Treatment of a ruptured blister aneurysm of the left internal carotid artery with telescoping Pipeline Flex embolization devices with Shield Technology

Karol P. Budohoski, MD, PhD, Robert C. Rennert, MD, Vance Mortimer, AS, William T. Couldwell, MD, PhD, and Ramesh Grandhi, MD

Department of Neurosurgery, Clinical Neurosciences Center, University of Utah, Salt Lake City, Utah

Ruptured blister aneurysms have significant rates of morbidity and mortality, but evidence of positive results with use of flow-diverting stents such as the Pipeline embolization device (PED) is growing. The authors describe the staged endovascular treatment of a ruptured left internal carotid artery blister aneurysm in a patient with a Hunt and Hess grade IV subarachnoid hemorrhage. PED placement was done via the common femoral artery using a triaxial delivery system. The telescoping stent technique performed over 48–72 hours achieved sufficient coverage of the aneurysm neck while limiting treatment time during the acute presentation and allowing interim dual antiplatelet treatment. A staged approach allows the targeting of a second PED placement in patients whose aneurysm continues to fill on the first follow-up angiogram. The authors have not experienced increased thromboembolic complications with this approach. Complete occlusion was achieved by postbleed day 8.

The video can be found here: https://stream.cadmore.media/r10.3171/2022.7.FOCVID2264
https://thejns.org/doi/abs/10.3171/2022.7.FOCVID2264

**KEYWORDS** ruptured blister aneurysm; endovascular; flow diversion; Pipeline embolization device; video
device with Shield Technology. Intraprocedurally, intravenous Integrilin was administered in two aliquots. A total of 90 µg/kg were administered in two different doses. Our protocol is to administer 45 µg/kg in two separate doses, with the first dose administered as we are starting to deploy the Pipeline embolization device. The second aliquot is given just before releasing the Pipeline embolization device off of the wire.

**3:14 Postoperative Care.** A postembolization run after placement of the Pipeline embolization device showed excellent placement of the Pipeline embolization device at the target proximal and distal landing zones. There were no thromboembolic complications noted. Immediately after Pipeline placement, we start an Integrilin infusion postoperatively at 1 µg/kg/min. A noncontrasted CT scan of the head is obtained on the morning of postoperative day 1. We review the CT scan of the head to confirm no further hemorrhagic complications post–Pipeline treatment with no further expansion of the intracranial hemorrhage. After confirming that that CT scan is stable, we load the patient with aspirin and prasugrel. Starting on postoperative day 2, we start the patient on daily aspirin 81 mg and prasugrel 10 mg. On postbleed day 2, we brought the patient back for placement of a second Pipeline Flex embolization device with Shield Technology.

**4:21 Placement of Second Pipeline Flex Device.** We placed a 4.25 × 18-mm device, telescoping it through the original device. At our center, we believe that placement of a telescoping Pipeline embolization device is important in patients with ruptured blister aneurysms. The patient was then brought back to the angio suite on postbleed day 6. That angiogram showed persistent filling of the Pipeline embolization device. Daily TCDs showed elevations in the middle cerebral artery velocities on the left. Thus, the patient was brought back on postbleed day 8 for a subsequent diagnostic cerebral angiogram and intra-arterial verapamil administration.

**5:10 Diagnostic DCA and Management.** The angiogram, performed on postbleed day 8, clearly showed obliteration of the blister aneurysm and no further filling. During the patient’s hospitalization, we encountered severe vasospasm. Our management involved augmenting the patient’s blood pressure, administering intrathecal nicardipine through the external ventricular drain, and bringing her back to the angio suite for intra-arterial verapamil administration. On postbleed day 23, we were able to successfully tie off her external ventricular drain and an MRI was obtained. The MRI showed that there was no evidence of significant ischemic burden from vasospasm.

**5:56 Follow-Up.** At the 3-month mark, the patient was independently mobile, with some mild, expressive aphasia. She was continuing outpatient rehabilitation, and her CT scan of her head showed no hydrocephalus.

**Acknowledgments**

We thank Kristin Kraus, MSc, for editorial assistance.

**References**

1. Chalouhi N, Zanaty M, Tjoumakaris S, et al. Treatment of blister-like aneurysms with the pipeline embolization device. *Neurosurgery*. 2014;74(5):527-532.
2. Foreman PM, Ilyas A, Cress MC, et al. Ruptured intracranial aneurysms treated with the Pipeline Embolization Device: a systematic review and pooled analysis of individual patient data. *AJNR Am J Neuroradiol*. 2021;42(4):720-725.
3. Lin N, Brouillard AM, Keigher KM, et al. Utilization of Pipeline embolization device for treatment of ruptured intracranial aneurysms: US multicenter experience. *J Neurointerv Surg*. 2015;7(11):808-815.
4. Mokin M, Chinea A, Primiani CT, et al. Treatment of blood blister aneurysms of the internal carotid artery with flow diversion. *J Neurointerv Surg*. 2018;10(11):1074-1078.
5. Peitz GW, Sy CA, Grandhi R. Endovascular treatment of blister aneurysms. *Neurosurg Focus*. 2017;42(6):E12.

**Disclosures**

Dr. Couldwell: editor of *Neurosurgical Focus: Video*. Dr. Grandhi: personal fees from Medtronic Neurovascular, Cerenovus, Integra, and Balt Neurovascular outside the submitted work.

**Author Contributions**

Primary surgeon: Grandhi, Couldwell. Assistant surgeon: Couldwell. Editing and drafting the video and abstract: all authors.Critically revising the work: Grandhi, Budohoski, Rennert. Reviewed submitted version of the work: Grandhi, Budohoski, Rennert, Couldwell. Approved the final version of the work on behalf of all authors: Grandhi. Supervision: Grandhi.

**Correspondence**

Ramesh Grandhi: Clinical Neurosciences Center, University of Utah, Salt Lake City, UT. neuropub@hsc.utah.edu.