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Pipeline Embolization Device for Difficult-to-Treat, Extra-Cranial Carotid Dissections with High-Grade Stenosis: Report of 2 Cases and Review of the Literature

Branden John Cord MD, MS, PhD, BA; Jacky Yeung MD; Ryan Matthew Hebert MD; Charles Christian Matouk BSc MD
Yale New Haven Hospital

Introduction

Flow-diverting stents (FDS) are braided, self-expanding stents designed for the treatment of intra-cranial aneurysms. Their unique properties may also make them well suited for treating extra-cranial carotid artery dissections with high-grade stenosis. Here we report our experience treating two patients with the Pipeline Embolization Device (PED) in addition to a literature review focused on indications, clinical results, and complications.

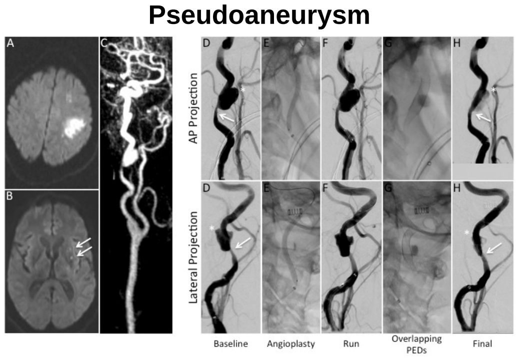
Methods

Two patients with symptomatic, medically refractory, extra-cranial carotid artery dissections underwent treatment with overlapping PEDs. A PUBMED search identified four articles reporting treatment of extra-cranial carotid dissections with FDS. Our analysis is restricted to those with high-grade stenosis.

Results

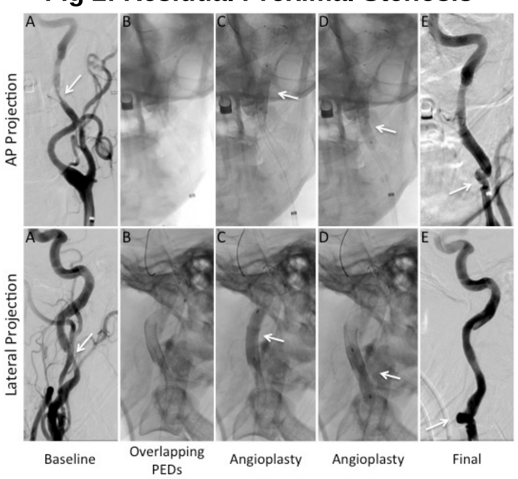
Case 1: 58yM former smoker, h/o HTN, HL fibromuscular dysplasia, bilateral carotid dissections. Started on Plavix for after suffering a left parietal stroke (Fig 1A) 1 year prior to current presentation. MRA of his left carotid artery demonstrating a severe stenosis proximal to a pseudoaneurysm at the time of his initial stroke (Fig 1C). He presents with new symptomatic thromboembolic strokes (Fig 1B) despite compliance with medical management. CTA demonstrates stable left chronic ICA dissection with high-grade stenosis and pseudoaneurysm (not shown). He was successfully treated in a two-stage procedure. The AP and lateral views of the initial treatment angiogram are shown in Fig1.

Fig 1: Carotid Dissection & Pseudoaneurysm



Initial control runs demonstrate severe ICA stenosis (arrow) just proximal to a large pseudoaneurysm (asterix) (Fig 1D) in the high-cervical region. The severity of the stenosis precluded the use of an embolic protection device. Balloon angioplasty (Fig 1E) caused improvement in the stenosis (Fig 1F). Three overlapping PEDs were then successfully placed with good flow and stasis in the pseudoaneurysm (Fig 1G and Fig 1H). Note was made of narrowing of the PED through the region of maximal stenosis.

