
Neurointerventional Report

Endovascular Embolization by Parent Artery Reconstruction of a Symptomatic Fusiform Posterior Cerebral Artery Aneurysm Using Onyx HD-500: A Neurointerventional Report

Einar T. Bogason, MD, Akshal S. Patel, MD, Kevin M. Cockroft, MD, MSc

For the Department of Neurosurgery Penn State Hershey Medical Center Hershey, PA (ETB, ASP, KMC); Department of Radiology Penn State Hershey Medical Center Hershey, PA (KMC).

ABSTRACT

BACKGROUND AND PURPOSE

Posterior cerebral artery aneurysms are treatment challenge for the neurosurgeon. Parent artery occlusion, trapping and bypass have been the classic treatment options for aneurysms in this location. With the introduction of newer embolic agents such as Onyx[®], endovascular intervention is now a viable therapy for these aneurysms.

CASE SUMMARY

We report the case of a 60-year-old man who presented with a symptomatic, though unruptured, fusiform left posterior cerebral artery aneurysm. Given the distal location of this dominant sided aneurysm, post-operative visual deficits and aphasia were a concern if parent vessel occlusion were to be performed. Therefore, an endovascular reconstruction using Onyx HD-500 and two closed-cell stents was performed.

CONCLUSIONS

This report illustrates the ability of a high-density liquid embolic agent to provide immediate reconstruction of a fusiform aneurysm in a distal location.

Keywords: Aneurysm, posterior cerebral artery aneurysm, fusiform endovascular embolization liquid embolic agent vascular reconstruction.

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Correspondence: Address correspondence to Kevin M. Cockroft, Department of Neurosurgery, H110 Pennsylvania State University, Penn State MS Hershey Medical Center, PO Box 850, Hershey, PA. E-mail: kcockroft@psu.edu.

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Introduction

Fusiform aneurysms of the posterior cerebral artery (PCA) make up only 0.1% of all intracerebral aneurysms.¹ Given the location and configuration of these aneurysms, they are often difficult to treat with direct surgical clip reconstruction, and may require trapping or proximal occlusion either with or without bypass.²⁻⁵ Pial collaterals in the occipital region are often well-established, but post-operative stroke with subsequent partial visual loss and even aphasia for lesions on the dominant are well recognized complications.^{2,5} The use of endovascular techniques to treat fusiform intracranial aneurysms is not novel, but in the past this has mostly been a deconstructive process involving parent vessel occlusion with either coils or a liquid embolic agent. Here we report the *reconstructive* treatment of a large fusiform PCA aneurysm with parent vessel preservation using a combination of intravascular stents and a liquid embolic agent.

Case Report

This previously headache free 60-year-old right handed man presented to his primary care physician with a two week history of left sided headaches and intermittent mild word finding difficulties. The patient denied any other associated symptoms. He was an otherwise healthy, non-smoker who exercised reg-

ularly and was an avid triathlete. He had a negative review of symptoms other than reporting involvement in a motor vehicle accident 6 months prior to admission. His initial neurological examination was unremarkable.

Due to the persistent nature of his symptoms, a CT scan was performed. This initial study showed a hyperdense, homogeneously enhancing, 1.4 × 1.4 cm lesion adjacent to the left cerebral peduncle (Fig 1A and B). A subsequent CT angiogram confirmed a large fusiform aneurysm of the left PCA. Given the large size and presenting symptoms, expeditious treatment was felt to be appropriate. Surgical or endovascular parent vessel occlusion was contemplated, but due to the proximal location of the aneurysm and the dominant hemisphere location with associated language symptoms, the decision was made to attempt occlude the aneurysm and preserve the PCA.

