Endovascular Treatment of a Mycotic Intracavernous Carotid Artery Aneurysm Using a Stent Graft

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Summary

Intracavernous carotid artery mycotic aneurysms are rare and management is determined by clinical presentation. We describe the first documented proximal intracranial mycotic aneurysm treated by a balloon expandable Aneugraft PCS covered stent. An 11-year-old female child presented with acute onset fever, headache, chemosis followed by diplopia, right-sided ptosis with ophthalmoplegia. Magnetic resonance imaging revealed bilateral cavernous sinus thrombosis. Subsequent work-up included serial computed tomographic arteriography and digital subtraction angiography which revealed a progressively enlarging intracavernous carotid aneurysm. An Aneugraft PCS covered stent was successfully deployed endovascularly, and complete exclusion of the aneurysm was achieved while maintaining the patency of the parent artery. The use of covered stents in intracranial vasculature can be an effective and safe treatment modality for exclusion of the mycotic aneurysm in selected cases.

Introduction

Mycotic aneurysm, an infection-related false aneurysm, is a rare entity and represents only 2-5% of all intracranial aneurysms [1]. These are usually located in distal branches of the middle cerebral arteries particularly at the bifurcation point [2]. Intracavernous carotid aneurysm (ICCA) accounts for 3-5% of all intracranial aneurysms [3]. The rarity of the mycotic ICCA, its non-specific clinical picture and its unpredictable natural history provide a challenge for both diagnosis and management. The management of ICCA mycotic aneurysm is controversial, owing to a significant risk of complications associated with surgical intervention in the region of the cavernous sinus, potential for aneurysm rupture and distal embolization of the thrombus [3]. The advent of endovascular intervention techniques, particularly with intracranial covered stents, provides a new dimension to the treatment.

To the best of our knowledge, this is the first reported case of a mycotic ICCA successfully treated with a covered stent (Aneugraft PCS).

Case Report

An 11-year-old previously healthy female child developed a pustule over the left ala of her nose associated with high-grade fever and right-sided frontal headache. After four days she developed left sided chemosis and eye-lid swelling. Contrast-enhanced magnetic resonance imaging (MRI) of brain and orbit demonstrated expansion of bilateral cavernous sinuses with lateral convex margin and multiple filling defects on post contrast images suggestive of bilateral cavernous sinus thrombosis (Figure 1). A diagnosis of bilateral cavernous sinus thrombosis secondary to spread from a pustule over a dangerous area of the face was considered and the patient was started on intravenous Ceftriaxone 1 g 12 hourly and Lincomycin 300 mg 12 hourly. Two weeks later she developed worsening headache and right-sided retro-orbital pain, chemosis, ophthalmoplegia

