Pipeline Embolization Device: A New Source for Embolic Retinal Vascular Occlusion

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Abstract: A 57-year-old woman underwent treatment of a left internal carotid artery aneurysm with a Pipeline embolization device. She subsequently experienced multiple branch retinal artery occlusions in her left eye. Although rare, ophthalmic complications may follow this new technique in the treatment of intracranial aneurysms.

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The Pipeline embolization device (PED; ev3/Covidien, Irvine, CA) has emerged as a novel endovascular treatment for intracranial aneurysms. It is a cylindrical braided wire mesh implant that creates a pathway to bypass aneurysmal cavities. By diverting blood flow through the implant, blood in the aneurysmal cavity is left to stagnate leading to thrombosis, thus walling it off from the parent vessel. Approved by the Food and Drug Administration in 2011, it has shown success in treating intracranial aneurysms, especially those with challenging anatomic subtypes (1–4). Although there have been rare reports of vision loss related to the device, we describe a patient who presented with multiple branch retinal artery occlusions (BRAOs) following PED placement for treatment of an intracranial aneurysm of the internal carotid artery.

CASE REPORT

A 57-year-old woman was evaluated for left-sided headache, neck pain, and excess lacrimation from the left eye. Her medical history was significant for hypertension, and she had a brother who died 4 years previously from complications related to a subarachnoid hemorrhage. Magnetic resonance imaging (MRI), magnetic resonance angiography (MRA), and computed tomography angiography revealed a 6.8 × 6.4 × 6.8-mm³ aneurysm at the anterior genu of the left internal carotid artery, opposite to the origin of the left

FIG. 1. Three-dimensional reconstructed computed tomographic angiogram shows an aneurysm of the left internal carotid artery (arrow). The origin of the ophthalmic artery is not visible in this projection.
ophthalmic artery (Fig. 1). The patient was treated with 2 Pipeline devices telescoped from the origin of the left posterior communicating artery to the vertical segment of the petrous portion of the left internal carotid artery covering the entire length of the aneurysm (Fig. 2). There were no reported intraoperative or immediate postoperative complications, and postprocedure angiography of the parent and branching vessels appeared normal (Fig. 3A). The patient was discharged on clopidogrel and aspirin.

Three weeks after the procedure, she presented to the emergency department with sudden, painless vision loss in her left eye. Emergent computed tomography, MRI, and MRA of the head and neck revealed no acute abnormalities, expected artifact from the Pipeline device, and no evidence of aneurysmal filling (Fig. 4). The patient refused cerebral angiography. Neuro-ophthalmic examination disclosed visual acuity of 20/25, right eye, and 20/40, left eye. Color vision was impaired in the left eye, and there was a left relative afferent pupillary defect. Eyelids, slit-lamp examination, and extraocular movements were normal. The right fundus was unremarkable while the left showed area of retinal whitening along the superotemporal and inferotemporal arcades, which contained plaque material. Cotton wool spots were seen temporal and superonasal to the optic disc (Fig. 5). Fluorescein angiography revealed delayed filling of the superotemporal arteriole with eventual retrograde perfusion (Fig. 6).

Platelet inhibition at the time of the patient’s vision loss was measured using the VerifyNow point-of-care system (Accumetrics, San Diego, CA). P2Y12 and aspirin reaction units were within normal limits. The patient was diagnosed with multiple BRAOs and instructed to continue her aspirin and clopidogrel.

Cerebral angiography performed during routine 6-month follow-up showed patent flow through the Pipeline devices and complete obliteration of the aneurysm, with some narrowing of the proximal Pipeline device at its proximal and distal ends (Fig. 3B). The left ophthalmic artery filled through the walls of the Pipeline devices, and there was an intact choroidal blush of the left eye. The patient’s visual acuity stabilized at 20/20 bilaterally, with a dense visual field defect in the right eye.

**DISCUSSION**

The PED represents a significant improvement in the treatment of intracranial aneurysms compared with conventional microsurgical techniques in both aneurysmal occlusion rates and patient outcomes (4,5). The PED is placed within the parent artery and, because of this, carries a risk of thromboembolic complications until endothelialization is complete. Most Pipeline procedures are performed with double antiplatelet therapy to decrease these risks because aneurysmal occlusion occurs over many months (5,6).

The Pipeline for Uncoilable or Failed Aneurysms (PUFS) trial was the major clinical study that led to Food and Drug Administration approval and included safety and efficacy data.

**FIG. 2.** Lateral skull radiograph shows the Pipeline devices (arrows) within the left internal carotid artery immediately after placement.

**FIG. 3.** Lateral view of subtracted cerebral angiogram. **A.** Immediately after Pipeline device placement, there is faint contrast blush (arrow) within the aneurysm. The ophthalmic artery (arrowhead) is patent. **B.** Six months later, there is no filling of the aneurysm, and the ophthalmic artery remains patent. Arrows denote the proximal and distal ends of the second Pipeline device where there is mild narrowing.
on 108 patients (1). Although our patient’s aneurysm was smaller than the criteria used in the PUFS study, a PED was used in our patient because of the wide neck of the aneurysm. The PUFS report included 5 cases of amaurosis fugax, none of which occurred in direct relationship to the procedure. The other 4 occurred after Day 90 and there was no evidence of retinal arteriole occlusion. There was 1 case of cilioretinal artery occlusion that occurred on the day of the procedure (1). Several subsequent large studies failed to report permanent visual loss due to embolic arteriole occlusion (4–11).

In our patient, it is presumed that the narrowing of the second Pipeline device may have caused a disruption of flow into the ophthalmic artery, or thrombus, that embolized distally into the retinal arterioles. The cause of the narrowing is unclear, and although the use of angioplasty to widen the areas of stenosis was considered, ultimately this was dismissed because of the patient’s stable clinical course.

Long-term data are still needed to fully evaluate the risk of delayed events related to Pipeline device placement, and patients should be appropriately counseled regarding the risk of vision loss both during and in the months after the procedure.

REFERENCES


