Infectious Aneurysm of the Cavernous Carotid Artery in a Child Treated With a New-Generation of Flow-Diverting Stent Graft: Case Report

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OBJECTIVE: To report a unique case of wide-necked mycotic cerebral aneurysm treated with a new generation of intracranial stent.

CLINICAL PRESENTATION: A 10-year-old girl presented with meningitis complicated by an infectious intracavernous large aneurysm revealed by cranial nerve palsy.

INTERVENTION: The aneurysm was treated by a new-generation, flow-diverting, endoluminal implant (SILK; BALT EXTRUSION, Montmorency, France) placed across the aneurysm neck without coiling. Angiographic controls showed complete thrombosis of the aneurysmal sac with dramatic improvement of symptoms a couple of weeks after the procedure. Follow-up magnetic resonance imaging and digital subtraction angiography 3 months after the procedure, confirmed total occlusion of the aneurysm with normal circulation in the parent vessel

CONCLUSION: This is a simple and highly effective way to exclude an aneurysm from the parent vessel without the difficulties observed with the semi-rigid stents. Flow-disrupting stent grafting may be a safe and effective alternative treatment for large intracranial aneurysms.

KEY WORDS: Embolization, Flow-diverting stent, Intracavernous aneurysm, Intracranial aneurysm, Large aneurysm, Mycotic aneurysm, SILK stent, Stent graft

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The use of stents in the treatment of aneurysm continues to offer new fields of investigation. New technologies, such as flow-diverting stents, allow previously uncoilable cerebral aneurysms to be treated with great success. We report a rare case of mycotic intracavernous carotid aneurysm in a child treated with a new-generation of stent.

CASE REPORT

A 10-year-old girl was admitted to our emergency unit with headache, fever, and meningeal syndrome. She had a history of uncomplicated hemolytic-uremic syndrome. The initial workup confirmed the diagnosis of streptococcal meningitis, and the patient was treated conservatively. On day 8, however, the patient reported severe facial edema, diplopia, ptosis, and mydriasis of the right eye caused by cranial nerve III palsy. Brain magnetic resonance imaging revealed thrombosis of the right cavernous sinus associated with a large infectious aneurysm of the intracavernous segment of the right carotid artery. The aneurysm was confirmed by digital subtraction angiography, which showed a wide-necked, 15-mm diameter, intracavernous aneurysm with a sluggish filling of the aneurysm lumen.

The patient received 6 weeks of antibiotics: intravenous cefotaxime combined with metronidazole and fosfomycin for the first 2 weeks and intravenous ceftriaxone with amoxicillin-clavulanate for the following 4 weeks. Because of the decreased flow, spontaneous thrombosis of the aneurysmal sac was expected. Therefore, we decided to wait with monthly regular blood cultures and clinical, and imaging follow-up. However, the patient experienced sudden paralysis of cranial nerve IV at 3 months. We performed an angiographic control that showed an increase in the size of the aneurysmal sac. After discussion with our pediatric neurosurgeons, we decided to perform a test occlusion of the internal carotid artery to assess the arterial network and determine the possibility of internal carotid artery occlusion. The test had to be prematurely stopped a few minutes after internal carotid artery occlusion because of mild left hemiparesis and late opacification of the distal branches.

On reconsideration of the treatment, we used a new endoluminal flow-diverting implant, the SILK stent (BALT EXTRUSION, Montmorency, France) graft technique. The patient was pretreated for 7 days with

