernous fistula (CCF) may be associated with traumatic fracture of the skull base and the sphenoid bone, which produces a direct communication between the internal carotid artery (ICA) and the cavernous sinus (CS). The clinical manifestation of CCF is related to the venous drainage pattern, which may lead to various symptoms, such as pain, exophthalmos, conjunctival chemosis, visual impairment, ocular movement disorder, and intracranial hemorrhage.[4)]

The goal of treatment of high flow CCF is to obliterate the arteriovenous shunt at the site of the fistula, while preserving the patency of the ICA as much as possible. The current treatment of choice is transarterial obliteration of the fistula with detachable coils.[2,8,14,15)] However, the use of detachable coils can lead to incomplete or temporary occlusion of the fistula due to its high blood flow velocity. An increasing body of evidence has demonstrated that a graft stent lined with polyfluorotetraethylene or Gore-Tex is an alternative for the treatment of CCF.[3,7,10,17)]

We present our experience using a graft stent to treat high-flow CCF and review the pertinent literature to identify potential indications for a graft stent.

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Case Report

A 27-year-old male patient suffered blunt head trauma by a motor vehicle accident. He suffered from multiple traumas such as skull base fracture, mandible fracture, and diffuse axonal injury.

Two weeks later accident, left exophthalmos, ptosis, and chemosis developed. The proptosis of left eyeball was identified on the computed tomographic scan (Figure 1).

Initial left ICA angiography demonstrated a left CCF draining into the superior ophthalmic vein, pterygoid plexus, and petrosal sinus, with no intracranial blood flow above the CCF (Figure 2). An angiography of the right ICA and both vertebral arteries showed a prominent collateral blood flow through the anterior and both posterior communicating artery. We performed a balloon occlusion test to evaluate adequate collateral flow. While the balloon remained inflated for 30 minutes during the test occlusion, the patient did not show the neurologic deteriorations. Taking into consideration the less tortuosity of ICA and the previous successful experience using a graft stent, we decided to treat the fistula with a graft stent (Jostent Graft-Master, Abbott Vascular Devices, Amersfoort, the Netherlands).

The patient was premedicated with clopidogrel, 75 mg/day, and acetylsalicylic acid, 100 mg/day, starting 7 days before the procedure. Systemic heparinization was administered intravenously at the beginning of the interventional procedure (a bolus of 5,000 U) and was continued to maintain an activated clotting time of around 250 seconds. To advance a graft stent to the level of the CCF, we used a triaxial access system. We started with a 7F long sheath (Shuttle; Cook, Bloomington, IN, USA), which was advanced to the level of the common carotid artery. A 6F Envoy catheter (Cordis, Miami Lakes, FL, USA) was then advanced coaxially as close as possible to the cavernous ICA. Using a microcatheter (Tracker Excel-14; Boston Scientific, Natick, MA, USA) and a Transend-14 wire (Boston Scientific, Natick, MA, USA), we selected the middle cerebral artery and advanced the microcatheter tip to the level of the angular artery. The microguidewire was then replaced with a 0.014-inch, 300-cm exchange guidewire Transend ES (Boston Scientific, Natick, MA, USA). The Jostent GraftMaster stent (4× 19 mm) was then advanced over the wire. The stent was positioned to occlude the fistula and prevent occlusion of the ophthalmic artery. The fistula was completely obliterated following stent deployment (Figure 3). The patient developed a proximal ICA vasospasm that was successfully treated with an intraarterial injection of nicardipine (2 mg) through the guiding catheter.

FIGURE 1. Brain computed tomographic scan showing the exophthalmos of the left eye ball (arrow).

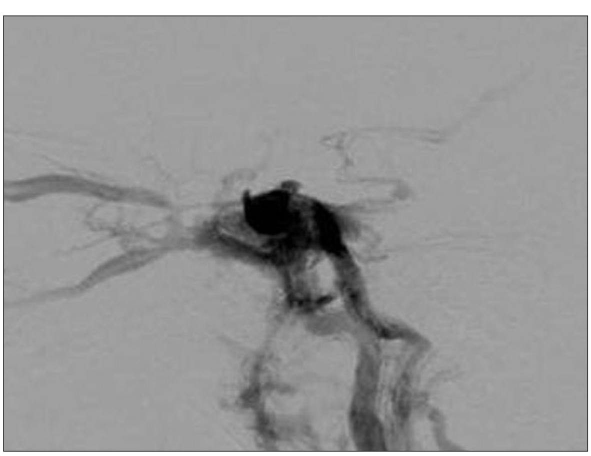

FIGURE 2. Lateral angiogram of the left internal carotid artery showing total steal of flow toward the superior ophthalmic vein, pterygoid plexus, contralateral cavernous sinus, and petrosal sinus.

