



EDITORIAL

Discipline and training

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PHYSICIANS from several different disciplines currently perform endovascular treatment of cerebral aneurysms, i.e., neurosurgery, radiology, and neurology. Early studies using administrative databases showed that better outcomes could be achieved with endovascular techniques compared with surgical clipping for both ruptured and unruptured aneurysms, and that higher volume centers had better outcomes as compared to lower volume centers.^{5,8} In 2002, the International Subarachnoid Aneurysm Trial (ISAT) demonstrated the relative benefit of endovascular coil occlusion of ruptured aneurysms compared with surgical clipping.¹² Since that time, endovascular treatment has become the preferred approach at most centers throughout the world. Presently, neurosurgeons and radiologists comprise the majority of physicians treating cerebral aneurysms, but neurologists are now training in greater numbers and comprise a growing segment of neurointerventional specialists. Does the training background of the operating physician matter? Fennell et al. suggest that it does.² Using the University HealthSystem Consortium (UHC) database, the authors examined the rate of complications incurred in the treatment of ruptured and unruptured cerebral aneurysms. These authors suggest that neurosurgeons achieve better clinical outcomes, especially when compared with neurologists, and to a lesser degree, compared with radiologists.

These are strong assertions. Like any accusation, it is important to have substantial evidence to support the claim. If the article had meaningful evidence, then it could potentially represent a serious indictment. Unfortunately, the UHC database does not provide conclusive information, and therefore the assertions in this paper are weak. As Fennell et al. dutifully note, specific deficiencies of this study include: 1) the UHC database is self-reporting

(i.e., not objective); 2) the UHC database does not readily provide individual patient characteristics or demographics under its current reporting structure; 3) there could be significant differences in patient profiles with potentially disparate impact on outcomes due to patient selection; and 4) differences could also be attributed to the overall cerebrovascular volume of the treating center as well as the treating physician.² Therefore, it is not possible using the UHC database to know whether a complication occurred before, during, or after treatment. In addition, it is also not possible to compare preoperative morbidity of patients within the 3 physician groups, and this single factor alone could represent an impactful and confounding factor in outcomes and results. Other “potential” conclusions that could just as easily be reached from the data set include the possibility that neurosurgery physicians and hospitals are “underreporting” their true complication rates or that neurology and radiology physicians are treating more difficult and complex patients with aneurysms at centers where open cerebrovascular surgery is not readily available, and that neurosurgeons are simply treating less difficult and less complex cases, and having more complex cases undergo surgical clip placement. Each of these arguments could lead to incorrect assertions, as exemplified by the article by Fennell et al., because the data upon which it is referenced is insufficient to draw a meaningful conclusion.

Comorbidities have long confounded studies to assess treatment effect, particularly for ruptured aneurysms. Simply selecting out patients with Hunt and Hess Grade I–III subarachnoid hemorrhage for endovascular treatment, while excluding patients with Hunt and Hess Grades IV and V, will influence good outcomes favoring specialists and hospitals. Nevertheless, all physicians should strive to

improve patient outcomes through the definition and implementation of guidelines for best practices.^{1,10,11,13}

Using the same UHC database in the 1990s, Johnston et al. showed better outcomes at lower cost for endovascular treatment of unruptured aneurysms, but it is not clear that that benefit has been maintained a decade later.⁸ Using the New York Statewide Planning and Research Cooperative System (SPARCS) database, Zacharia et al. compared treatment outcomes from a time when patients with aneurysms mostly underwent surgical clipping, to the present when endovascular treatment predominates, and found no improvement in patient outcomes.¹⁸ The study of Zacharia et al. indicates that the same complication rates associated with craniotomy and surgical clipping now occur during endovascular aneurysm procedures, even in patients with unruptured aneurysms.¹⁸ Moreover, this stagnation in outcomes occurs during an era when the endovascular discipline has experienced increasing adoption by neurosurgeons. Does this mean that neurointervention as a discipline, now dominated by neurosurgery, has not achieved the promised benefits of the endovascular paradigm? Quite possibly, yes, especially if endovascular techniques are misapplied.

