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Technical Note

Novel double catheter technique with detachable microcatheter for the treatment of arteriovenous malformations: A technical note

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Abstract

Background: Onyx has improved the safety and efficacy of endovascular treatment in the management of cerebral arteriovenous malformations (AVMs). However, during injection inadvertent reflux around the delivery microcatheter into important normal arterial branches remains a major challenge.

Methods: We describe a new double arterial catheterization technique using a detachable tip microcatheter in conjunction with a second microcatheter to form a proximal antireflux Onyx plug. This novel technique allows for increased amounts of Onyx to be steadily injected while avoiding dangerous backflow in the treatment of AVMs.

Results: The patient tolerated the procedure well without changes in hemodynamics. Using the novel double catheter technique, a significant portion of the AVM was embolized and the patient had no complications postoperatively.

Conclusions: The novel double catheter technique with a detachable microcatheter is a safe and effective technique to increase the amount of Onyx embolization material into the AVM nidus.

Key Words: Cerebral arteriovenous malformations, embolization, Endovascular treatment, Onyx

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INTRODUCTION

Endovascular treatment is commonly used as an adjuvant therapy in the management of cerebral arteriovenous malformations (AVMs), either for preoperative reduction in vascularity, or pre-radiosurgical volume reduction. The widespread use of Onyx has improved the curative rates of embolization as it allows for more controlled injection over a period of time.[4] However, inadvertent occlusion of the draining vein before complete occlusion of the nidus and reflux around the delivery microcatheter into an important arterial branch remains a major challenge. We describe a new double arterial catheterization technique using a detachable tip microcatheter in conjunction with a second microcatheter to form a proximal Onyx plug to treat an AVM.

ILLUSTRATIVE CASE

A 21-year-old man was admitted secondary to intracerebral hemorrhage due to rupture of a known AVM. He had an external ventriculostomy drain placed

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for hydrocephalus that was weaned without the need for shunting. Cerebral digital subtraction angiography (DSA) showed a right frontal Spetzler–Martin grade V AVM with supply from right middle cerebral artery (MCA) and anterior cerebral artery (ACA) feeders with superficial and deep drainage. Four sessions of Onyx embolization were performed to occlude the medial deeper portion of the AVM with intranidal aneurysm along a distal right ACA feeder. In the fifth session, a double catheterization technique was used to create an antireflux Onyx plug around the detachable part of an Apollo™ micro catheter to allow for greater penetration of the nidus [Figure 1].

Through a 6 Fr Envoy guide catheter, an Echelon-10 microcatheter was advanced over a 0.08 in microwire (Mirage, ev3) to access a distal M4 branch supplying the AVM. An Apollo™ 3 cm detachable tip microcatheter was navigated alongside the first catheter in the same feeder but more distally into the nidus. Super selective microinjection was performed through both catheters to identify the distal aspect of the target vessel supplying the nidus and identifying any en-passage vessels. The Echelon microcatheter tip was positioned between the most distal marker and the detachment zone of Apollo and preloaded with 0.34 cc of dimethyl sulfoxide DMSO. Under continuous roadmap guidance, approximately 0.4 cc of Onyx 34 was embolized into the feeding branch vessel to build an Onyx plug to prevent reflux. Once an adequate plug had been created, the Echelon catheter was removed under fluoroscopic guidance. The Apollo microcatheter was then preloaded with 0.23 cc of DMSO and 1.7 cc of Onyx 18 was embolized into the nidus of the AVM.

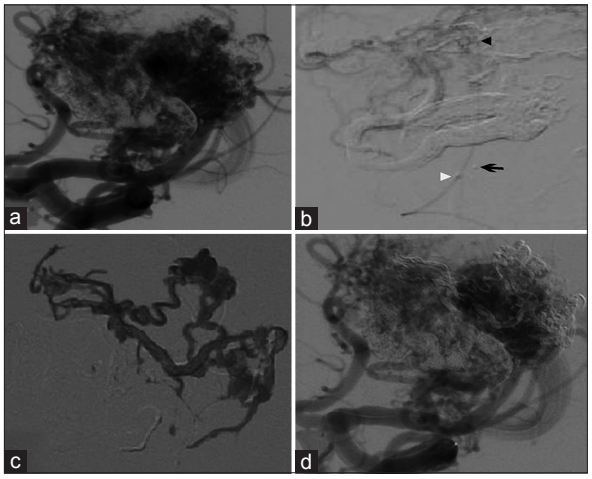

Figure 1: (a) Digital subtraction angiography prior to staged embolization with right internal carotid artery selective injection demonstrating arteriovenous malformation (AVM) (b) Double microcatheter technique with superselective injection ensuring that Onyx will not enter en-passage arteries; black arrowhead points to the detachment zone of the Echelon microcatheter with contrast injection, white arrowhead points to the coil detachment of the Echelon microcatheter, and the arrow points to the detachment tip of the Apollo microcatheter (c) Onyx within nidus of AVM after detachment of Apollo. (d) Control angiogram shows reduction in AVM opacification

