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Clinical Study

Endovascular stenting for treatment of mycotic intracranial aneurysms

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ABSTRACT

Mycotic intracranial aneurysms (MIA) are a rare form of cerebrovascular pathology for which obliteration must be undertaken when they present with rupture or fail to respond to antibiotic therapy. Intracranial stents provide the unique ability to simultaneously preserve parent vessel integrity while obliterating the aneurysmal sac, but their use for the treatment of MIA has only been reported in a few instances for proximally located lesions. We report a patient with a MIA treated with endovascular stenting and review the literature for similar cases. Three case reports of four MIA treated with either stent monotherapy or stent-assisted coil embolization were identified. The clinical and radiographic features of each case were detailed. A 35-year-old with bacterial endocarditis from *Streptococcus mitis* was diagnosed with a ruptured 3 mm MIA of the pericallosal anterior cerebral artery after episodic diplopia. The MIA was successfully treated with stent-assisted coil embolization utilizing a Neuroform EZ stent (Stryker Neuroendovascular, Kalamazoo, MI, USA). Follow-up magnetic resonance angiography at 3 months demonstrated complete aneurysm obliteration, and the patient was neurologically intact. In the literature, a M1 segment middle cerebral artery MIA, bilateral cavernous carotid MIA, and a unilateral cavernous carotid MIA were also successfully treated with Neuroform, Helistent (Hexacath, Rueil-Malmaison, France), and SILK (BALT Extrusion, Montmorency, France) stents, respectively. We present the first patient with a pericallosal MIA treated with stent-assisted coil embolization. Proper treatment of the causative organism with antibiotics minimizes the risk of infectious seeding of the stent. Intracranial stenting may be safely and effectively utilized to treat select cases of MIA.

1. Introduction

Mycotic intracranial aneurysms (MIA) represent a unique class of cerebrovascular pathology and account for approximately 1–6% of cerebral aneurysms [1,2]. The management of MIA consists of antibiotic coverage of the offending organism with or without aneurysm obliteration via microsurgical or endovascular approaches. In contrast to classical saccular intracranial aneurysms, treatment of MIA is challenging due to the fragile nature of the affected parent artery and aneurysm wall which frequently precludes simple microsurgical clipping or endovascular coil embolization. Sacrifice of the parent artery, by either microsurgical or endovascular techniques, is a definitive solution but is not always possible without resultant significant neurological morbidity [3,4]. The development of intracranial stents has drastically broadened the ability of endovascular interventionalists to treat a wider array of aneurysm morphologies [5]. However, the use of intracranial stents to treat MIA has only been reported in a few cases for proximally located aneurysms. We describe a patient with a ruptured pericallosal MIA treated with stent-assisted coil embolization and performed a literature review of all cases of MIA treated with endovascular stenting.

2. Methods

The clinical and radiographic data from our case report was collected by review of our electronic medical records at the University of Virginia. All imaging, including CT scan, CT angiography, MRI, magnetic resonance angiography (MRA), and digital subtraction angiography (DSA), was obtained from our institution's picture archiving and communication system. The patient was treated at the University of Virginia, USA, as an inpatient on the cardiothoracic surgery service and followed up as an outpatient in our neurosurgery clinic following his MIA treatment.

We performed a comprehensive search of the English literature up to and including February 28, 2013 using PubMed to identify all patients with MIA treated with endovascular stenting with or without additional coil embolization. Three case reports of four MIA were identified, comprising a single cavernous internal carotid artery (ICA) MIA, bilateral cavernous ICA MIA, and a proximal middle cerebral artery (MCA) MIA [4,6,7]. The clinical characteristics,

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including patient age, presentation, infectious etiology, causative organism, duration of follow-up, and modified Rankin Scale score at last follow-up, are detailed in Table 1. The radiographic characteristics, including aneurysm rupture status, location, size, and angiographic outcome at follow-up, type of stent used, and procedural complications were reported as well (Table 2).

3. Case report

A 35-year-old immigrant from El Salvador was diagnosed with bacterial endocarditis at a referring hospital. Blood cultures were positive for *Streptococcus mitis* and transthoracic echocardiography showed aortic and mitral valve vegetations. The patient was started on intravenous vancomycin, piperacillin-tazobactam, and gentamicin at the referring hospital prior to transfer to our institution. Upon evaluation by our infectious diseases team, the patient's vancomycin was converted, based on the blood culture results, to penicillin G continuous infusion. Transesophageal echocardiography confirmed the aortic and mitral valve vegetations accompanied by severe mitral regurgitation through a large perforation in the anterior leaflet of the mitral valve. Due to the patient's cardiac decompensation from his valvular vegetations, the cardiothoracic surgery team elected to pursue surgical repair.