The patient was anesthetized with general endotracheal anesthesia in the angiography suite. Neurophysiological monitoring electrodes for somatosensory evoked potentials (SSEP) and electroencephalography (EEG) were placed. A diagnostic cerebral angiogram was obtained via right common femoral artery access. Injection of the right vertebral artery (VA) revealed a large spherical appearing fusiform aneurysm arising from the left posterior cerebral artery, at approximately the P2-P3 region, measuring 14.4 × 16.3 mm in AP projection and 11.0 × 12.9 mm in the lateral projection (Fig 2A-C). In

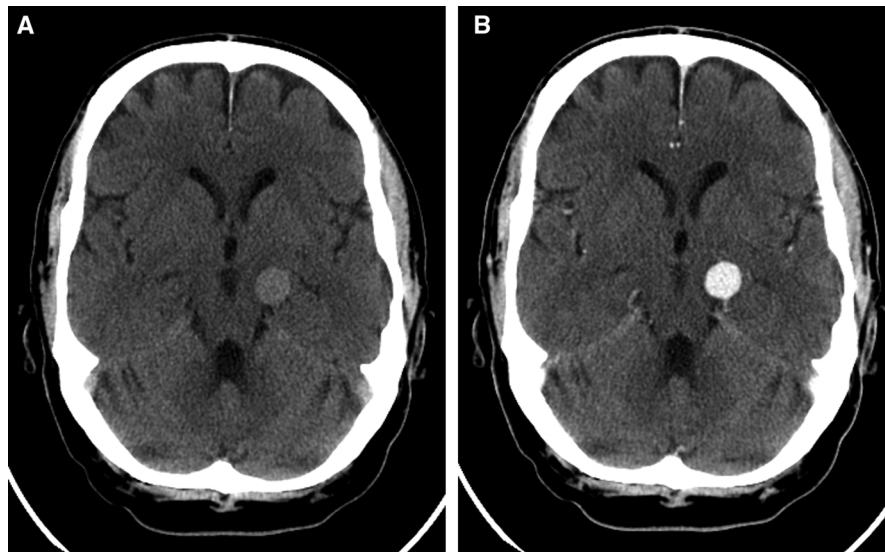


Fig 1. Axial non-contrast CT image (A) demonstrates a spherical appearing hyperdense lesion in the left occipital region, which avidly and homogeneously enhances after intravenous contrast (B).

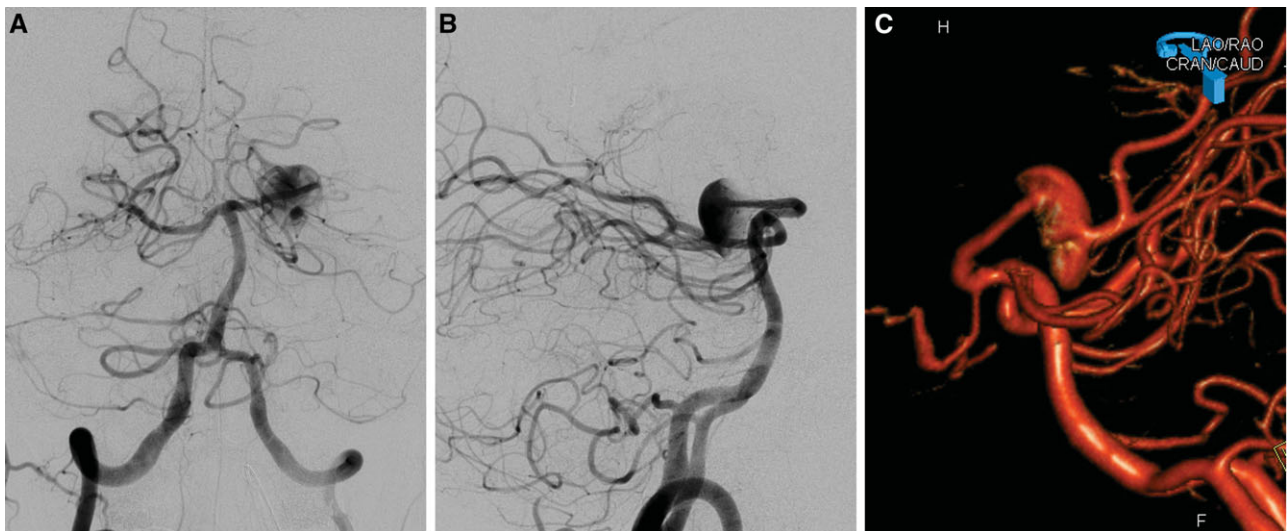


Fig 2. AP (A) and lateral (B) images from a right vertebral artery injection as well as a surface rendered reconstruction (C) of a rotational angiogram from the same location demonstrate a large fusiform aneurysm of the left PCA.

addition, a superselective microcatheter angiogram was performed by navigating an Echelon-10 microcatheter (eV3 Neurovascular, Irvine, CA) into the PCA distal the aneurysm. These images revealed direct opacification of the occipital pole and primary visual cortex.