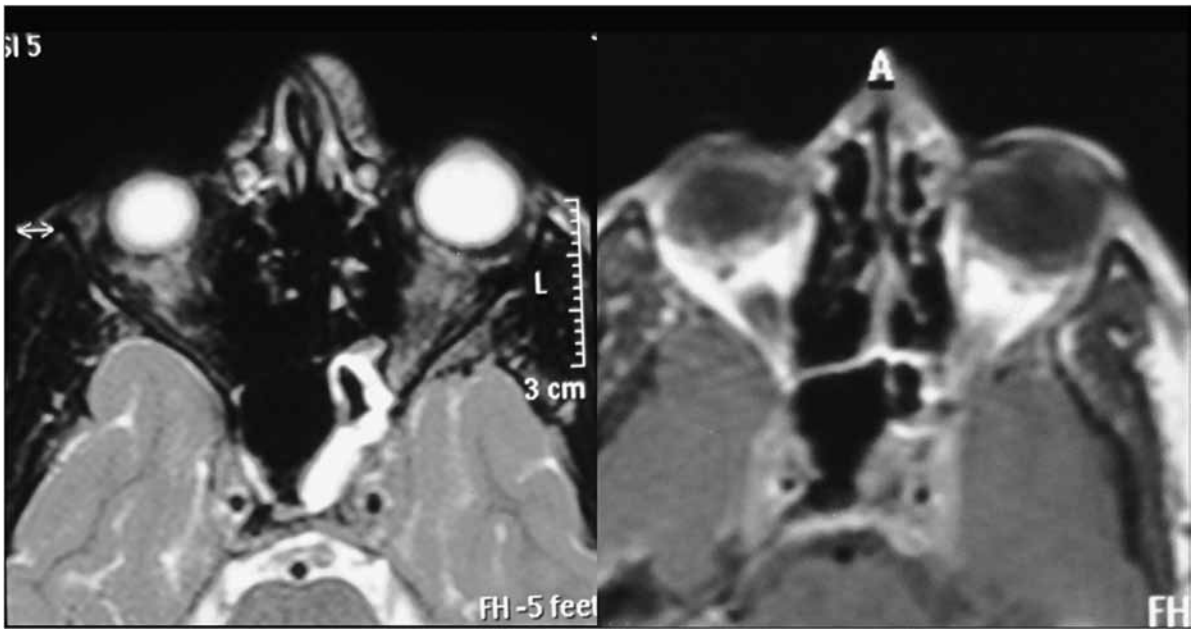

Figure 1 T2 W axial (A) and post gadolinium T1 W axial (B) sections of the orbit and cavernous sinuses reveal expansion of the bilateral cavernous sinuses with lateral convex margin and multiple filling defects on post contrast images suggestive of bilateral cavernous sinus thrombosis. Also seen is some soft tissue in the left sphenoid sinus suggestive of sinusitis.

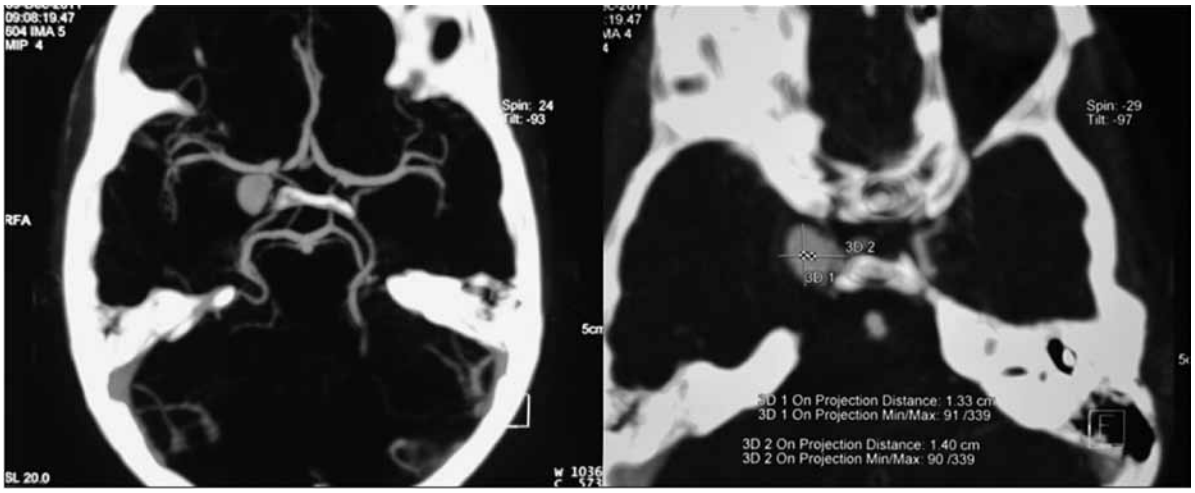

Figure 2 CT angiography of the brain (MIP images) after 2 weeks reveal a right intracavernous internal carotid artery aneurysm measuring 13.2×14.1×10.2 mm.

and ptosis. There was diplopia on distant vision. She was afebrile with no meningeal signs or vomiting. Hematological work-up revealed leucocytosis (14.8×10^9/L) with neutrophilia (13.6×10^9/L) and raised inflammatory markers (ESR 93 mm/Hr and CRP 181 mg/L). She developed right third, fourth and sixth nerve palsy, with reduced visual acuity more in the right eye 6/48 than the left 6/18. On fundus examination there was no evidence of papilledema. Echocardiography showed no evidence of abnormalities of the cardiac valves or of left ventricular dysfunction. Blood culture was negative at two days, so intravenous Flucloxacillin 1 g six hourly, Ceftriaxone 1 g daily and Metronidazole 500 mg eight hourly were empirically

instituted to provide broad spectrum cover.

