Clinical Neurology and Neurosurgery 115 (2013) 2528–2532

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

Endovascular treatment of distal intracranial aneurysms with Onyx 18/34

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ARTICLE INFO

Article history:
Received 10 August 2013
Received in revised form 1 October 2013
Accepted 27 October 2013
Available online 1 November 2013

Keywords:
Aneurysm
Distal
Endovascular
Intracranial
Onyx

ABSTRACT

Objective: Surgical clipping and coil embolization of distally located intracranial aneurysms can be challenging. The goal of this study was to assess the feasibility, safety and efficacy of treatment of distal aneurysms with the liquid embolic agent Onyx 18/34.
Methods: Sixteen patients were treated with Onyx 18/34 for distally located aneurysms in our institution between March 2009 and September 2012. The technique consists of occluding the aneurysm as well as the parent vessel at the level of aneurysm with Onyx 18 or 34. Candidates for this treatment were patients with distal aneurysms including mycotic aneurysms, dissecting aneurysms, and pseudoaneurysms in which coiling was considered impossible.
Results: Of the 16 patients, 12 presented with subarachnoid and/or intracerebral hemorrhage. Median aneurysm size was 4.6 mm. Aneurysm locations were as follows: Posterior inferior cerebellar artery ($n = 5$), distal anterior inferior cerebellar artery ($n = 3$), distal pericallosal ($n = 3$), distal anterior cerebral artery ($n = 3$), lenticulostriate artery ($n = 1$), and anterior ethmoidal artery ($n = 1$). There were 4 mycotic aneurysms. Complete aneurysm obliteration was achieved in all 6 patients with available angiographic follow-up. There was only 1 (6.3%) symptomatic complication in the series. There were no instances of reflux or accidental migration of embolic material. Favorable outcomes were noted in 82% of patients at discharge. Two patients with mycotic aneurysms died from cardiac complications of endocarditis. No aneurysm recanalization or rehemorrhage were seen.
Conclusion: Parent vessel trapping with Onyx 18/34 offers a simple, safe, and effective means of achieving obliteration of distal challenging aneurysms.

1. Introduction

Distally located aneurysms are rare accounting for only 7–9% of anterior cerebral artery aneurysms, 5% of posterior cerebral artery aneurysms, and 2–7% of middle cerebral artery aneurysms [1]. Distal aneurysms are often small, fusiform, thin-walled, and prone to hemorrhage, which makes endosaccular access and coiling technically difficult and hazardous, so that parent artery sparing is usually neither feasible nor safe. Surgical clipping is also challenging due to difficulty in aneurysm localization and may be associated with significant morbidity [2,3]. The purpose of this study was to assess the feasibility, safety and efficacy of treating distal intracranial aneurysms with the liquid embolic agent Onyx 18/34 (EV3, Irvine, California, USA).

2. Methods

The study protocol was approved by the University Institutional Review Board. Between March 2009 and September 2012, a total of 16 patients were treated with Onyx 18/34 for distally located intracranial aneurysms in our institution.

The technique consists of occluding the aneurysm as well as the parent vessel at the level of aneurysm with Onyx 18 or 34. Candidates for this treatment were patients with distal aneurysms including mycotic aneurysms, dissecting aneurysms, and pseudoaneurysms in which coiling was considered impossible. The decision to sacrifice the parent vessel was based on the extent of the collateral circulation, the eloquence of the involved artery, and in some cases on amobarbital injection testing at the operator's discretion.

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http://dx.doi.org/10.1016/j.clineuro.2013.10.018

A retrospective chart review was performed to determine patient baseline characteristics, procedural specifics, and treatment outcomes.

2.1. Technique

All procedures were performed under general anesthesia and continuous electrophysiological monitoring including somatosensory evoked potentials, brainstem auditory evoked responses, and electroencephalography. Patients who sustained a subarachnoid hemorrhage with a Hunt and Hess grade of III or higher underwent placement of ventriculostomy catheters, central venous catheters, and radial arterial lines. Patients with unruptured aneurysms received an initial 100 u/Kg bolus of heparin and then activated clotting time was maintained at 2–3 times the baseline intraoperatively. For aneurysms coiled in the setting of SAH, a bolus of 50 u/Kg of heparin was given.

After femoral access was obtained and a guide catheter placed, a Marathon 10 microcatheter (EV3, Irvine, California, USA) directed by a Synchro-10 microguidewire (Stryker, Fremont, California, USA) was advanced into the target vessel. The microcatheter was positioned at the origin of the aneurysm, whenever possible. A superselective angiogram was performed to evaluate the aneurysm and the outflow. Onyx was then slowly injected to occlude the aneurysm and the parent vessel, limiting distal migration to just past the aneurysm neck. The choice between Onyx 18 and Onyx 34 was mostly based on operator's preference. When the microcatheter could not be navigated into the ostium of the aneurysm, Onyx 18 was generally preferred because of its ability to travel more distally along the vessel. Once embolization was complete, cerebral angiograms were performed to confirm aneurysm obliteration.