At this point the decision was made to proceed with attempted aneurysm occlusion and PCA reconstruction. We briefly considered a balloon test occlusion of the PCA, but, given the patient's presentation and the vessel size/location, we felt that the risks of this would outweigh the benefits. Onyx HD-500 (eV3 Endovascular, Irvine, CA) was chosen because of its ability to contour around an occlusion balloon thereby creating a new, more normal cylindrical channel. Two microcatheters were utilized to deliver the Onyx HD-500 in order to speed the delivery of the agent and lessen the length of temporary occlu-

sion. In addition, an intracranial stent was used to provide an additional "framework" for the Onyx HD-500, with the thought that this would better support a circumferential reconstruction with the liquid embolic agent.

The left common femoral artery was cannulated to allow for multiple catheter use. Intravenous heparin was administered to prolong the patient's Activated Clotting Time (ACT) to greater than 250 seconds. In addition, a loading dose of clopidogrel (600 mg) was delivered via an orogastric tube. A 6F Neuron-070 guide catheter (Penumbra Incorporated, San Leandro, CA) was placed into the left vertebral artery (VA), while a 5F Terumo Soft Tip Guider (Terumo Medical Corporation, Somerset, NJ) was positioned in the right VA. The aneurysm was crossed with a Prowler Plus catheter (Cordis Neurovascular, Miami, FL) navigated over an X-pedion-10

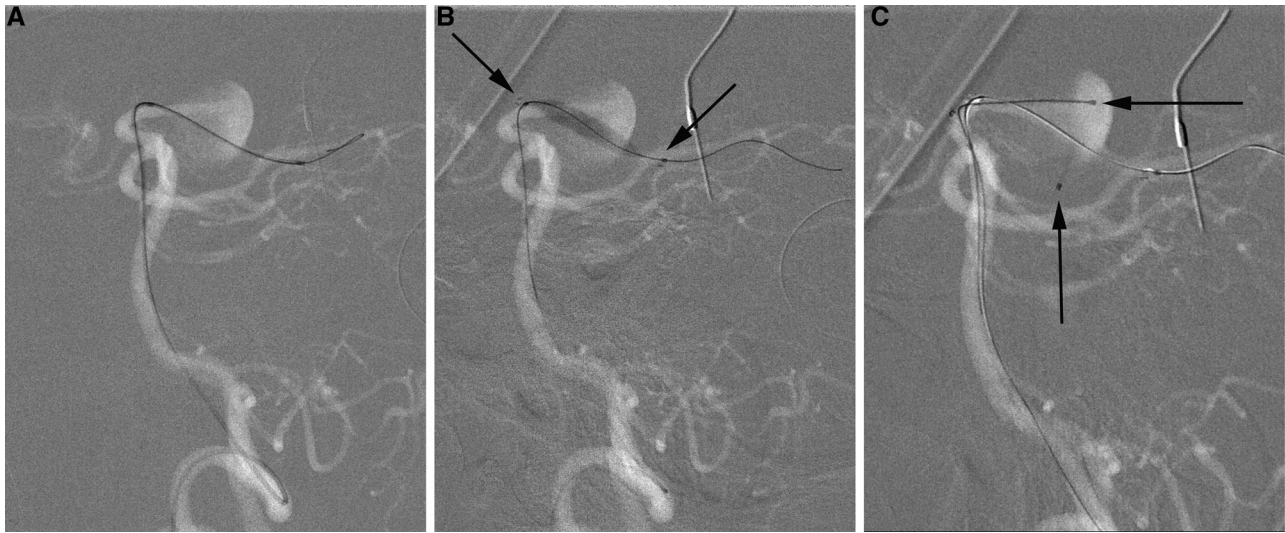


Fig 3. Roadmap images show Prowler Plus stent delivery catheter placed across the aneurysm into the distal PCA (A), followed by test inflation of the HyperGlide (4 × 30 mm) balloon within the Enterprise (4.5 × 28 mm) stent (B) with proximal and distal stent markers seen near the ends of the balloon (arrows) and, lastly (C), dual Echelon-10 microcatheters placed in the inferior (vertical arrow) and superior (horizontal arrow) hemispheres of the aneurysm.