At two weeks after the procedure, left side pulsatile tinnitus was developed suddenly. Follow-up angiogram demonstrated partial reopening of fistula with residual filling of the inferior petrosal sinus. We performed 4.5 mm-sized balloon inflation over nominal pressure to close the fistula. However, despite multiple balloon inflations, a small endoleak was persistent (Figure 4). Follow-up angiogram at 8 months demonstrated complete occlusion of the CCF with preserved ICA, disappearance of endoleak, and small petrous pseudoaneurysm (Figure 5).

Discussion

The ideal treatment for high flow CCF was transarterial obliteration of the fistula with a detachable balloon, first introduced by Serbinenko.[16] Although a detachable balloon is an excellent therapeutic device, there are some limitations in its use: 1) it can spontaneously deflate; 2) the balloon may not fit the caliber of the vessel. With the advent of endovascular techniques, detachable coils in combination with a bare stent have proven to be an excellent therapeutic tool to treat CCF.[2,8,14,15] However, coil occlusion is not always safe and effective. The disadvantages of coil occlusion are incomplete occlusion, high cost, and possible occlusion of the cortical draining vein afferent to the cavernous sinus by coil migration. Also, the mesh of coils within the cavernous sinus may be responsible for cranial nerve palsy.

Graft stents were originally designed for the management of coronary and peripheral vessel pathologies.[5,9] In the neurovascular field, graft stents have been employed in the treatment of carotid and vertebral artery injuries such as pseudoaneurysm, dissection, and fistula.[1,11] Recently, a growing body of evidence has demonstrated that graft stents are a promising therapeutic alternative for treating CCF with preservation of the parent artery.[3,6,7,10,17]

There are several technical difficulties regarding the graft stent placement for CCF. The main drawback is the limited flexibility that prevents navigation of the stent over the lesion. To overcome this problem, a neurointerventionist must use a rigid and long sheath or guiding catheter to provide extra support. Also, it is important to insert the guiding catheter as close as possible to the cavernous ICA. The second drawback is the possibility of vessel wall injury including dissection, vasospasm, and traumatic pseudoan-

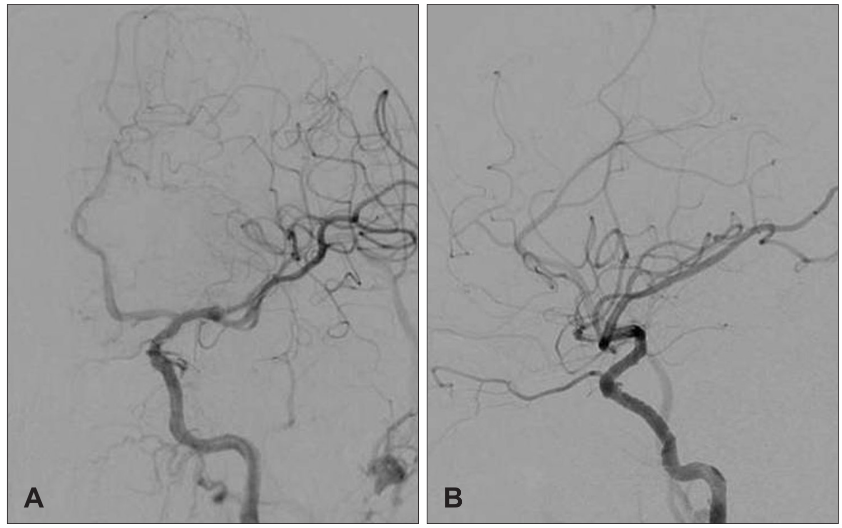

FIGURE 3. Immediate post-procedural left internal carotid angiogram, left oblique (A) and lateral views (B), demonstrating complete occlusion of carotid cavernous fistula and normal patency of internal carotid artery.