3. Results

The median patient age in the series was 59.5 years, with a range of 25–78 years. Seven patients were women and 9 were men. Median aneurysm size was 4.6 mm, with a range of 1–12 mm. Of the 16 patients, 12 (75%) presented with subarachnoid and/or intracerebral hemorrhage. There were 4 (25%) mycotic aneurysms, 3 of which had caused a hemorrhage (the remaining aneurysm was discovered incidentally in a patient with a history of drug abuse and endocarditis). Aneurysms were associated with an arteriovenous malformation in 3 patients and with moyamoya disease in 1 patient. Aneurysm locations were as follows: Distal posterior inferior cerebellar artery (PICA) ($n = 5$), distal anterior inferior cerebellar artery (AICA) ($n = 3$), distal pericallosal ($n = 3$), distal anterior cerebral artery ($n = 3$), lenticulostriate artery ($n = 1$), and anterior ethmoidal artery ($n = 1$).

The aneurysm was occluded with Onyx 18 in 12 (75%) patients and Onyx 34 in 4 (25%) patients. The median volume of Onyx used was 0.3 ml. In all patients, complete obliteration (100%) of the aneurysm and parent vessel was achieved. There was only 1 (6.3%) symptomatic complication in the series. This was a patient with a distal PICA aneurysm who developed new bilateral cerebellar infarcts after the procedure but recovered well with complete reversal of his symptoms by the time of discharge. There were no instances of reflux or accidental migration of embolic material.

At time of discharge, favorable outcomes (Glasgow outcome scale IV or V) were noted in 13 (82%) patients. Two patients with mycotic aneurysms died from cardiac complications of endocarditis and 1 patient with a nonmycotic aneurysm presenting with a Hunt and Hess grade III subarachnoid hemorrhage was left significantly disabled secondary to refractory vasospasm. Two patients were lost to follow-up. All 12 patients with available clinical follow-up, including 2 patients with mycotic aneurysms, achieved a favorable outcome at a median follow-up time of 7 months. Six patients underwent follow-up angiography at a median of 6 months. There was complete aneurysm occlusion in all 6 patients. There were no instances of rehemorrhage in the series.

4. Illustrative cases

4.1. Case 1

A 60-year-old woman was transferred to our institution with a grade III subarachnoid hemorrhage. After placement of a ventriculostomy catheter, she was taken to the interventional neuroradiology suite where a cerebral angiography demonstrated a distal right AICA aneurysm consistent with a dissecting aneurysm (Fig. 1A). Given the location of the aneurysm, the small caliber of the AICA, and the dissected nature of the vessel, we decided to occlude the AICA and the aneurysm with Onyx. Although there was a risk of right-sided deafness in this patient (as the supply to the cochlea is from a branch of the AICA), in case of proximal occlusion, an abundant collateral network is present, including the anterior tympanic branch of the internal maxillary artery, the inferior tympanic branch of the ascending pharyngeal artery, the posterior tympanic artery from the stylo-mastoid artery. Under roadmap guidance, a Marathon microcatheter was advanced into the right AICA. Superselective injections were performed, confirming the position of the catheter just proximal to the aneurysm (Fig. 1B). We subsequently injected 0.3 ml of Onyx 34 (Fig. 1C). The microcatheter was removed and final control angiograms demonstrated complete occlusion of the parent vessel and preservation of the proximal AICA (Fig. 1D). The procedure and postoperative course were uneventful and the patient was neurologically intact at clinical follow-up.

4.2. Case 2

A 40-year-old man with a history of intravenous drug use was transferred to our institution after being found unconscious at his home. Emergent CT scanning demonstrated a left frontoparietal parenchymal hemorrhage with mild adjacent subarachnoid hemorrhage. CT angiography demonstrated 2 mycotic aneurysms, one in the left middle cerebral artery at an M2 bifurcation unrelated to the hemorrhage and another located distally in the anterior cerebral artery within the intracerebral hemorrhage. The patient was taken to the interventional neuroradiology suite for treatment of his aneurysm. On digital subtraction angiography, in the area of the intracerebral hemorrhage, there was a 2 mm mycotic aneurysm arising distally from the anterior cerebral artery (Fig. 2A). Under roadmap guidance, a Marathon microcatheter was advanced into the anterior cerebral artery (Fig. 2B). Superselective injections confirmed the position of the microcatheter just proximal to the aneurysm (Fig. 2C). The vessel was occluded with 0.3 mL of Onyx 18. Control angiography demonstrated complete aneurysm obliteration with no evidence of distal embolization (Fig. 2D). There were no procedural complications. The plan was to treat his M2 aneurysm surgically at a later time. The patient was diagnosed with aortic valve endocarditis and recovered well from a neurological standpoint. He later developed complete heart block, however, and expired on post-operative day 13.

5. Discussion

Endovascular techniques have been gaining ground in the management of intracranial aneurysms. At our institution, endovascular therapy has become a first-line option for most aneurysms [4–10]. In this study, we assessed our experience with Onyx embolization of distal aneurysms. Onyx is a non-adhesive liquid embolic