microwire (eV3 Neurovascular, Irvine, CA). An Enterprise (4.5 × 28 mm) stent (Cordis Neurovascular, Miami, FL) was delivered across the aneurysm, reconstructing the vascular lumen. The Prowler Plus catheter was used to maintain access across the stent and was exchanged over an Accelerator-10 wire (eV3 Neurovascular, Irvine, CA) for a HyperGlide (4 × 30 mm) occlusion balloon (eV3 Neurovascular, Irvine, CA). The balloon was navigated through the stent spanning the aneurysm from in-flow to out-flow (Fig 3A–C). Two Echelon-10 microcatheters were placed, one via each guide catheter, to lie in both the superior and inferior hemispheres of the aneurysm.

Onyx HD-500 was introduced through both catheters simultaneously with the balloon inflated across the channel through the aneurysm (Fig 4A). The Onyx HD-500 infusions were continued on five to six minute cycles with approximately two to three minutes of infusion followed by approximately 3 minutes to allow for solidification of the embolic material before balloon deflation. These cycles were repeated several times to allow filling of the aneurysm (Fig 4B and C). Towards the end of the aneurysm filling, intermittent decreases in the right upper extremity SSEP were noted; these would improve with balloon deflation. These changes, combined with the near complete obliteration of the aneurysm, as well as the slight extension of the Onyx HD-500 into the “normal” PCA, led to the decision to halt infusion of the liquid embolic at this point. After waiting ten minutes, both microcatheters were gradually withdrawn. Because of concern over possible “dog ear” at the proximal neck of the aneurysm (Fig 4D), a second intracranial stent (Enterprise 4.5 × 22 mm) was placed across the inflow portion of the aneurysm to provide some possible flow diversion and act as scaffold for eventual endothelialization. Final angiographic images were obtained which revealed good occlusion of the aneurysm with a persistent channel through the aneurysm and normal filling of the distal posterior cerebral artery distribution (Fig 5A–C).

The patient was extubated in the angiography suite and was found to have some minor word finding difficulties as well as mild weakness in the right upper extremity. These symptoms resolved shortly after he was transferred to the ICU. The patient remained on aspirin 81 mg and clopidogrel 75 mg daily throughout his hospital stay and was discharged home on these medications on post-procedure day three. At discharge patient was at his neurologic baseline with no weakness and no discernable word finding difficulty.

Discussion

The use of Onyx HD-500 for the treatment of large or giant, side wall aneurysms is well-described.^{6–8} However, this is the first reported case of the use of Onyx HD-500 for the reconstructive treatment of a fusiform distal posterior cerebral artery aneurysm.

Onyx HD-500 is a cohesive liquid embolic agent FDA approved for the treatment of broad-based, sidewall, intracranial aneurysms. The active ingredient is an ethylene-vinyl alcohol co-polymer. The material is dissolved in dimethylsulfoxide (DMSO) and micronized tantalum powder is used to create radiographic opacification. On contact with hydrophilic mediums such as blood, Onyx HD-500 will rapidly polymerize and harden. An intracranial stent may be used in conjunction with Onyx HD-500, but such a device is not a prerequisite.⁹

This case illustrates the ability of a liquid embolic agent to reconstruct a vessel lumen around a temporary occlusion balloon. However, because of the likelihood of Onyx HD-500 extension beyond the aneurysm itself, this technique may not be appropriate for other fusiform aneurysm locations, such as the basilar artery trunk, where important perforators are in close proximity. Unlike a vessel reconstruction using a flow diverting device, the use of a high-density liquid embolic produces immediate aneurysm occlusion. In a case such as this, where