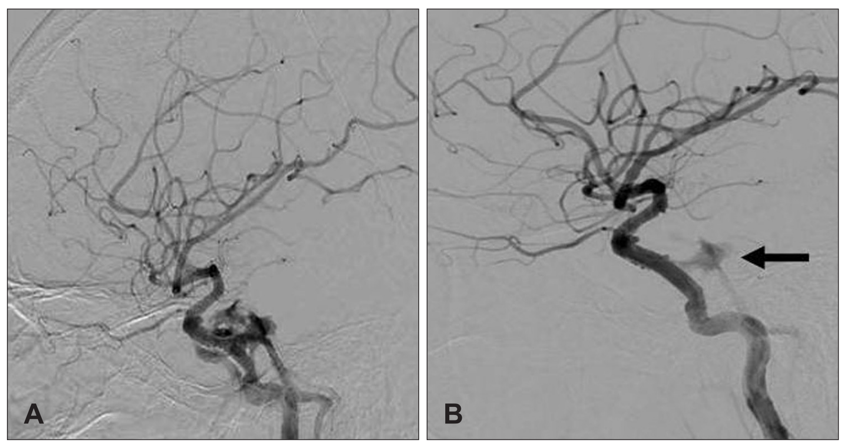

FIGURE 4. Left lateral internal carotid angiogram on day 14 after treatment demonstrating the partial reopening of the fistula (A) and endoleak (arrow) after angioplasty with a coronary balloon (B).

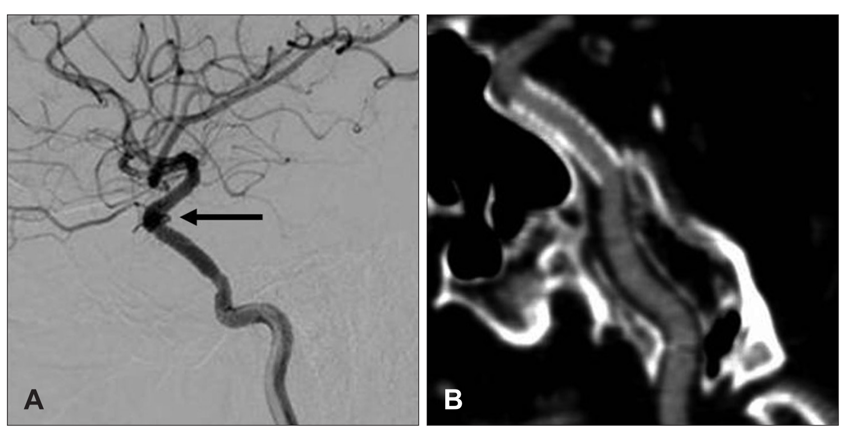

FIGURE 5. Lateral angiogram of left internal carotid artery after 8 months showing a complete obliteration of carotid cavernous fistula and pseudoaneurysm of the distal end of the stent (arrow) (A). Computed tomographic angiography 8 months later reveals normal patency of the internal carotid artery (B).

eurysm. The third issue is the long-term patency of the parent artery and durability of the graft stent. Although there is little known about the long-term patency of a graft stent in the cerebral arteries, some reports have demonstrated positive mid-term results.[6,10,11,17] Further follow-up will elucidate the long-term efficacy of graft stents. Another important concern is postdeployment endoleak, which may be caused by incomplete apposition of the graft to vessel wall.[11] We also experienced partial reopening of the CCF after complete obliteration 12 days later. Despite multiple attempts to expand the stent using a coronary balloon of a larger diameter, a small endoleak persisted. However, the small endoleak was spontaneously obliterated at the follow-up angiogram.

In the literature, there are several indications for graft stent placement for the treatment of CCF. A graft stent will be a suitable alternative therapeutic tool: 1) When complete occlusion using coils or balloon fails due to herniation or stretching of coil loops into the parent artery or small fistula orifice that does not allow the passage of coil or balloon.[2,3,7,10,12,13] 2) When cranial nerve palsy is caused by coil mesh.[12] 3) When the ICA is less tortuous.[12,17] 4) When the critical perforators is not existed around the fistula.[17]

Conclusion

Currently, graft stents may be used as an alternative treatment modality in the treatment of traumatic CCF when embolization using coils or balloon fails and the anatomical characteristics of ICA are favorable. Further technical development and long-term follow-up are necessary to assess the efficacy of graft stents in treating traumatic high-flow CCF.

■ The authors have no financial conflicts of interest.

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