Current State-of-the-Art: Intracranial Aneurysm

"Intracranial aneurysm surgery is in a substantial process of evolution," stated Arthur L. Day, MD, Brigham and Women's Hospital, Boston, MA. Dr. Day spoke of a new era in aneurysm surgery that requires what he referred to as 'finesse"—the refinement and delicacy of performance, execution, or artisanship. "We are past the days when just putting a clip across the vessel was good enough," he said. "Total recovery and perfection in result are now expected from such surgery."

The refinement of aneurysm surgery requires a combination of equipment, technique, and training. Because we are now dealing with complex aneurysms more frequently, hands-free surgical microscope adjustment is a necessity. One of the largest areas of improvement has been in intraoperative imaging/visualization, which now allows us to view the lumen and branches using both traditional DSA as well as indocyanine green (ICG) dye. The rationale for using both techniques is to allow the surgeon to confirm complete exclusion of the aneurysm and the patency of the parent artery, as well as branch/perforator preservation.

A good view is key to successful surgery. Surgery on the brain is not minimally invasive, but it must be minimally disruptive to the brain, and this requires exposure that is sufficient for manipulation, visualization, brain relaxation, and vein preservation. Dr. Day prefers a skull base approach, during which extensive portions of the skull are removed to facilitate basal visualization without undue brain or cranial nerve retraction. Surgical refinements that are now being used include orbital rim or anterior clinoid removal for anterior circulation aneurysms, and an anterior subtemporal approach coupled with medial petrosectomy for low lying or complex basilar artery aneurysms.

Combination techniques increasingly are being used for difficult complex surgeries. Endovascular surgery, which is minimally invasive, may be performed before, after, or in conjunction with traditional surgery. Stenosis or vasospasm may be managed with surgery followed by endovascular treatment; surgical remodeling can improve the anatomy of an aneurysm to allow more straightforward stenting/coiling. The specific features of a patient's aneurysm and superb anatomical knowledge are critical when choosing the most appropriate approach. In theory, a particularly complex basilar apex aneurysm could be best treated with endovascular and open surgery simultaneously.

"The rapid evolution of endovascular therapy has substantially changed the landscape of our discipline," Dr. Day concluded. He recommends that in the future, neurosurgeons have both microsurgery and endovascular training post-residency.

Highlights from the

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Endovascular surgery is a minimally invasive technique that allows the placement of intravascular balloons, stents, and coils in difficult-to-reach vessels. It is quickly replacing open surgery for treating many intracranial aneurysms. Since 1996, endovascular treatment for aneurysms has increased in his practice from 5% of cases to 66% in 2004, pointed out Michel E. Mawad, MD, Baylor College of Medicine, Houston, TX. In his exclusively endovascular practice, 75% of aneurysms are treated with either balloon protection or stent reconstruction of the parent artery. Overall mortality and morbidity are decreasing with this approach; the average complication rate is about 5% because of the development of coils that are softer and easier and faster to detach. Adding to this has been the improvement in imaging technology.

However, large aneurysms, aneurysms with wide necks, aneurysms with poor packing, and particularly those with dysplastic or atypical parent vessels remain a challenge for endovascular surgery and often are associated with a high rate (10-50%) of recanalization.

Surface-modified coils and new filling materials seem to reduce the recanalization rate in these difficult-to-treat aneurysms, while reconstruction of the parent artery in conjunction with the use of stents can successfully treat many complex and wide-neck aneurysms.

New tools and techniques, such as horizontal stenting of bifurcation aneurysms, reconstruction of dysplastic arteries, virtual stenting, and dense packing of the vessel with coils, are improving endovascular outcomes. A new neurovascular microstent, the Cordis Enterprise stent, composed of nitinol, with a closed cell design, was specifically developed for the treatment of wide-necked intracranial cerebral aneurysms. Flow diverters coupled with digital subtraction angiography (DSA) are being used in order to divert embolic material away from the arteries that carry blood to the brain.