After a static clinical course for two weeks, brain computed tomographic arteriography (CTA) was performed (16 slice, Siemens Medical Solutions, Erlangen, Germany) revealing an ICCA measuring 13.2×14.1×10.2 mm (Figure 2). Digital subtraction angiography (DSA) (Philips Allura Xper FD20/10 biplane) demonstrated a narrow neck saccular ICCA with narrowing of the cavernous segment of internal carotid artery (ICA) both proximal and distal to the aneurysm neck (Figure 3A). The most likely diagnosis was mycotic ICCA secondary to post infective cavernous sinus thrombosis. The patient was put on oral antibiotics Linezolid 400 mg 12 hourly and Faropenem 200mg eight hourly for a month after which her diplopia, headache, lid swelling and chemosis resolved with an improvement in visual acuity (R-6/24, L-6/12) and persistent ptosis. Follow-up CTA after a month revealed an increase in size of the ICCA which then measured 16.5×15.5×14.3 mm with the neck measuring 3 mm. Repeated blood culture remained negative.

A trial balloon occlusion of the cervical ICA was performed to assess the safety of carotid sacrifice or the need for by-pass. This resulted in no neurological deficit and demonstrated good flow from the posterior circulation through the posterior communicating artery. Of note was a significant resolution of the degree of narrowing of the cavernous internal carotid artery over a period of one month (Figure 3B). In consultation with the neurosurgery team, endovascular treatment with covered stent placement was chosen as treatment.

Endovascular Procedure

The procedure was performed under general anesthesia and full heparinization through a right femoral artery approach. Antiplatelet therapy consisting of 75 mg of clopidogrel and 325 mg of aspirin was administered daily for four days before the procedure. A 6 F introducer sheath was placed in the right femoral artery and selective catheterization of the external carotid artery was performed with a 5 F diagnostic catheter (Picard, Cook Inc., Bloomington, IN, USA) and a 180 cm, 0.035 inch hydrophilic guide wire (Radiofocus; Terumo, Tokyo, Japan). With the aid of a 0.035 inch exchange guide wire (Radiofocus; Terumo, Tokyo, Japan), the diagnostic catheter and 6 F introducer sheath were replaced by a 9 F 90 cm arterial shuttle sheath (Cook Medical, Bloomington, IN, USA) with its tip placed in the distal cervical ICA. A 7 F guiding catheter (Envoy; Cordis, Miami, FL, USA) was advanced through the shuttle sheath into the distal cervical ICA over a 0.035 inch guide wire to achieve more distal placement and enough support for delivery of the stent graft. A 0.014 microcatheter (Echleon; 0.014", ev3 Neurovascular, Irvine, CA, USA) was advanced over a 0.014 inch microguide wire (Xpedion; 0.014", ev3 Neurovascular, Irvine, CA, USA) through the guiding catheter and placed in a temporal branch of the right middle cerebral artery. The microwire was then replaced by a stiffer exchange length microguide wire (Road runner, Cook, Inc., Bloomington, IN, USA) for better support. After retrieval of the microcatheter, and using a road-mapping technique, a 3.5×27 mm balloon expandable covered coronary stent (Aneugraft PCS, ITGI Medical, Or Akiva, Israel) was placed at the level of the aneurysmal neck. Nominal pressure (8 atm) was administered. At that time, control angiography showed slight filling of the aneurysm caused by lack of sealing at the distal portion of the stent (Figure 3A). The balloon was additionally inflated to 13 atm and final angiography showed complete exclusion of the aneurysm (Figure 3B). In the postoperative course, the patient received double antiplatelet therapy with 75 mg of clopidogrel and 150 mg of aspirin daily. The procedure was well-tolerated and there were no complications. Dysfunction of the third, fourth and sixth cranial nerves had improved, but not fully resolved at consultation one month after the procedure. Follow-up CTA at one week confirmed ICA patency at the level of the stent-graft, with no filling of the aneurysmal sac (Figure 5). The patient remained on the dual antiplatelet regimen for three months and subsequent to that only aspirin was continued. Two-year follow- up of the patient is available which showed gradual resolution of the symptoms with no recurrence.

