Balloon-Assisted Technique for Trapped Microcatheter Retrieval Following Onyx Embolization

A Case Report

A. SANTILLAN, W. ZINK, J. KNOPMAN, H. RIINA, Y.P. GOBIN

Department of Radiology, New York Presbyterian Hospital - Cornell; New York, USA

Key words: AVM, arteriovenous malformation, Onyx, microcatheter retrieval, balloon

Summary

During embolization of a large frontal arteriovenous malformation (AVM), Onyx-18 (eV3) was injected into an M3 branch of the middle cerebral artery via a Marathon microcatheter (eV3). After 40 minutes of embolization, the microcatheter could not be retracted due to fixation within the Onyx cast despite prolonged, robust attempts. A balloon microcatheter (Hyperform™, eV3) was advanced distally and inflated to provide distal counter tension, allowing microcatheter retrieval with minimal traction on the vasculature.

Introduction

Difficulty removing the microcatheter after Onyx injection is a well known drawback of liquid embolization materials and there are multiple reported (and probably many more unpublished) cases of catheters glued into the cerebral circulation after Onyx injection¹⁻⁸. We describe a case of successful retrieval of a retained microcatheter during a preoperative AVM embolization with Onyx-18.

Case Report

A 34-year-old right-handed man presenting with seizures underwent magnetic resonance angiography, demonstrating a large right fron-

tal AVM. The patient then underwent cerebral angiography and treatment by staged endovascular embolizations.

Following right groin puncture and placement of a 6 French (Fr) sheath into the right common femoral artery (CFA), cerebral angiography was performed. A right common carotid injection demonstrated feeding arteries arising from multiple enlarged Sylvian branches of the right middle cerebral artery (MCA). The right anterior cerebral artery (ACA) was not opacified due to steal effect. A left common carotid artery injection demonstrated filling of the bilateral ACAs, with multiple feeding arteries arising from markedly enlarged right A2 and A3 branches. The left and right vertebral artery injections contributed supply to the AVM via a patent right posterior communicating artery (PCoA) and the right MCA. Decision was made to perform an embolization of approximately 25-30% of the AVM nidus using for access a branch of the right MCA.

Following diagnostic angiography, a 6-French Envoy catheter was advanced over a 0.035 angled Glidewire into the distal right internal carotid artery (ICA). Intravenous (iv) heparin was administered and a Marathon microcatheter was advanced over a Mirage 0.008 microwire into an anterior MCA feeding branch. The microcatheter was navigated into the AVM nidus, flushed with saline followed by dimethyl sulfoxide (DMSO) and Onyx-18 was carefully

Figure 1 Lateral projection fluoroscopy demonstrates a Marathon microcatheter fixed into position by Onyx-18 embolization material within an M2 segment of the right middle cerebral artery (MCA). Robust attempts at retraction caused straightening of the M2 segment, without catheter retraction.

injected through the microcatheter into the anterosuperior aspect of the AVM nidus under subtraction fluoroscopy for approximately 40 minutes. After verifying adequate penetration of the nidus, a post-embolization ICA an-

Figure 2 A balloon microcatheter was advanced into the same M2 branch containing the fixed microcatheter. The balloon was inflated, providing counter tension and allowing retraction and removal of the previously fixed microcatheter.

giogram showed successful embolization of approximately 25% of the AVM at the anterosuperior aspect of the nidus. Patent feeding arteries arising from the right MCA and ACA were identified and the decision was made to perform further embolization at a later time.

Following embolization, microcatheter retraction from the MCA feeding artery was attempted without success, despite prolonged, robust attempts during which there was displacement of the Onyx cast (Figure 1). It was decided to advance a balloon into the same feeding artery for the purpose of applying counter tension and facilitating retraction of the trapped microcatheter. The left common femoral artery then was punctured and 6-French sheath placed into the left CFA. A 6-French envoy catheter was advanced over a 0.035 angled Glidewire into the right ICA. A 4 mm x 7 mm Hyperform balloon (eV3) was advanced over a microwire into the same distal right MCA branch occupied by the trapped microcatheter (Figure 2). The balloon was inflated under fluoroscopic guidance to match the arterial diameter and the Marathon microcatheter was retracted with moderate traction while the balloon catheter was pushed forward to provide counter-support, with no movement of the Onyx cast. Following catheter retrieval, the balloon was deflated and removed. Post-extraction right ICA angiography demonstrated mild vasospasm of the right MCA, without evidence of extraluminal contrast extravasation or other arterial injury. Verapamil (5 mg in 20 cc of saline) was injected into the right ICA and angiography demonstrated resolution of vasospasm.