After embolization was confirmed by control angiogram, the Apollo tip was successfully detached and was withdrawn under fluoroscopic guidance. Flow was eliminated through a significant portion of the nidus using this technique. The patient remained hemodynamically stable throughout the procedure and no immediate complications were noted.

DISCUSSION

While the nonadhesive nature of Onyx (ev3, Irvine, California), allows for prolonged and repeated injections from the same point, resulting in deeper penetration into the larger part of the nidus. However, there is still a significant risk of reflux into vessels supplying the normal brain and early inadvertent occlusion of the draining vein, which might limit the procedure. The maximal safe reflux distance along the feeding vessel judged on the initial angiogram should usually be no more than 2 cm back or 1 cm distal to a cortical branch of the feeding artery.[2] Normally, good results with Onyx injection and flow control during embolization are obtained by creating a plug in the vascular lumen just proximal to the microcatheter tip. This technique is a necessary time consuming step which prolongs the procedure length, thereby potentially increasing the risk of thromboembolic complications. In addition, formation of an extensive retrograde Onyx cast around the catheter can lead to possible vessel perforation as the catheter is retrieved. This latter issue may be avoided by using a detachable tip Apollo microcatheter.[1]

There has been recent development of Onyx-compatible double lumen balloons (HyperForm and HyperGlide [ev3] and Sceptor C and Scepter XC [MicroVention]) as a way to avoid the need for a plug and its associated risks, as well as to minimize reflux around the microcatheter by inflating proximal to the Onyx injection site, thereby minimizing the risk of catheter retention. The main limitation of this technique is the difficulty encountered while navigating the dual lumen balloon into distal arterial feeders, especially the small ones as these vessels can often be accessed only with flow-directed microcatheters.[3] There is also a major concern of potential injury and rupture when inflating and deflating a balloon in very small or tortuous arteries.

To overcome these limitations, we report a new technique using a second microcatheter to form an Onyx plug for creating a seal around the distally placed detachable tip. This wedge flow condition reduced the blood supply through the AVM and contrast washout during selective injections. It prevented Onyx from reflux into important vessels and allowed for more forceful and thorough embolization. After

the initial embolization epoch with more viscous Onyx-34, with the plug well formed, we switched to Onyx-18, which is less viscous and penetrated the AVM more easily.[5]

Chapot *et al*.[2] described a "pressure-cooker" technique based on a similar concept but used injectable or detachable coils ahead of a diluted mixture of acrylic glue (NBCA). Coils are used to contain the plug between the distal tip and the detachment zone. However, higher density Onyx-34 is perfectly suited for the creation of short casts due to its highly viscous nature and undergoes final solidification in under 5 min. We demonstrate that a plug can be accurately formed with Onyx-34, and thus circumvent the use of injectable or detachable coils which have relative instability.

CONCLUSION

In conclusion, this technique has the dual benefit of potentially lowering fluoroscopy times and of increasing the amount of Onyx that can be injected in AVMs while simultaneously avoiding dangerous backflow. It might increase the curative potential of large AVMs and reduce the number of treatment sessions.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Altschul D, Paramasivam S, Ortega-Gutierrez S, Fifi JT, Berenstein A. Safety and efficacy using a detachable tip microcatheter in the embolization of pediatric arteriovenous malformations. Child's Nerv Syst 2014;30:1099-107.
2. Chapot R, Stracke P, Velasco A, Nordmeyer H, Heddier M, Stauder M, *et al*. The Pressure Cooker Technique for the treatment of brain AVMs. J Neuroradiol 2014;41:87-91.
3. Peschillo S, Caporlingua A, Colonnese C, Guidetti G. Brain AVMs: An Endovascular, Surgical, and Radiosurgical Update. Scientific World Journal 2014;2014:834931.
4. Potts M, Zumofen D, Raz E, Nelson P, Riina H. Curing arteriovenous malformations using embolization. Neurosurg Focus 2014;37:E19.
5. Sekhar LN, Biswas A, Hallam D, Kim LJ, Douglas J, Ghodke B. Neuroendovascular Management of Tumors and Vascular Malformations of the Head and Neck. Neurosurg Clin N Am 2009;20:453-85.