Discussion

With the advent of antibiotics, sources of infection leading to mycotic aneurysms are now more commonly extravascular adjacent septic foci, rather than embolic sources such as bacterial endocarditis. Meningitis, cavernous sinus thrombophlebitis, osteomyelitis or sinusitis are

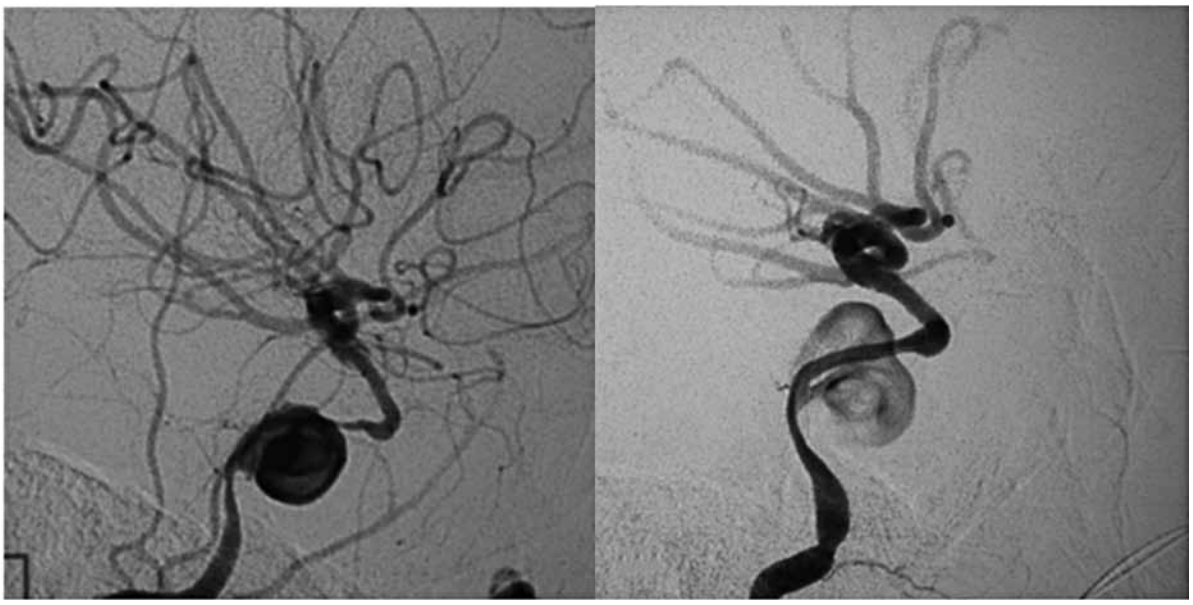

Figure 3 A) Angiogram at presentation showing the aneurysm with narrowed ICA segment. B) Follow-up angiogram after a month demonstrating an enlarged aneurysm and reduced narrowing of the ICA.

the usual causes [2,4-7]. The rare cavernous carotid mycotic aneurysms are thought to be caused by local cavernous sinus inflammation [3,8]. In our patient, the source of the cavernous sinus inflammation was infection, probably secondary to a nasal vestibulitis.

The interval from sepsis to aneurysmal dilatation is variable and can be as short as 24h [9]. In our case the time interval between initial MRI and CTA demonstration of the aneurysm was one month. Since mycotic aneurysms are unpredictable and have been shown to improve symptomatically or shrink in size, disappear, enlarge or develop thrombosis during antibiotic treatment [4,6,8], serial surveillance imaging has also been advocate [8,10], particularly in those with ophthalmoplegia [5,6,10]. Preliminary treatment with antibiotics is thought to allow reparative fibrosis to occur and thus facilitate surgical repair [11]. Early surgery or endovascular treatment can be used to manage a readily accessible or progressively enlarging mycotic aneurysm.

