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## Flow Diverters for Unruptured Internal Carotid Artery Aneurysms: Dangerous and Not Yet an Alternative for Conventional Endovascular Techniques

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demetic endeavors but also about how their teachers look. “Hot” professors make, on average, 6% higher wages than their not-so-hot counterparts. This observation applies to many other professions, including football players and CEOs of the largest Fortune 500 companies. Charitable organizations know this well; their most beautiful solicitors generally bring in more donations. Handsome public attorneys are more likely to move into the private sector later in life than ugly ones. Attractive political candidates get twice as many votes as their opposites. In economics, this is known as “customer discrimination”—that is, a good-looking person becomes a part of what the customer is buying. The store chain Abercrombie & Fitch is well-known to hire, promote, and use in publicity only individuals they rate as “hot,” a behavior that brought a large lawsuit based on its discriminatory policies.<sup>17</sup> Of course, that has not changed the behavior of many similar businesses—just walk into one of these stores and you will find yourself surrounded by beautiful, mostly female, employees in their late teens or early 20s.

Customers may, more concretely, buy beauty. An Internet search that I did for purposes of this Perspectives revealed several advertisements by “beautiful and clever” women selling their eggs to infertile couples. In Great Britain, where a standard egg donation goes for about £250, beautiful women’s eggs may fetch up to £12,000.<sup>18</sup> The Web site <http://www.beautifulpeople.com> went as far as offering sales of sperm from handsome men, and in 2010, its CEO expelled 5000 members for being ugly.<sup>19</sup> Because mixing 2 sets of genes generates an enormous amount of randomness and variability, good looks cannot be completely guaranteed if one buys these eggs and sperm. Evolution selects the best-looking individuals, and why not? On average, they have better lifestyles, earn more, and are healthier, physically and mentally. There are still great jobs where physical beauty is not critical, but they are becoming scarce. Being the editor of a scientific journal is one of them, but I wonder, if I were better-looking would *AJNR* have more subscribers?

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## EDITORIAL

# Flow Diverters for Unruptured Internal Carotid Artery Aneurysms: Dangerous and Not Yet an Alternative for Conventional Endovascular Techniques

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With interest,<sup>2</sup> we read the article of Lanzino et al<sup>1</sup> about the use of flow diverters for proximal internal carotid artery aneurysms in 21 patients. There was a higher rate of complete occlusion at follow-up with flow diverters than in a matched series of aneurysms treated with conventional techniques (coiling, stent placement, ICA occlusion). Most important, there were no complications leading to permanent neurologic deficits or death, though 1 patient was found to have a complete ICA occlusion at 6 months without symptoms. The message in the article is that although longer follow-up is needed, flow diverters are probably better than conventional techniques for these ICA aneurysms because of a higher complete occlusion rate at follow-up.

The results in this study are exceptionally good (if we disregard the asymptomatic ICA occlusion at follow-up) and better than most previously reported series. Briganti et al<sup>2</sup> recently reported the initial experience with flow diverters in Italy and found, in a cohort of 273 patients with unruptured aneurysms, a morbidity of 3.7% and a mortality of 5.9% at 1-month follow-up. There were 7

delayed aneurysm ruptures in aneurysms that had never bled before treatment. In posterior circulation aneurysms, the mortality went up to an alarming 19% (7 of 37). In (harmless) cavernous sinus aneurysms, the mortality was still 4% (3 of 76). Briganti et al summarize the complications of 6 large studies on flow diverters. In 471 patients, the morbidity was 4.2% (95% confidence interval [CI], 2.7%–6.5%) and the mortality was 5.1% (95% CI, 3.4%–7.5%). Also in the French experience in 64 patients, combined morbidity and mortality were higher than 10%.<sup>3</sup> This means that almost 1 of every 10 patients with an unruptured aneurysm either dies or ends up with permanent neurologic deficits directly related to the flow-diverter treatment. In addition, at follow-up, there remains a certain risk for delayed aneurysm rupture and delayed in-stent thrombosis. Velioglu et al<sup>4</sup> combined their results with those of 4 other studies and found that in >11% (22 of 197) of aneurysms treated with a flow diverter, the parent artery became occluded. We must realize that this high complication rate and high rate of unintended parent vessel occlusion concerns elective treatments of unruptured aneurysms with an often low chance of rupture or a benign natural history (cavernous sinus aneurysms) for which safer conventional treatments are available.

In our practice, ICA balloon occlusion is still the first choice in the treatment of (large and giant) ICA aneurysms.<sup>5</sup> Three-quarters of patients can tolerate ICA occlusion, and this tolerance can be safely and reliably tested with angiography.<sup>6</sup> ICA occlusion is simple to perform without the need for anesthesia, is extremely effective, safe, definitive (no imaging follow-up needed), and cheap, and leads to aneurysm shrinkage and alleviation of symptoms of mass effect in most patients. Delayed aneurysm rupture does not occur.<sup>5,7–9</sup> In contrast to the fear expressed by Lanzino et al,<sup>1</sup> there is no increased risk for the development of de novo aneurysms in the long term and also cerebral perfusion is not impaired very long after ICA occlusion.<sup>10,11</sup> Regardless, long-term risks after ICA occlusion are definitely much lower than the substantial risk of delayed aneurysm rupture and parent vessel occlusion after placement of flow diverters with intended preservation of the ICA.

In patients with unruptured aneurysms who cannot tolerate ICA occlusion (25% of patients), we should be reluctant to offer a treatment with a risk of delayed ICA occlusion with subsequent certain neurologic deficit or even death. Delayed ICA occlusion on follow-up may occur in >11% of cases with flow diverters, after filling the aneurysm with Onyx (ev3, Irvine, California), or after surgical bypass procedures. Selective coiling with or without stent assistance seems the safest option in these patients. In unruptured aneurysms, neck or aneurysm remnants on follow-up have little or no clinical consequences, not even in ruptured aneurysms,<sup>12</sup> and additional coiling can be performed at a low complication rate.<sup>13,14</sup> The risk of recurrence with conventional parent artery sparing techniques can never be an argument to proceed with dangerous flow-diverter treatment.

In patients presenting with unruptured aneurysms, our first goal is to do no harm. A treatment strategy with ICA occlusion when tolerated, selective coiling when necessary, and conservative treatment when possible (cavernous sinus aneurysms) has very

low complication rates approaching 0% and is effective in preventing first-time SAH or in alleviating symptoms of mass effect and has no negative consequences in the long term. We welcome the good results of Lanzino et al<sup>1</sup> with flow diverters. Their results are as good as those they achieved with selective coiling in 126 mostly small paraclinoid aneurysms.<sup>15</sup> However, one swallow does not make a summer. With 10% combined morbidity and mortality together with the risk of delayed aneurysm rupture and delayed parent vessel occlusion, flow diverters should, for now, be considered a dangerous therapy for unruptured aneurysms, especially in patients who cannot tolerate ICA occlusion.

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