Extended intracranial applications for ethylene vinyl alcohol copolymer (Onyx): mycotic and dissecting aneurysms

Technical note

Donald V. La Barge III, M.D.,1 Perry P. Ng, M.D.,1 Edwin A. Stevens, M.D.,1 Nathan K. Friedline, M.D.,2 John R. Kestle, M.D.,2,3 and Richard H. Schmidt, M.D., Ph.D.3

Department of1 Radiology, Division of Neuroradiology and 1Neurosurgery, University of Utah; and 2Division of Pediatric Neurosurgery, Primary Children’s Medical Center, Salt Lake City, Utah

The authors describe the off-label use of Onyx for embolization of fusiform mycotic and dissecting intracranial aneurysms based on their experience with 3 patients treated at the University of Utah Hospital from 2006 through 2007.

Technical success in occluding the parent artery/aneurysm was achieved in all patients. There were no complications. The authors conclude that Onyx can be used to achieve occlusion of fusiform mycotic and dissecting intracranial aneurysms in conjunction with parent artery occlusion. (DOI: 10.3171/2009.1.JNS08845)

Key Words • dissecting aneurysm • fusiform aneurysm • infectious intracranial aneurysm • mycotic aneurysm • parent artery occlusion

Endovascular treatment of intracranial berry aneurysms using detachable coils has become an established alternative to open microneurosurgery for the treatment of intracranial aneurysms. Distally located aneurysms often have a fusiform morphology and can be difficult to treat with preservation of the parent artery. Previous reports have established a role for aneurysm embolization in conjunction with parent artery occlusion in such cases using cyanoacrylate glue and/or coils.1,3,7

Onyx (ev3, Inc.) is a liquid embolic agent dissolved in an organic solvent (dimethyl sulfoxide) and precipitates to form a cast in the space into which it is injected. Its role in the treatment of intracranial berry aneurysms and AVMs has been established.2,9,10,14,17,18 The nonadhesive nature and predictable viscosity of Onyx permits a slow, controlled injection into target vessels.

We report the successful use of Onyx for the endovascular occlusion of fusiform mycotic and dissecting intracranial aneurysms distal to the circle of Willis.

Extended intracranial applications for ethylene vinyl alcohol copolymer (Onyx): mycotic and dissecting aneurysms

Methods

A retrospective review of the medical records and imaging studies of 3 patients treated with Onyx-18 at our institution for fusiform mycotic and dissecting intracranial aneurysms from 2006 through 2007 was undertaken after obtaining approval through our institutional review board. The patients’ ages and the type and location of their lesions are presented in Table 1.

Results

Technical success in occluding the parent artery/aneurysm was achieved in all patients. The embolic agent used was Onyx-18 for all 3 cases. There were no technical, clinical, or procedural complications. Outcome was classified as 2 on the modified Rankin Scale in all cases.

Illustrative Cases

Case 2

This 68-year-old woman with a remote history of endocarditis presented with complaints of fever, chills, and joint pains of 1 week’s duration. Echocardiography

Abbreviations used in this paper: ACA = anterior cerebral artery; AVM = arteriovenous malformation; n-BCA = n-butyl cyanoacrylate; PTA = posterior temporal artery.
revealed severe mitral regurgitation, mitral valve prolapse, and a patent foramen ovale. Blood cultures were positive for Staphylococcus aureus. The patient’s neurological condition rapidly declined, and a head CT without contrast revealed intraventricular and subarachnoid hemorrhage as well as a large right temporoooccipital intraparenchymal hemorrhage (Fig. 1). Catheter angiography revealed a fusiform, presumably mycotic, aneurysm of the right PTA (Fig. 2). Embolization with Onyx-18 was performed with complete occlusion of the aneurysm and parent artery (Fig. 3). At 1-year follow-up the patient was clinically stable and had no new neurological deficits.

**Case 3**

This 37-year-old man underwent craniotomy for clipping of a ruptured left pericallosal artery saccular aneurysm in the context of an anomalous proximal bifurcation of the pericallosal and callosomarginal arteries at the usual location of the A1/A2 junction. Follow-up digital subtraction angiography 2 months later showed occlusion of the pericallosal artery and development of 2 small fusiform aneurysms along the left callosomarginal artery with an intervening stenosis suggestive of dissection as an underlying cause (Fig. 4). There was no clinical or laboratory evidence of sepsis to suggest an infectious cause. The patient underwent superselective sodium amytal testing of the callosomarginal artery followed by Onyx-18 embolization of the aneurysms and parent artery (Fig. 5).

He was discharged home the following day with no neurological deficits and remained asymptomatic at follow-up 1 year later.

**Discussion**

Parent artery occlusion for the treatment of small distally located aneurysms, including mycotic aneurysms, appears to be a safe and effective treatment. In a series of 19 distally located intracranial aneurysms (15 saccular, 4 fusiform) treated with parent artery occlusion using detachable coils or n-BCA glue, no adverse outcomes occurred with lesions of the anterior cerebral artery and middle cerebral artery, but permanent visual field deficits
occurred in 33% of the patients in whom posterior cerebral artery aneurysms were treated.  