A rapidly developing, progressively enlarging aneurysm in a young child secondary to cavernous sinus thrombophlebitis prompted us to consider the diagnosis of mycotic aneurysm instead of non-infectious incidental aneurysm. Since the aneurysms persisted and continued to enlarge despite antibiotic treatment, endovascular treatment was considered. Initially parent artery occlusion was considered especially as the patient tolerated the balloon occlusion test. But since there is still a risk of ischemic events even after tolerating balloon occlusion, this plan was later reviewed in favor of a covered stent. The risk of stent infection, a dreaded complication, was also considered but as the patient had already received intravenous antibiotics for two weeks prior to the procedure and blood cultures were negative, this risk was thought to be minimum. Antibiotics were continued for one more week after the procedure.

Endovascular techniques in such cases include a reconstructive approach using stent grafts or other devices like flow diverters and a deconstructive approach (sacrifice of parent vessel and aneurysm) using permanent balloons or platinum coils. A balloon occlusion test is typically performed before sacrifice of the parent vessel to assess for collateral flow and predict subsequent neurological deficit. Though it helps in taking a decision of parent vessel occlusion, it may not help in identifying the small subset of patients in whom delayed hemodynamic ischemia develops after the ICA is permanently occluded. This complication results from factors such as thromboembolism from an acutely occluded carotid artery, or delayed failure of a collateral vessel.