There is great variation in the application of endovascular procedures to treat cerebral aneurysms from medical center to medical center. Some centers report nearly exclusive use of endovascular techniques to treat patients with cerebral aneurysms. At others, endovascular treatment represents a more modest component of all aneurysm procedures. In another study, Zacharia et al. examined patient outcomes at high-volume academic medical centers, again using the SPARCS database.¹⁷ Although treatment of cerebral aneurysms at many centers is controlled by neurosurgery, patient outcomes vary fairly dramatically (Fig. 1).¹⁷ At some cerebrovascular centers, only 75% of patients with unruptured aneurysms achieved good outcomes. The causes of this variability in outcomes are not explored in this paper, but there are many reasons to seek improvements, such as centralization of care to cerebrovascular centers of excellence, to the general good of all patients with cerebral aneurysms.

Sometimes, outcome data have suggested differences according to physician specialty. When studied further, differential outcomes were attributable to patient comorbidities. Carotid artery revascularization comparing surgical endarterectomy to stent-angioplasty offers some useful similarities to the issues surrounding the treatment of cerebral aneurysms. Carotid artery stenosis is a neurovascular disease treated by a spectrum of physician specialties. While early studies pointed to the benefits of an endovascular paradigm with stent-angioplasty,¹⁶ trials were not universally successful and indicated important problems involving training and technique.^{9,14} The Carotid Revascularization Endarterectomy versus Stenting Trial (CREST) lead-in data had suggested significant differences in the outcomes of physicians from different specialties (Fig. 2).⁷ In the CREST lead-in, there appeared to be a broad range of outcomes even among neurosurgeons, while neuroradiologists experienced the most favorable outcomes compared with cardiologists. Differences by physician specialty were also noted in lead-in data for the Carotid

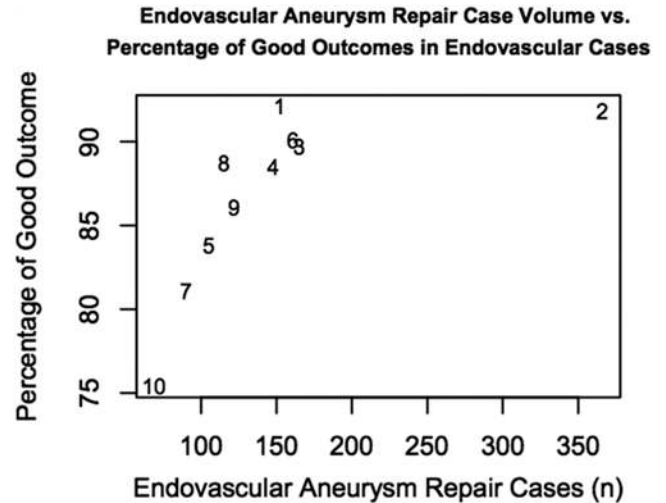


FIG. 1. Comparison of outcomes by aneurysm treatment volume at high-volume medical centers in New York.¹⁷ Centers are numbered by decreasing aneurysm case repair volume. Disparities in patient outcomes at high-volume centers raise questions that remain difficult to answer at this time but are likely not explained by physician specialty. Reproduced with permission from Zacharia et al: *Stroke* 45:1447–1452, 2014.

Acculink/Accunet Post-Approval Trial to Uncover Unanticipated or Rare Events (CAPTURE), raising concerns about training and operator experience.³ In both studies, differences in outcome according to physician specialty dissipated when adjusted for patient comorbidities.

