Carotid Cavernous Fistula After Pipeline Placement: A Single Center Experience and Review of Literature

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Introduction

Carotid Cavernous Fistula (CCF) development after Pipeline Embolization Device (PED) treatment of Cavernous Carotid Aneurysms (CCA) can be a challenging pathology to treat for the neurointerventionalist.

Methods

A database of all patients whose aneurysms were treated with the PED since its FDA approval in 2011 was retrospectively reviewed. Demographic information, aneurysm characteristics, treatment technique, antiplatelet regimen and follow-up data were culled. A literature review of all papers that describe PED treatment of CCA was then completed.

Results

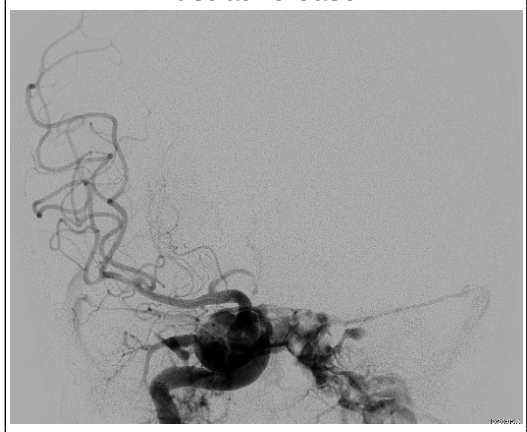
A total of 44 patients with 45 CCAs were identified (38 females, 6 males). The mean age was 59.9 ± 9.0 yrs. The mean maximal aneurysm diameter was 15.9 ± 6.9 mm (mean neck 7.1 ± 3.6 mm). A single PED was deployed in 32 patients with two PEDs deployed in 10 patients and three PEDs in 3 patients. Adjunctive coiling was performed in 3 patients. Mean follow-up duration based on final imaging (MRA or DSA) was 14.1 ± 12.2 months. Five patients (11.4%) developed CCFs in the post-procedural period after PED treatment, all within two weeks of device placement. These CCFs were treated with a balloon test occlusion followed by parent artery sacrifice.

Our literature review yielded only three reports of CCFs after PED placement with the largest series having a CCF rate of 2.3%.

Illustrative Case 1

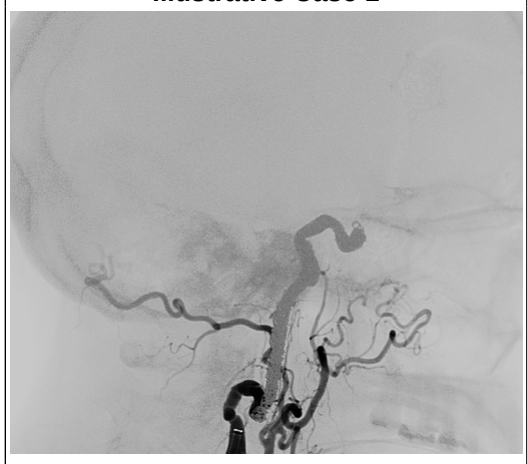
An elderly patient with headaches was diagnosed with a Right MCA aneurysm and a CCA with a maximal diameter of 19 mm and a 7 mm neck. The patient initially underwent an uneventful clipping of the MCA aneurysm but later presented with a right CN VI palsy and was later treated with the PED for the CCA. The patient presented on PPD 6 with worsening headaches, nausea and diplopia, and DSA revealed a CCF. Transvenous embolization was attempted and the right cavernous sinus was catheterized but the CCF could not be accessed. The patient subsequently passed a BTO and underwent a parent artery sacrifice by coil embolization.

Illustrative Case 1



CCF

Illustrative Case 1



Coil Sacrifice

Conclusions

CCF formation is a known risk of PED treatment of CCA. Although transvenous embolization can be used for treating CCFs, parent artery sacrifice remains a viable option on the basis of these data. Studies support that adjunctive coiling may have a protective effect against post-PED CCF formation.

Our overall CCF rate (11.4%) is higher than reported by Tanweer et al(2.4%). On average, we deployed 1.36 PEDs per aneurysm versus 3.8 PEDs per aneurysm by Tanweer et al which could be a contributing factor. A protective effect from flow pattern changes with more coverage of the aneurysm with increasing numbers of PEDs is postulated, however, the recent IntrePED database has also discussed intraparenchymal hemorrhages being associated with multiple PEDs. We have changed our treatment approach to simultaneously treating CCAs with both PED and coils if the aneurysm is greater than 15mm. As a general principle, we attempt to obtain coil packing density of 1/3 to 1/2 the amount typically achieved for complete embolization of an aneurysm treated without flow diversion, in order to embolize the aneurysm without adding to the mass effect of the aneurysm, which is often causing neurologic symptoms. None of the coiled aneurysms in our database or within the literature have ruptured. Follow-up data will lead to better understanding the safety profile of the PED for CCA.

References

Tanweer O, Raz E, Brunswick A, et al. Cavernous carotid aneurysms in the era of flow diversion: a need to revisit treatment paradigms. AJNR Am J Neuroradiol. Dec 2014;35(12):2334-2340.

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