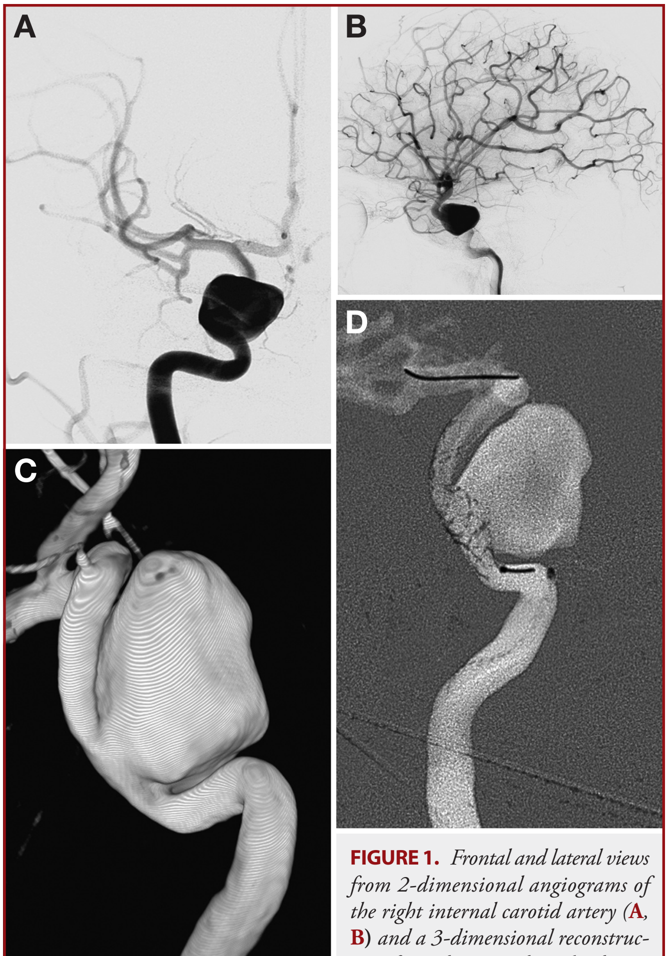

FIGURE 1. *Frontal and lateral views from 2-dimensional angiograms of the right internal carotid artery (***A***,* **B***) and a 3-dimensional reconstruction from dynamic digital subtraction angiography (***C***) showing a 22 × 15 × 10-mm cavernous sinus aneurysm.* **D***, digital subtraction angiography of the right carotid artery during the endovascular procedure, which used road -mapping for placement of the SILK stent across the aneurysm neck.*

aspirin (3 mg/kg/d) and clopidogrel (75 mg/d). A bolus dose of heparin (40 IU/kg) was administered at the start of the procedure. A 6-French, 90-cm Envoy guiding catheter was placed in the internal carotid artery and a Vasco microcatheter (BALT EXTRUSION) was then inserted coaxially and navigated in the carotid siphon distal to the aneurysm using a 0.0014 microwire. After removing the microwire, the stent delivery system was advanced inside the Vasco microcatheter, and the stent was finally deployed by pushing the delivery system over the microcatheter.

The angiogram obtained right before stent placement showed that the aneurysm measured 22 × 15 × 10 mm (Figure 1*).* Using road map guidance, the flow-diverting, self-expandable, intracranial SILK stent (4 mm wide, 25 mm long) was deployed in the parent vessel across the aneurysm neck (Figure 1B). Control angiography performed 5 and 15 minutes after stent placement showed progressive reduction of filling followed by stagnation of contrast in the aneurysm with a fluid-fluid level (Figure 2).

Postoperatively, the patient received heparin for 2 days as a continuous drip (20 IU/kg/h), plus aspirin (160 mg/d orally for 1 week, then 75 mg/d for 6 months) and clopidogrel (75 mg/d orally for 1 week, then 37.5 mg/d

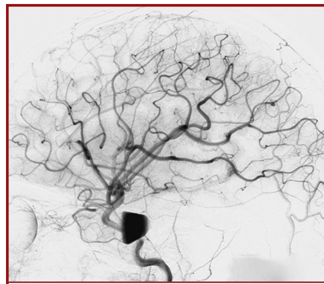

FIGURE 2. *Digital subtraction angiography performed 15 minutes after stent placement showing decreased blood flow in the aneurysm sac with partial filling of the lumen. Note the fluid-fluid level indicating significant stagnation of the contrast medium in the aneurysmal sac.*

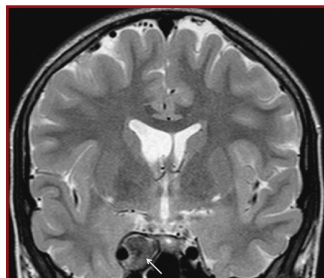

FIGURE 3. *Coronal T2-weighted magnetic resonance imaging performed 5 days after placement of the semi-covered stent. The right cavernous sinus appears hypointense because of recent thrombosis (white arrow), whereas the signal intensity of the carotid siphon is normal.*

for 3 months). The patient tolerated the operation well. At the time of discharge, the cranial nerve III and IV palsies were stable. The first control magnetic resonance imaging, performed 5 days after the procedure, confirmed the efficacy of the treatment with subtotal thrombosis of the aneurysmal sac and normal patency of the parent artery (Figure 3).