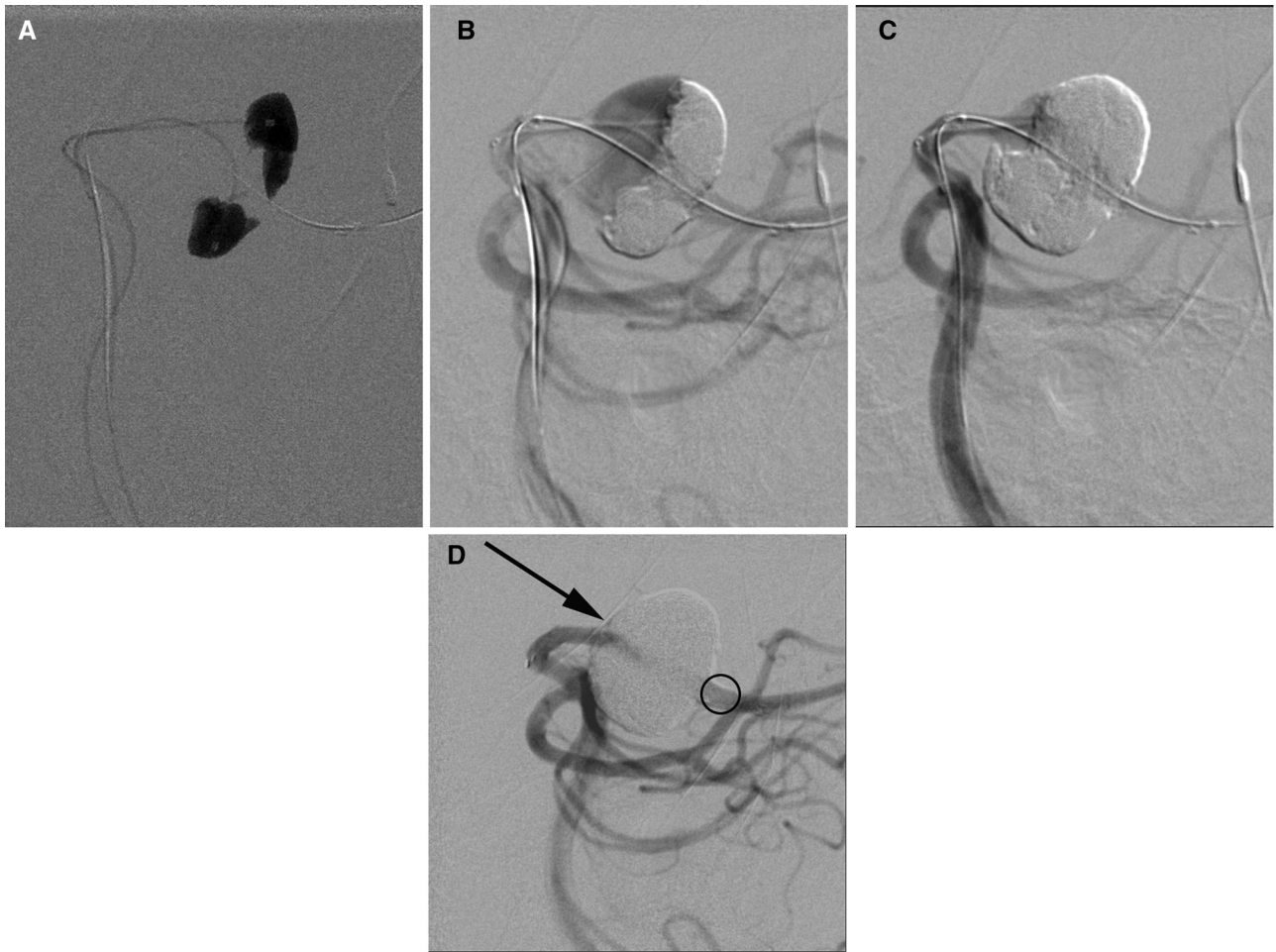


Fig 4. Roadmap image (A) shows Onyx HD-500 being introduced through dual Echelon-10 microcatheters simultaneously with the inflated HyperGlide (4 × 30 mm) balloon creating a channel through the aneurysm. Serial angiograms (B, C) demonstrate progressive filling of the aneurysm. Later control angiogram (D) shows near complete obliteration of the aneurysm with a small “dog ear” of filling proximally (arrow). Slight extension of the Onyx HD-500 into the “normal” PCA distally can also be appreciated (circle).