Prior to the planned cardiothoracic surgical intervention, the patient complained of intermittent diplopia but was otherwise neurologically intact. MRI of the brain showed multiple foci of septic emboli. CT scan and computed tomography angiography of the head revealed a ruptured 3 mm MIA of the right distal pericallosal artery with associated hemorrhage in the anterior corpus callosum (Fig. 1). After discussion with the cardiothoracic surgery team, we felt that intraoperative administration of high-dose intravenous heparin during cardiac valvular repair would pose an unacceptably high risk of rerupture of the pericallosal MIA. Therefore we decided to secure the aneurysm by an endovascular approach prior to valvular repair. The patient was pre-treated with 5 days of dual antiplatelet therapy consisting of aspirin 325 mg daily and clopidogrel 75 mg daily in addition to the aforementioned broad spectrum antibiotics for 7 days prior to our intervention. Aspirin and P2Y assay reactions showed serum levels of 640 aspirin reaction units and 9 P2Y12 reaction units, respectively.

We successfully performed endovascular stent-assisted coil embolization of the patient's pericallosal MIA arising from the A3–A4 segment junction (Fig. 2). After obtaining femoral access, 3000 units of intravenous heparin was administered to achieve an activated clotting time of 228 seconds and a 6 French Chaperon guiding catheter (MicroVention, Tustin, CA, USA) was navigated into the right ICA over a guidewire. An Excelsior XT-27 pre-shaped flex microcatheter (Stryker Neuroendovascular, Kalamazoo, MI, USA) was navigated into the distal right anterior cerebral artery (ACA) over a Synchro2 microwire (Stryker Neuroendovascular) under roadmap guidance after which the microwire was carefully removed and a 2.5×15 mm Neuroform EZ stent (Stryker Neuroendovascular) was positioned across the neck of the aneurysm but not deployed. Next, an Excelsior SL-10 microcatheter (Stryker Neuroendovascular) was advanced into the aneurysm sac over a Synchro2 microwire under roadmap guidance. The stent was then deployed into the right A3 segment ACA across the aneurysm neck, jailing the SL-10 microcatheter in the aneurysm. The XT-27 microcatheter was carefully removed prior to coil delivery. A single Stryker Target 360 Ultra 1×3 mm coil was deployed into the aneurysm resulting in 20% packing density. After the first coil was deployed, an additional 2000 units of intravenous heparin was administered. We achieved 90% aneurysm obliteration with only mild residual neck filling. DSA also revealed two additional mycotic aneurysms of the bilateral distal MCA, including an irregular 1.5×3 mm left MCA M3 segment opercular aneurysm and a fusiform 4×1 mm right MCA M4 segment posterior cortical branch aneurysm. There were no periprocedural complications, and dual antiplatelet was continued through the cardiac valve surgery.

One week later, the patient subsequently underwent an uncomplicated aortic valve replacement and mitral valve repair. The patient was transitioned from dual antiplatelet therapy to therapeutic anticoagulation on warfarin for his valvular repairs. The patient was discharged from the hospital 1 week following his cardiac surgery after a total hospital stay of 3 weeks. At discharge his initial broad spectrum antibiotics were narrowed down to only ceftriaxone, a third generation cephalosporin, following finalization of cultures and antibiotic susceptibilities. Followed by the infectious diseases service, the patient subsequently underwent a total 6 week course of intravenous antibiotics. At his 3 month clinical and radiographic follow-up, the patient remained neurologically intact and MRA showed complete obliteration of the pericallosal MIA as well as shrinkage of the left MCA MIA and resolution of the right MCA MIA (Fig. 3).

4. Literature review

Sugg et al. reported the first patient with a MIA treated with endovascular stenting [4]. A 47-year-old with a medical history including atrial fibrillation, peripheral vascular disease, and diabetes mellitus presented with headache and hemiplegia. CT scan of the head showed an acute left basal ganglia ischemic infarct and a small amount of subarachnoid hemorrhage. DSA showed a fusiform supraclinoid ICA aneurysm with superimposed focal aneurysms of the distal supraclinoid ICA, ICA bifurcation, and left MCA M1 segment. The patient was diagnosed with bacterial endocarditis after transesophageal echocardiography demonstrated a mitral valve vegetation thereby establishing the diagnosis of MIA. After 11 days of broad spectrum antibiotic and antifungal therapy, repeat DSA showed enlargement of the focal aneurysms as well as development of an accessory lobule in the proximal MCA aneurysm. Due to the initial pattern of infarct and subarachnoid hemorrhage, the M1 segment MIA was presumed to have ruptured. With the development of a daughter aneurysm on repeat DSA, there was high suspicion for risk of rerupture. Therefore, the decision was made to proceed with endovascular therapy. A Neuroform stent was successfully deployed across all three MIA spanning the distal

Table 1
Summary of patient characteristics and outcomes

Reference (Year)	Age, years	Clinical presentation	Etiology	Pathogen	Follow-up	Modified Rankin Scale score
Current patient (2013)	35	Diplopia	Bacterial endocarditis	*Streptococcus mitis*	3 months	0
Sugg et al. [4] (2006)	47	Hemiplegia, headache	Bacterial endocarditis	Unknown	None	3
Yen et al. [7] (2007)	46	Ophthalmoplegia	Meningitis	*Streptococcus constellatus*	6 months	1
Appelboom et al. [6] (2010)	10	Ophthalmoplegia	Meningitis	*Streptococcus pneumonia*	3 months	0