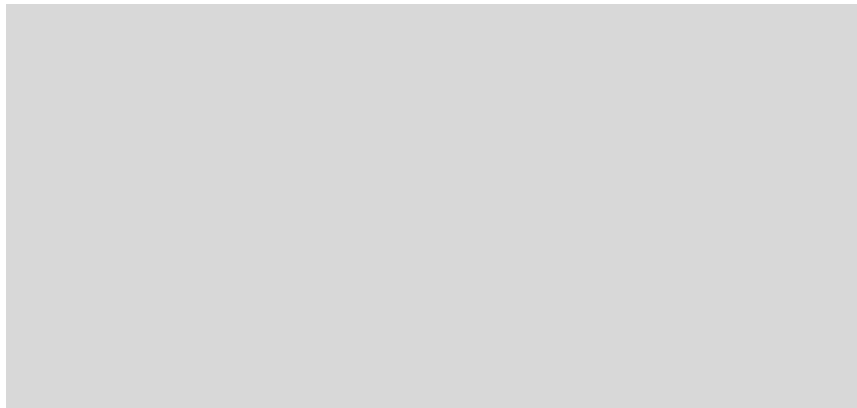


# Endovascular Management of Intracranial Aneurysms: Advances in Stenting Techniques and Technology

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## TO THE EDITOR

I have read, with interest, a recently published article in the Journal of Cerebrovascular and Endovascular Neurosurgery by Kim et al. titled 'A Self-expanding Nitinol Stent (Enterprise) for the Treatment of Wide-necked Intracranial Aneurysms: Angiographic and Clinical Results in 40 Aneurysms'.<sup>23)</sup> The authors report their outcomes with Enterprise (Codman, Raynham, MA, USA) stent-assisted coil embolization (SACE) of 40 wide-necked intracranial aneurysms in 39 patients. The mean neck width was 5.6 mm, and 30% were located in the posterior circulation. At the initial treatment, the rates of Raymond class 1, 2 and 3 angiographic outcomes were 20%, 15%, and 65%, respectively. The rate of overall complications was 12.5%, and the rate of symptomatic complications was 2.5%. The modified Rankin Scale (mRS) score was 3 or higher in six patients (15.4%), although four of the

six patients (66.7%) presented with subarachnoid hemorrhage (SAH). Of the 18 patients with available angiographic follow-up (mean duration 11.3 months, range 6 to 23 months), the rates of Raymond class 1, 2, and 3 outcomes were 72.2%, 22.2%, and 5.6%, respectively. Of note, 11 of 16 aneurysms with neck or sac remnants at initial treatment progressed to complete occlusion at follow-up (68.8%), and only one of those aneurysms developed recanalization (6.3%). Additionally, there were no cases of in-stent stenosis at follow-up. In the following discussion, we highlight recent advances in endovascular stenting techniques and technologies for the treatment of intracranial aneurysms.

Wide-necked (dome to neck ratio < 2 or neck width  $\geq$  4 mm) or large (diameter  $\geq$  10 mm) aneurysms are difficult to treat with endovascular coiling alone.<sup>30)</sup> Intracranial stents significantly expanded the endovascular armamentarium by providing a scaffold for coil support and promoting endothelialization across the

neck of large, wide-necked aneurysms.<sup>27)</sup> An analysis of 552 aneurysms (508 patients) treated with SACE, 91% electively and 9% in the setting of SAH, reported a 7% procedural complication rate.<sup>3)</sup> After a mean follow-up of 26 months, the aneurysm recanalization and retreatment occurred in 12% and 6%, respectively. The past few years have seen a transition from the use of stenting techniques from SACE, such as was used in the present series, to flow-diverting stents, such as the Pipeline Embolization Device (PED; ev3 Neurovascular, Irvine, CA, USA) and SILK stent (Balt Extrusion, Montmorency, France).<sup>1)15-18)20)25)</sup> A matched cohort study comparing PED flow diversion to coiling (including coiling alone, SACE, and balloon-assisted coiling) large, unruptured saccular aneurysms reported a significantly higher occlusion rate in the PED cohort (86% vs. 41%,  $p < 0.001$ ), with similar rates of complications and favorable outcome (modified Rankin Scale score 0-2).

A meta-analysis of 1,654 aneurysms (1,451 patients) treated with flow diverters reported complete occlusion in 76%, ischemic stroke in 6%, procedural morbidity in 5%, mortality in 4%, and postoperative subarachnoid hemorrhage, intraparenchymal hemorrhage, and perforator infarction each in 3%.<sup>2)</sup> Patients with posterior circulation aneurysms were significantly more prone to ischemic stroke ( $p < 0.0001$ ) and perforator infarction ( $p < 0.0001$ ) compared to those with anterior circulation aneurysms. An international, multicenter retrospective cohort study of 906 aneurysms (793 patients) treated with the PED at 17 centers reported a combined neurological morbidity and mortality rate of 8%, which was highest in posterior circulation aneurysms (16%) and lowest in internal carotid artery aneurysms  $< 10$  mm in diameter (5%).<sup>22)</sup> The overall rates of ischemic stroke, intracranial hemorrhage, and spontaneous aneurysm rupture were 5%, 2%, and 0.6%, respectively. Although our understanding of the typical complication profile of flow diversion is becoming more established, the optimal management of uncommon complications remains poorly defined.<sup>11)19)21)</sup>

Stents continue to play a crucial role in the treat-

ment of intracranial aneurysms, as well as numerous cerebrovascular disorders.<sup>4)5)7-9)12)14)26)32)</sup> Conventional high-porosity stents have given way, in recent years, to low-porosity flow diverters. Our understanding of the indications for SACE and flow diversion continues to evolve as evidence mounts for stent-based techniques and devices. An improved understanding of aneurysm biology may improve our ability to develop and employ emerging stent technologies for the treatment of complex aneurysms.<sup>6)10)13)24)28)29)31)</sup>

### Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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