Follow-up magnetic resonance imaging and digital subtraction angiography were performed 3 months after the procedure and confirmed total occlusion of the aneurysm with normal circulation in the parent vessel (Figure 4). The patient showed complete resolution of her symptoms with no complications as a result of the procedure.

DISCUSSION

We describe an intracranial infectious aneurysm treated with a flow-diverting semicovered stent. Infectious aneurysms represent 1.5% to 9% of all intracranial aneurysms. Their occurrence is usually related to infectious occlusion of the vasa vasorum of the parent vessel, leading to weakness of the arterial walls and thus formation of aneurysm dilation.[1] The treatment of choice for large septic aneurysms remains a subject of debate.[2] Nevertheless, the appropriate antibiotics should be administered as soon as possible, and the optimal treatment is usually occlusion of the parent vessel, leading to a decrease in the mass effect that is the cause of neurological symptoms.[3,4] In our case, the patient had cranial nerve III and IV palsies, but sacrifice of the right carotid artery was considered unsuitable because the balloon occlusion test was symptomatic.

Stent grafting is considered a promising alternative, but its use in the supra-aortic arteries has been described in the literature only in the past few years, with a lack of efficacy because of problems of flexibility and the risk of iatrogenic arterial dissection.[5,6] To overcome these limitations, a new generation of endoluminal flow-diverting devices is now available for specific use in intracranial vessels and is increasingly discussed in the literature with great expectations. The Pipeline neuroendovascular device (Pipeline NED; Chestnut Medical Technologies, Inc., Menlo Park, CA) offers the potential of aneurysm occlusion related to flow disruption.[7] Both devices share the prop-

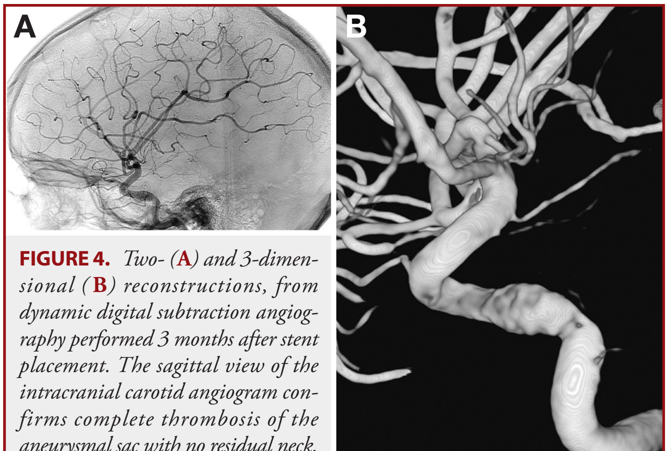

FIGURE 4. *Two- (**A**) and 3-dimensional (**B**) reconstructions, from dynamic digital subtraction angiography performed 3 months after stent placement. The sagittal view of the intracranial carotid angiogram confirms complete thrombosis of the aneurysmal sac with no residual neck. The image shows a reconstructed parent vessel, no filling of the previous aneurysmal sac, and a slight stent protrusion at the site of the neck.*

erty of forming a high coverage mesh that, once expanded, covers the neck and induces thrombosis of the aneurysmal sac while preserving patency of adjacent small branch vessels. The SILK stent is composed of 48 braided nitinol strands, which differs from other bimetallic implants. This stent is also original because it offers, once deployed, a sinusoidal radiopaque wire throughout the device that helps in a precise visualization of the stent.

The SILK stent system comprises a self-expanding stent, a delivery system, and a reinforced catheter for its placement. The delivery system comprises a delivery wire (pusher) and introducer. The self-expanding stent is preloaded on the delivery wire within the introducer. The delivery procedure is similar to coil delivery and allows resheathing and repositioning of the stent when up to 90% of it has been deployed.

To increase the stability of the stent, choose a stent length at least 3 times the diameter of the parent vessel plus the neck size. Furthermore, it is important to push slightly on the stent while delivering it to increase the tightness of the mesh. The theory behind this approach is to promote thrombosis of the aneurysm, to avoid long-term recanalization, and to derive benefit from the release of neural compression.

Our case illustrates this simple and highly effective way to separate an aneurysm from the parent vessel without the difficulties observed with semirigid stents designed for coronary use that were inappropriate for the curves seen in the internal carotid artery and basilar artery. More studies are needed to further address SILK stent use in the future, especially in children, because no long-term follow-up after flow-diverting stent placement is currently available. Only repeated clinical and angiographic controls over time will answer the question of the potential drawbacks of this device. It seems now to be an easy and cost-effective alternative treatment for large intracranial aneurysms.