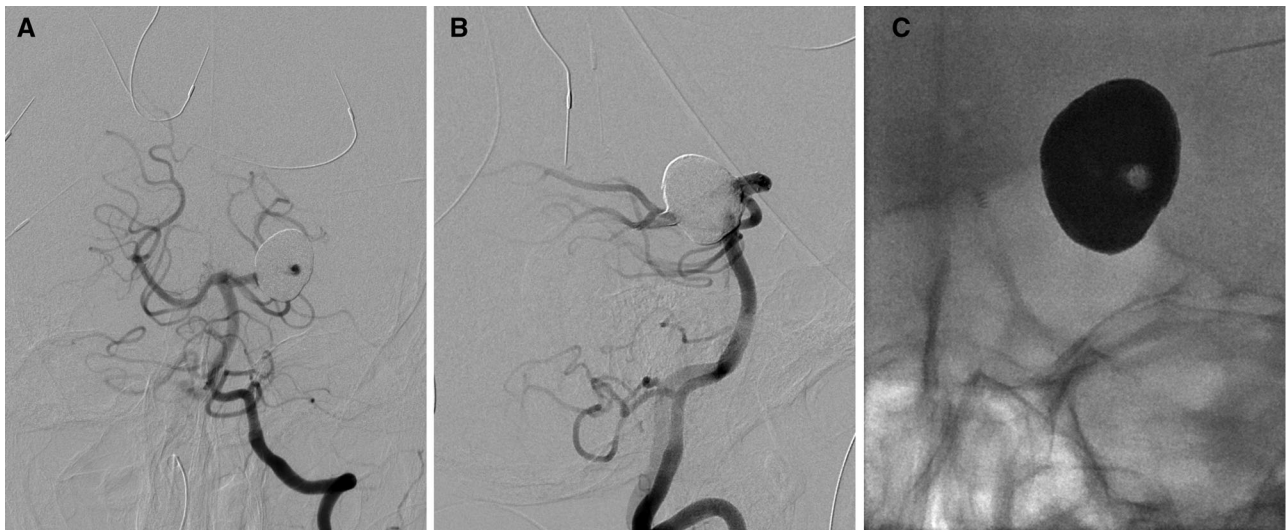


Fig 5. Final angiographic images (A, B) reveal good occlusion of the aneurysm with a persistent channel through the aneurysm and normal filling of the distal posterior cerebral artery distribution. An unsubtracted “down-the-barrel” image (C) shows the channel created through the Onyx HD-500 cast by the HyperGlide balloon.

a large, symptomatic aneurysm is present, concern over short-term rupture risk makes this a potentially important distinction. In this case, an intracranial stent was used as a supplemental scaffold due to the circumferential nature of the Onyx HD-500 cast, but it is not certain that this was absolutely necessary. As the stent and embolic material are both thrombogenic, until endothelialization has taken place, it is essential to utilize dual anti-platelet coverage both pre- and post-operatively.

Regrettably, at about 7 weeks after his procedure this patient discontinued his clopidogrel because of persistent headaches, which he attributed to the medication. Several days later, on a day when the outside temperature exceeded 90 degrees Fahrenheit, he went for a 30 mile bike ride. Soon after returning from the ride he experienced word finding difficulty and loss of vision in his right visual field. Upon presentation to the Emergency department he was hydrated, started on intravenous heparin and given an oral loading dose of clopidogrel. Fortunately, his clinical symptoms dramatically improved. However, subsequent imaging studies revealed that the left PCA had become occluded. Given the patient's improvement, no attempt was made to reopen the vessel. In the end the patient was left with some right inferior quadrant visual loss and very mild word finding difficulty. Clearly, prolonged dual anti-platelet therapy is essential after such a reconstruction and if the early experience with flow diverting devices is any indication, this anti-platelet therapy may need to be continued indefinitely.^{10,11}

Conclusion

The liquid embolic, Onyx HD-500, may be useful in the reconstructive occlusion of selected fusiform intracranial aneurysms. However, prolonged dual antiplatelet coverage is essential to maintain patency of such a construct.

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