Fig 2: Residual Proximal Stenosis



During the second stage of the procedure control runs again demonstrated narrowing of the PED at the area of previous maximal stenosis (Fig 2A, arrows), but notably the pseudoaneurysm no longer demonstrated filling. A distal embolic protection device was deployed, subsequently an overlapping, self-expanding open cell carotid stent was then placed proximally (Fig 2B), and the entire construct was then balloon angioplastied (Fig 2C and 2D, arrows). Resolution of the stenosis was achieved as demonstrated on the final runs (Fig 2E). Note was made of some proximal catheter-induced vasospasm (Fig 2E, arrows). Follow-up at 6 months demonstrated continued patency of the stent with no new stenosis, and continued occlusion of the pseudoaneurysm. The patient had no new symptoms/events.

Case 2: 59yM smoker with h/o HTN, HL, TIA; presents with acute left vision loss and transient aphasia and right sided weakness. Multiple left sided thromboembolic strokes are found on MRI (Fig 3A). His exam was noted to be blood pressure dependent and he continued to suffer events while kept supine on a heparin drip. Repeat MRI demonstrated increasing left sided thromboembolic burden (Fig 3B). A spontaneous left petrous-carotid dissection with severe stenosis was found during workup (Fig 3C oblique MRA). Fat Sat and CTA inset demonstrates dissection flap and mural hemorrhage (arrows).

The AP and lateral views of the treatment angiogram with overlapping PEDs are shown in Fig4. Initial control runs demonstrate severe petrous-segment ICA stenosis (Fig 4A, arrows). The stenosis was so severe that we were unable to place a distal embolic protection device. An initial PED was placed through the region of stenosis (Fig 4B), and note was made of severe wasting of the PED at the area of maximal stenosis (arrows). Subsequent control runs demonstrated slow flow (Fig 4C) secondary to continued severe petrous segment stenosis and an iatrogenic proximal ICA dissection. Several additional PEDs and a traditional self-expanding open cell carotid stent were then placed in rapid succession (Fig 4D). The procedure was subsequently complicated by difficulty in recrossing the stenotic area, with severe hypoperfusion and the need to emergently intubate the patient. Subsequently the stenotic area was recrossed and subsequently balloon angioplastied with good effect (Fig 4E). Final control runs demonstrated resolution of the stenosis and no thromboemboli to the brain. At 6 month follow-up the patient's stent contruct remains widely patent and he is free of additional symptoms/events.

Fig 3: Acute Carotid Dissection

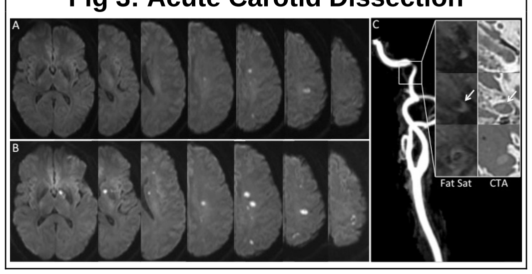
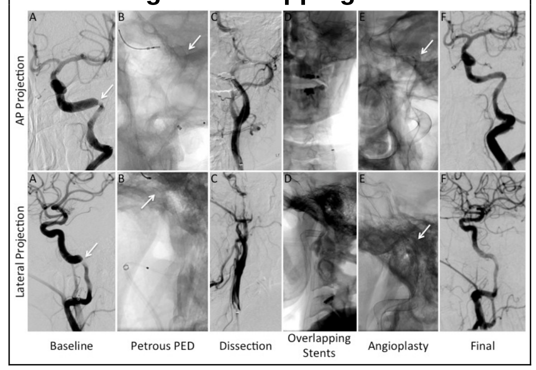


Fig 4: Overlapping PED



Review of the literature reveals 13 additional patients with 14 high-cervical carotid dissections and high-grade stenosis successfully treated with PEDs. Complications included iatrogenic dissection, delayed in-stent-thrombosis, and PED collapse.

Conclusions

FDS treatment of extra-cranial carotid artery dissections with high-grade stenosis demonstrates high technical success and good intermediate results. TCS are stiff, large-system stents not well suited for the angulation of the high-cervical ICA. Classical intracranial stents are only available up to 4.5-mm in size and therefore may be too small for this ICA segment. PEDs are extremely navigable and available in a 5.0-mm size (expanding up to 5.25-mm). Their low porosity decreases thromboembolic risk by trapping friable debris and promotes thrombosis of pseudoaneurysms.

References

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