Disclosure

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

REFERENCES

1. Clare CE, Barrow DL. Infectious intracranial aneurysms. *Neurosurg Clin N Am.* 1992;3(3):551-566.
2. Shibuya S, Igarashi S, Amo T, Sato H, Fukumitsu T. Mycotic aneurysms of the internal carotid artery. Case report. *J Neurosurg.* 1976;44(1):105-108.
3. Sluzewski M, van Rooij WJ, Slob MJ, Bescós JO, Slump CH, Wijnalda D. Relation between aneurysm volume, packing, and compaction in 145 cerebral aneurysms treated with coils. *Radiology.* 2004;231(3):653-658.
4. van Rooij WJ, Sluzewski M. Unruptured large and giant carotid artery aneurysms presenting with cranial nerve palsy: comparison of clinical recovery after selective aneurysm coiling and therapeutic carotid artery occlusion. *AJNR Am J Neuroradiol.* 2008;29(5):997-1002.
5. Felber S, Henkes H, Weber W, Miloslavski E, Brew S, Kühne D. Treatment of extracranial and intracranial aneurysms and arteriovenous fistulae using stent grafts. *Neurosurgery.* 2004;55(3):631-639.
6. Islak C, Kocer N, Albayram S, Kizilkilic O, Uzma O, Cokyuksel O. Bare stent-graft technique: a new method of endoluminal vascular reconstruction for the treatment of giant and fusiform aneurysms. *AJNR Am J Neuroradiol.* 2002;23(9):1589-1595.
7. Kallmes DF, Ding YH, Dai D, Kadirvel R, Lewis DA, Cloft HJ. A second-generation, endoluminal, flow-disrupting device for treatment of saccular aneurysms. *AJNR Am J Neuroradiol.* 2009;30(6):1153-1158.

COMMENTS

The authors relate a rare case of a large cavernous mycotic aneurysm in a child. They managed this lesion successfully with implantation of a novel flow-diverting stent. This report is important for several reasons.

Primarily, this report reveals that a permanent implant, such as a stent, can be placed safely in a septic environment. The authors argue that appropriate antibiotic management prevents the development of further infectious complications in this setting. Furthermore, this report confirms that this device can be implanted safely in a child. What remains to be seen, however, are the long-term durability of this implant and the overall patency of the artery.

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Appelboom et al present a case of a mycotic cavernous aneurysm that was initially treated with antibiotics but, 3 months later, showed evidence of expansion manifested by cranial nerve palsies confirmed on imaging studies and was treated successfully with a semicovered stent. Although still investigational, the use of semicovered and low-porosity stents as flow diverters in the treatment of cerebral aneurysms has been well documented in the literature.1-3 However, the report shows the usefulness of flow diversion in the amelioration of cranial nerve palsy because of the water hammer/mass effect in giant aneurysms and the effectiveness of the BALT SILK stent in this case.

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1. Fiorella D, Kelly ME, Albuquerque FC, Nelson PK. Curative reconstruction of a giant midbasilar trunk aneurysm with the pipeline embolization device. *Neurosurgery*. 2009;64:212-217.
2. Fiorella D, Woo HH, Albuquerque FC, Nelson PK. Definitive reconstruction of circumferential, fusiform intracranial aneurysms with the pipeline embolization device. *Neurosurgery*. 2008;62:1115-1121.
3. Lylyk P, Miranda C, Ceratto R, et al. Curative endovascular reconstruction of cerebral aneurysms with the pipeline embolization device: the Buenos Aires experience. *Neurosurgery*. 2009;64:632-643.

The authors report on a 10-year-old girl presenting with a pseudoaneurysm of the cavernous carotid artery treated with stent graft technique. Certainly, this is very problematic, and although vessel occlusion is a reasonable alternative, this new stent technology allows preservation of major cerebral vessels that have proximal pathology. One always has trepidation when inserting a foreign body in the presence of an infectious problem, but, on follow-up, their results clearly indicate that this was very successful in treating this lesion. One of the difficulties in placing devices within this vessel is knowing where the normal vessel ends and the diseased vessel begins.

I think additional follow-up is going to be essential in this young girl because the 3-month angiogram clearly indicates that an abnormal vessel still exists. Be that as it may, the results are impressive, and this new technology is certainly exciting and will allow more large vessels to be spared rather than sacrificed.

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