Discussion

Onyx is a cohesive, nonadhesive liquid embolic agent with which one can achieve better penetration of an AVM nidus than older embolic agents such as NBCA. The standard injection entails allowing the Onyx to reflux around the microcatheter tip to form a plug. After a peri-catheter plug has formed, Onyx is then advanced antegrade into the AVM nidus. Reflux along the microcatheter tip typically is up to 1-2 cm long and one Onyx injection can last 15 minutes to an hour or occasionally even longer. However, greater reflux and longer injection times are associated with difficulty removing the microcatheter. Even when Onyx is

not adherent to the microcatheter, the microcatheter can be mechanically fixed within the Onyx cast^{1,2,4,9}.

Several approaches can be taken to address retained microcatheters. The simplest is to prepare for the possibility prior to the case by using the Sonic (Balt, Montmorency, France) microcatheter, which has a detachable tip intended to remain in place within the Onyx cast following embolization. This catheter is not available in the United States. A monorail snare technique has been used when an unfractionated microcatheter is retained in the extracranial circulation. However, when used intracranially, the monorail snare poses risks of endothelial injury, perforation or dissection⁹. Alternatively, a retained microcatheter can be severed at the groin^{5,9} and left in place to endothelialize in coming days to weeks under antiplatelet pharmacotherapy^{9,10}. Neurologic complications associated with retained intracranial microcatheters are rare but include arterial thrombosis and cerebral infarction^{5,9,10}. In addition, pseudoaneurysm or thrombosis of the femoral artery puncture site secondary to a retained catheter have been described and can necessitate surgical removal^{5,10}.

In this case, we advanced a Hyperform balloon into the M3 branch where the microcatheter was stuck and inflated the balloon to match vessel diameter. Then, by simultaneously

pulling the microcatheter and pushing the balloon catheter, strong traction could be applied to the microcatheter with minimal movements of the Onyx cast, allowing for microcatheter retrieval.

While useful in some cases such as the one presented here, this technique is not without limitation. For example, if tension on the retained microcatheter and counter tension on the more proximal balloon are not balanced, the technique may cause MCA rupture and intracranial hemorrhage. In such a scenario, the balloon could be helpful for hemostasis. In addition, in the particular case of a proximal curve at the level of a bifurcation, force applied to the balloon could lead to plication of the parent vessel without intended counterforce applied in the region of the retained microcatheter. However, we feel that these pitfalls can be overcome by using continuous fluoroscopy to monitor for vessel plication and by providing careful attention to balancing the manual counter forces applied to the microcatheter and balloon.

Conclusions

Balloon assisted retrieval technique can be used to remove a retained microcatheter from an Onyx cast following AVM embolization.

References

- 1 Weber W, Kis B et Al: Endovascular treatment of intracranial arteriovenous malformations with onyx: technical aspects. *Am J Neuroradiol* 28: 371-377, 2007.
- 2 Lv X, Jiang C et Al: Results and complications of transarterial embolization of intracranial dural arteriovenous fistulas using Onyx-18. *J Neurosurg* 109: 1083-1090, 2008.
- 3 van Rooij WJ, Sluzewski M, Beute GN: Brain AVM embolization with Onyx. *Am J Neuroradiol* 28: 172-177; discussion 178, 2007.
- 4 Lv X, Jiang C et Al: Embolization of intracranial dural arteriovenous fistulas with Onyx-18. *Eur J Radiol* 2009.
- 5 Bingol H, Sirin G et Al: Management of a retained catheter in an arteriovenous malformation. Case report. *J Neurosurg* 106: 481-483, 2007.
- 6 Hauck EF, Welch BG et Al: Preoperative embolization of cerebral arteriovenous malformations with onyx. *Am J Neuroradiol* 30: 492-495, 2009.
- 7 Mounayer C, Hammami N et Al: Nidal embolization of brain arteriovenous malformations using Onyx in 94 patients. *Am J Neuroradiol* 28: 518-523, 2007.
- 8 Katsaridis V, Papagiannaki C, Aimar E: Curative embolization of cerebral arteriovenous malformations (AVMs) with Onyx in 101 patients. *Neuroradiology* 50: 589-597, 2008.
- 9 Kelly ME, Turner Rt et Al: Monorail snare technique for the retrieval of an adherent microcatheter from an onyx cast: technical case report. *Neurosurgery* 63: ONSE89; discussion ONSE89, 2008.
- 10 Zoarski GH, Lilly MP et Al: Surgically confirmed incorporation of a chronically retained neurointerventional microcatheter in the carotid artery. *Am J Neuroradiol* 20: 177-178, 1999.

Walter E Zink, PhD, M.D.
Department of Radiology
New York Presbyterian Hospital – Cornell
New York, USA
E-mail: waz2002@nyp.org