Training and outcomes remain important issues for neurointerventional surgery. The Society of NeuroInterventional Surgery (SNIS) includes a multidisciplinary board of directors composed of physicians from neurosurgery, radiology, and neurology. The SNIS had prepared to launch a program for training center certification when we were solicited to participate in the Senior Neurosurgical Society (SNS) Committee on Advanced Specialty Training (CAST) program for training and individual cer-

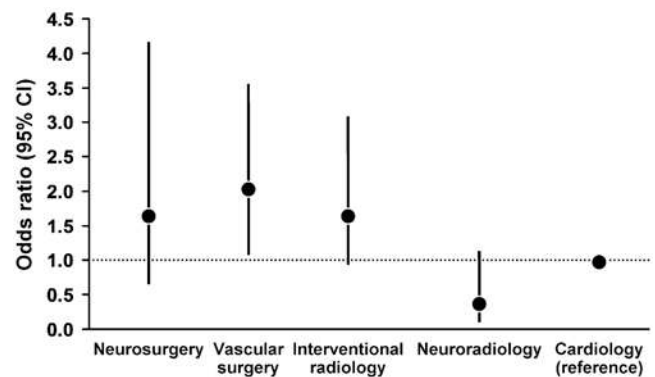


FIG. 2. Comparison of event rate from carotid stent-angioplasty by physician specialty.⁷ With Cardiology outcomes as the reference, other outcomes of other specialists are listed. Reprinted from *J Stroke Cerebrovasc Dis* 19: Hopkins et al. The Carotid Revascularization Endarterectomy versus Stenting Trial: Credentialing of Interventionalists and Final Results of Lead-in Phase, 153–162, 2010, with permission from Elsevier.

tification. To avoid creating a set of competing certification programs, we pursued collaboration in CAST for the training and certification of all participants in neurointerventional procedures, from neurosurgery, neuroradiology, and neurology backgrounds. While still in its formative stages, endovascular CAST represents an effort to implement training criteria for cognitive and technical competence, originally defined in 2000.^{4,6} Embracing multidisciplinary and highly specialized care in cerebrovascular centers of excellence strengthens the training and practice experience.¹⁵ In an era of cost-containment, the neurosciences will undoubtedly also face a call for greater efficiency in the care of patients with cerebral aneurysms. Collectively, we as a society should define and implement best practices for preparatory studies, training, outcomes, and ongoing monitoring of current standards of care, lest an external body determine them for us. Our efforts will pay dividends for future generations of neurointerventional specialists.

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Disclosure

Dr. Rasmussen is a consultant to, and has ownership in, Blockade Medical. Dr. McDougall serves as a consultant to Microvention and Covidien.

Response

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We thank Dr. Meyers and colleagues for their commentary on this subject. The authors of this editorial accurately reiterate the limitations of our analysis relative to the limitations of the UHC database, specifically that individual surgeon and case data are not available for comparison. The authors offer readers these reasons to ignore the data, but we believe it is potentially ignorant to turn a blind eye to what may be a relevant finding, and we stand by our conclusions.

We have presented data acquired through the methodology described. We disagree that the limitations of the database do not allow for meaningful conclusions in re-

gard to this data. While successful in repeating the weaknesses of the UHC database, the authors of this editorial seemingly ignore the strength of administrative databases such as the UHC, that is, the large numbers of cases. This paper features data on more than 20,000 contemporary cases of aneurysms treated by endovascular means. Unlike other administrative databases, it consists of university-based hospitals more likely to have busy centers with fellowship-trained interventionalists. Such case numbers and homogeneity of treatment centers minimize potential inconsistencies such as preoperative complications and preoperative morbidity, which the authors accurately refer to as potential confounding factors. On this point, the astute reader will note that most patients with treated unruptured aneurysms would, by definition, not have preoperative complications as these are treated electively. Furthermore, we believe patients with preoperative morbidity related to aneurysm rupture are exactly the type of patients who might be better served by a physician trained

in neurosurgical techniques in limiting death. This is obviously a point of conjecture, but may explain the data as presented.

We regret that the authors have read “strong assertions” into our analysis and disagree with their position that the paper represents an “accusation.” We believe the primary conclusion of our paper is sound, and reiterate it for the benefit of the reader: “In this study there was a statistically significant finding that neurosurgically trained physicians may demonstrate improved outcomes with respect to endovascular treatment of unruptured aneurysms in this cohort. This finding warrants further investigation.” Indeed, we welcome higher-level evidence on this interesting topic and believe that the Society of NeuroInterventional Surgery, with multispecialty leadership, is an ideal institution to carry this out as well as act to improve training and best practices in the endovascular treatment of cerebral aneurysms.