The use of coils in such distal cerebral vasculature may be hindered by the size of available microcoils and delivery microcatheters, which can exceed the size of the vessel lumen and occlude flow. The fragility of such small aneurysms, particularly if mycotic in origin or recently ruptured, makes intraprocedural perforation a significant concern. The use of n-BCA liquid adhesive may permit occlusion with a lower risk of intraprocedural aneurysm perforation compared with coils, but glue can be difficult to inject with precision due to its tendency to fragment and embolize distally at low glue concentrations. Moreover, lower glue concentrations have become increasingly popular for better penetration of AVM nidi, the most com-
mon indication for intracranial glue injections. Hence, recently trained endovascular neurosurgeons may be unfamiliar with the use of high glue concentrations such as were commonly used in the past. At high concentrations, n-BCA glue may be difficult to visualize without being mixed with tantalum powder, which is now seldom used and changes the injection characteristics of the solution.

In addition, high glue concentrations may be difficult to deliver accurately into the target lesion or vessel without proximal occlusion and/or reflux. In the event of reflux along the catheter tip, the working time is shortened and there is an increased risk of “gluing-in” of the microcatheter. If “gluing-in” of a microcatheter occurs, the catheter is typically cut at the groin sheath and pushed into the common femoral artery prior to sheath removal. As with all intravascular foreign bodies, microcatheter retention poses a thromboembolic risk and has been managed with anticoagulation, antiplatelet regimens, and surgical removal. In the prospective AVM treatment trial performed by the n-BCA trial investigators, entrapment of the microcatheter occurred in 4 of 52 patients. Onyx has the advantage of being highly visible and is also premixed to a predictable viscosity, thus permitting a slow, controlled injection under roadmapping or fluoroscopic observation. Although Onyx is nonadhesive, with prolonged injection times and the necessity of permitting a small amount of reflux along the distal catheter tip, catheter entrapment within the embolic cast can still occur. To our knowledge, there have been no clinical sequelae attributed to microcatheter entrapment in cases in which Onyx was used. Factors associated with an increased risk of catheter entrapment include prolonged injection times, the amount of reflux along the microcatheter tip, and proximity of the microcatheter tip to a curve in the selected artery, especially when reflux of Onyx extends into the curved segment. Natarajan et al. observed that microcatheter retrieval after Onyx injection was easier if steam-shaping of the catheter tip was avoided. There is a potential for significant vascular injury during prolonged traction on and/or vigorous attempts to remove a microcatheter that has been trapped in the distal cerebral vasculature.

Microcatheters with detachable tips of various lengths have been used successfully in Europe, and US FDA approval is currently pending. These detachable-tip microcatheters are designed to leave a short length of catheter tip embedded in the embolic cast after gentle traction, thereby reducing the risk of thromboembolic sequelae of a retained catheter and avoiding vessel injury during attempts to remove the microcatheter. A monorail snare technique for retrieval of an adherent microcatheter from an Onyx cast in the right occipital artery during the treatment of a posterior fossa dural arteriovenous fistula has also been described.

A unique consideration in the treatment of mycotic aneurysms is the potential for infection following placement of embolic material, which acts as a foreign body. In a series of 13 distally located mycotic aneurysms treated with parent artery occlusion using cyanoacrylate glue with or without Guglielmi detachable coils, there was no evidence of local infection or abscess formation associated with the embolic material. To our knowledge, there have been no reports of an infected Onyx cast following embolization of intracranial lesions (including Onyx treatment of mycotic aneurysms in 2 pediatric patients). The potential for infection of embolic material was highlighted in 4 cases of local infection following placement of microcoils for the treatment of intracranial aneurysms and dural arteriovenous fistulas. Abscess occurred 3 weeks–3.5 years following coil placement. In 2 patients, infection was thought to have been introduced at the time of the procedure, while in the other 2 cases infection was attributed to systemic sepsis. The authors proposed a mechanism of infection whereby the coiled aneurysm or vessel incites a surrounding inflammatory reaction resulting in cerebral edema, which provides a breeding ground for pathogens. In all 4 cases successful treatment with high-dose intravenous antimicrobial agents was achieved.

Conclusions

The intracranial application of Onyx can be extended beyond the embolization of saccular aneurysms and AVMs. We describe the successful use of Onyx for the treatment of fusiform mycotic and dissecting intracranial aneurysms in conjunction with parent artery occlusion. In our small series, the use of Onyx for these lesions appeared to be safe and durable and no evidence of infection of the embolic cast was apparent. Larger studies are required to verify this initial experience.

Disclaimer

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References

8. Kelly ME, Turner R IV, Gonugunta V, Rasmussen PA, Woo HH, Fiorella D: Monorail snare technique for the retrieval of


This work was presented in poster form at the 46th Annual Meeting of the American Society of Neuroradiology, New Orleans, Louisiana, June 2–5, 2008.

Please include this information when citing this paper: published online February 27, 2009; DOI: 10.3171/2009.1.JNS08845.

Address correspondence to: Donald V. La Barge III, M.D., University of Utah, Department of Radiology, 30N 1900E #1A71, Salt Lake City, Utah 84132. email: donald.labarge@hsc.utah.edu.