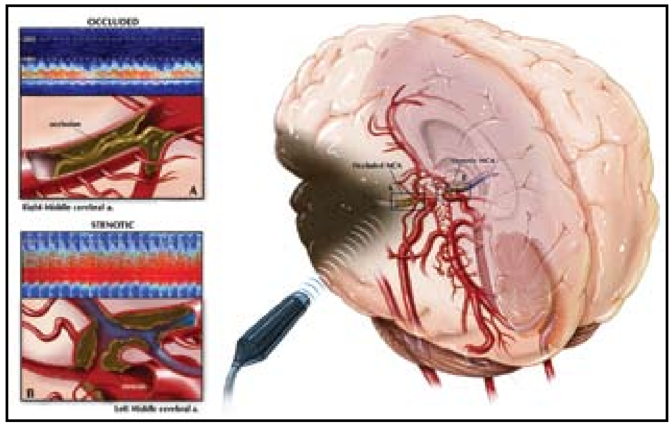
Endovascular techniques will continue to grow in their application to the treatment of intracranial aneurysms. In the future, hybrid imaging technology and robotic enhancement of angiographic instruments will add precision and improve reproducibility. Continuous improvements in coil design—eg, enhanced coils—are making endovascular treatment safer and decreasing the recanalization rate. Parent artery reconstruction will become a major component of endovascular treatment, while new flow diverters will produce a paradigm shift from endosaccular obliteration of the aneurysm to endoluminal repair of the parent artery.

Stroke in Sickle Cell Disease: Recent Successes

The reported incidence of all types of stroke in childhood is relatively low, with 2.6 occurring per 100,000 white children and 3.1 per 100,000 in black children (Broderick et al. *Child Neurol* 1993). However, additional analyses indicate that children with sickle cell disease (SCD) face a huge relative risk of ischemic stroke compared with a healthy population (RR=220; Earley et al. *Neurology* 1998). Chronic blood transfusion therapy has been employed as secondary prevention of stroke in patients with SCD for over 30 years. This session discussed the epidemiology of SCD as well as the risks and benefits of using chronic transfusion therapy in primary stroke prevention.

Robert J. Adams, MD, Medical University of South Carolina, Charleston, SC, gave an overview of the Stroke Prevention Trial in Sickle Cell Anemia (STOP). Transfusion of every child with SCD is not warranted due to the high number needed (200) to save one child from a stroke, side effects, inconvenience to families, and cost. The STOP trial therefore sought to identify children at highest risk of stroke using transcranial Doppler ultrasound (TCD; Figure 1). Children were screened using TCD, and those with 2 measurements ≥200 cm/s were randomized to either periodic transfusion or standard care (including occasional transfusion). The study found that periodic transfusion reduced the risk of stroke by 92%, reduced other complications, and led to better height and weight gain (Adams et al. *NEJM* 1998).

Figure 1. Stroke Risk Identification Using TCD.



The presentation by Heather Fullerton, MD, University of California, San Francisco, CA, addressed whether the STOP trial findings influenced treatment of SCD patients. Using a California-wide database, Dr. Fullerton and colleagues found a downward trend in strokes in patients with SCD post-1998, the year that the STOP results were published. Data from a Kaiser Permanente cohort showed an upward trend in the numbers of SCD patients obtaining a first TCD post-1998, suggesting that the decrease in strokes were related to the identification of high-risk patients. "We definitely have some cause for optimism. We think that the stroke rates are declining, and we think this is due to implementation of this primary stroke prevention strategy," commented Dr. Fullerton. Obstacles remain, however. In a survey of 207 hematologists, 9 of 10 reported issues with acquiring TCDs, citing poor patient adherence and lack of facility availability. "This is really an issue for our neurology community, who is trying to make this [technology] increasingly available to these children," said Dr. Fullerton.

Michael DeBaun, MD, MPH, Washington University, St. Louis, MO, gave an overview of silent cerebral infarctions and future research in SCD-associated stroke prevention. Silent cerebral infarct is defined as an increased signal on T2-weighted imaging that is not accompanied by focal neurologic deficits. "We think about one-fifth of children