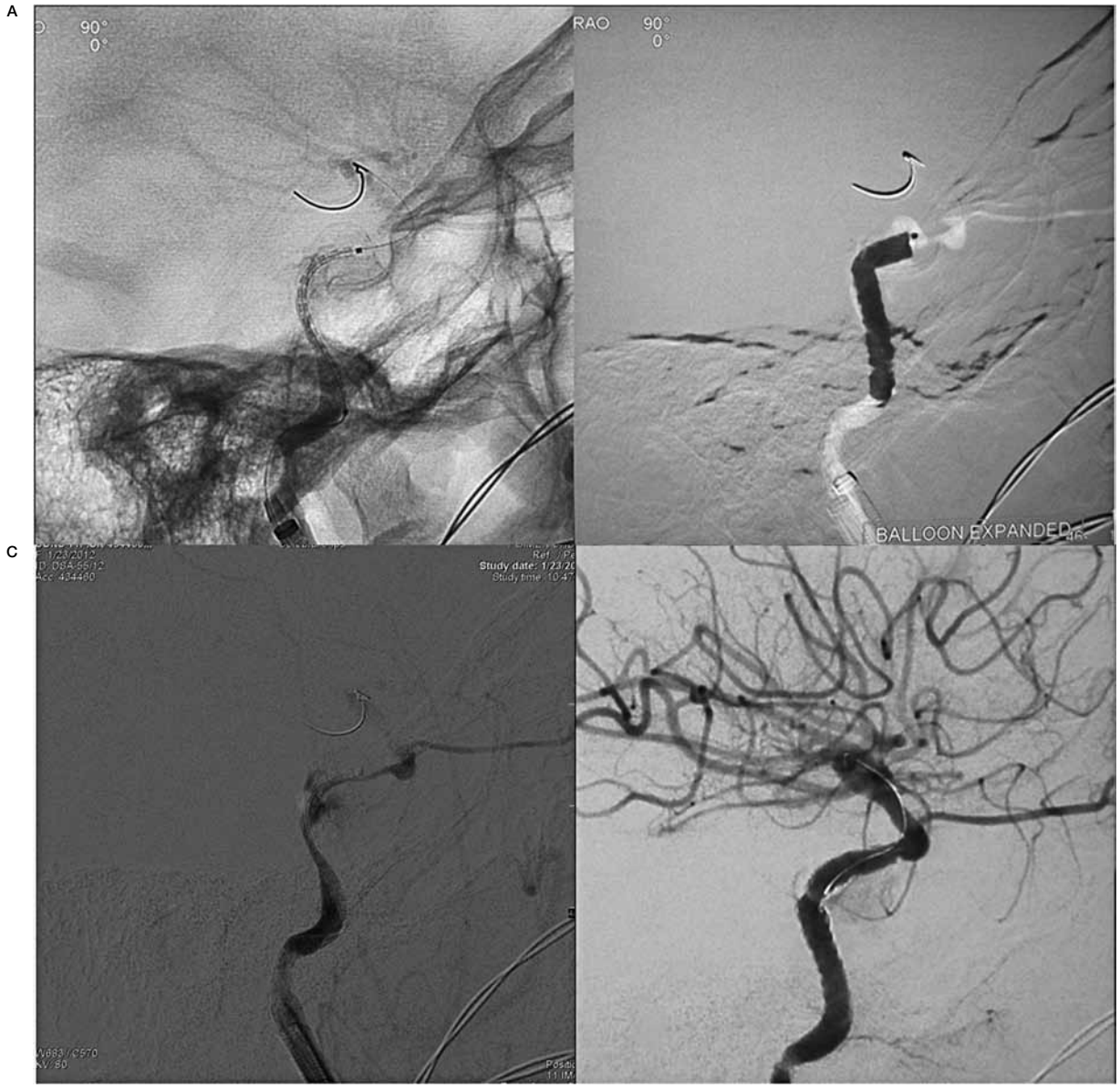

Figure 4 A,B) The microwire is negotiated beyond the aneurysm and a balloon expandable stent graft (Aneugraft PCS) deployed over it. C) The post-stenting angiogram shows slight residual filling of the aneurysm. D) Final check angiogram after the 2nd balloon inflation revealed non opacification of the aneurysm with patent cavernous ICA.

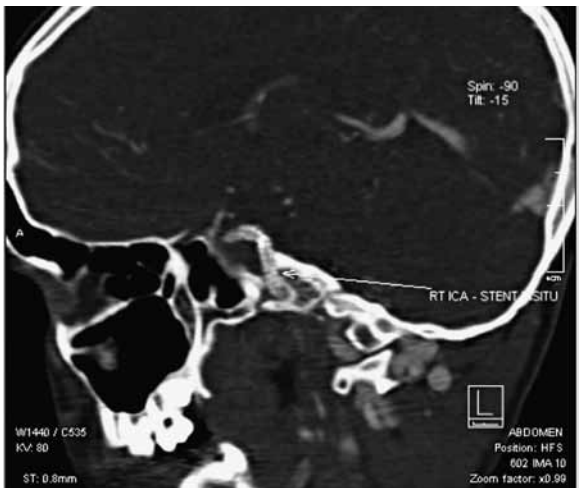

Figure 5 Follow-up CT angiography at 1 week confirmed ICA patency at the level of the stent-graft, with non opacification of the aneurysmal sac.

Reconstructive approaches include reconstruction of the involved vessel and segregation of the aneurysm using either a stent graft or flow diverter. Poly-tetra-fluoro-ethylene (PTFE)-covered stents and polyethylene terephthalate endograft prostheses have also been successfully used for treatment of pseudoaneurysms of the cervical ICA and common carotid artery blow-out. Chang et al. recommended use of covered stent in patients with acute carotid blow-out that precludes performance of an occlusion test, as well as when carotid occlusion poses an unusually high risk of neurologic morbidity [12]. With the use of covered stents there is a risk of occlusion of side branches, which may lead to neurological deficit. In our case, however, there was minimal concern about side-branch occlusions because the stent graft was to be placed in the vertical and horizontal portion (C5-C3) of the intracavernous ICA and a wide range of anastomoses are present in this area which permit their covering without neurologic damage [13,14]. Another type of reconstructive approach was recently demonstrated by Appelboom et al. who reported successful treatment of mycotic ICCA using a SILK flow-diverting endoluminal implant placed across the aneurysm neck [15]. Flow diverters are relatively safer to place compared to more rigid stent grafts, but complete occlusion of the aneurysm is not immediate and there is definite risk of delayed hemorrhage.

The covered stent used in the index case was the 'Aneugraft PCS', a percutaneous implantable device consisting of a 316L stainless steel bare metal stent covered by an equine pericardium cylinder. The pericardium cylinder is sutured with a polypropylene suture onto the bare metal stent designed to set a barrier between the blood vessel wall and its lumen. The stent assembly is mounted on a balloon catheter specially designed for tortuous vessels. Treatment with this stent offers the additional advantage of maintaining the patency of the parent artery with respect to previously reported endovascular treatments.

Although we report only one successful case, we suggest that the stent graft could be an additional treatment consideration for those patients with proximal intracranial mycotic aneurysms not responding to medical treatment. However, further investigation on the use, long-term effectiveness, and safety of this stent should be undertaken before routine use in the treatment of mycotic aneurysms.

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