

# Future Role of the Endovascular Stroke Therapist

Examining the skills and knowledge of the endovascular therapist for managing acute stroke.

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**T**he role of the endovascular therapist in acute stroke management should be examined by subclassifying stroke into its ischemic and hemorrhagic components. In patients with hemorrhagic stroke due to a ruptured blood vessel (ie, cerebral aneurysm, cerebral arteriovenous malformation [AVM], or dural arteriovenous fistulas), the role of the endovascular therapist defines the gold standard of care.

## HEMORRHAGIC STROKE

For ruptured cerebral aneurysms, ISAT (International Subarachnoid Aneurysm Trial)<sup>1,2</sup> clearly showed the superiority of endovascular coiling over surgical ligation (clipping) in patients presenting with subarachnoid hemorrhage (SAH). ISAT results showed a decrease in mortality in patients with aneurysmal SAH who were treated with endovascular coiling compared to those treated using surgical ligation of the aneurysm with clips. As catheter-based technologies for aneurysms (eg, stents, flow diverter, new coils) continue to improve, the longevity of these therapies will only increase, and catheter-based techniques will be used in a larger percentage of patients presenting with aneurysmal SAH.

Flow diverters have been used to treat cerebral aneurysms in registries outside the United States.<sup>3</sup> This catheter-based therapy does not require coil placement inside the aneurysm; rather, a small, pore-sized, flexible, stent-like device can be placed adjacent to the aneurysm. This endoluminal construct diverts most of the blood past the aneurysm and significantly lowers intra-aneurysmal pulse pressures. Endoluminal flow diversion shows

great promise, yet its application to cerebral aneurysms located at bifurcations remains unproven.

Intracranial hemorrhages due to cerebral AVMs are usually caused by feeding pedicle aneurysm rupture, venous outflow obstruction, or hypertension. After these patients are stabilized, it is possible to deliver microcatheters into the feeding pedicles to block the pedicles and small vessels with “glue” material. Injection of an acrylate monomer that polymerizes on contact with blood, such as Trufill n-butyl cyanoacrylate (Codman Neurovascular, a Johnson & Johnson Company; Raynham, MA),<sup>4</sup> or the Onyx liquid embolic system (ev3 Inc., Plymouth, MN),<sup>5,6</sup> a precipitate polymer delivered in a dimethyl sulfoxide solution, can result in occlusion of these lesions.

Both of these materials occlude the feeding pedicle and, to a varying extent, the nidus (fine vessels) in the AVM. This therapy can be used adjunctively with focused stereotactic radiation and/or surgical resection. A randomized controlled study is enrolling patients to compare medical management to endovascular or surgical intervention or radiation therapy.<sup>7</sup> The endovascular therapist will continue to play a pivotal role in treating both cerebral AVM and cerebral arteriovenous fistulas in the future.

## ISCHEMIC STROKE

In ischemic stroke, catheter-based interventions have reported recanalization rates approaching 80%. Improvements in outcomes have been seen in approximately 50% of patients using a 3-month time point with modified Rankin scores or global stroke scores.<sup>8</sup> Although the outcomes for cerebral catheter-based revascularization show an improvement over intravenous tissue plas-

minogen activator therapy for acute stroke, a randomized prospective trial has never been conducted comparing these two therapies. Any such study would be cost prohibitive. Widespread adoption of catheter-based reperfusion strategies are stalled as endovascular therapists and stroke neurologists wait for a technology that would increase good outcomes seen in days rather than months. Stroke therapists are still innovating while using multiple catheters and devices in any given patient.

A few hundred sites exist in North America that offer catheter-based intra-arterial recanalization therapy for acute stroke patients. Regardless of outcome, catheter-based therapies offer the acute stroke patient the best chance for vessel recanalization. Direct visualization of the cerebral circulation in real-time helps guide recanalization therapy to the source of vessel occlusion. Minimally invasive imaging cannot yet provide real-time vascular flow imaging, but new magnetic resonance (MR) imaging techniques may be able to deliver the images of distal peripheral cerebral vasculature as never seen before. Presently, x-ray angiography and catheter-based therapies provide the only site-specific intervention.

## SKILL SET OF THE ENDOVASCULAR STROKE THERAPIST

The future role of the endovascular stroke therapist may largely depend on each therapist's individual skill set. These skills are usually governed by the physician's training. Stroke practitioners from all backgrounds bring various expertise to the diagnosis and treatment of stroke patients; this article attempts to outline the overall skill set of a stroke physician.

Management of ischemic stroke patients requires a unique combination of skills. A working knowledge of multiple medical and surgical disciplines is required to adequately manage these patients. Although a combination of specialists would be able to accomplish this task, coordinating their efforts is in itself a full-time job. To ensure longevity as a practitioner in the care of stroke patients, it is essential to deliver more than just a catheter-based therapy. A functional knowledge of patient management skills is an essential tool for success and longevity.

### Critical Care Training

The development of an ischemic stroke specialist requires training in neurology and critical care. Cardiologists gain critical care skills in fellowship and during internal medicine training. Neurologists should seek a neurocritical care fellowship, pulmonary critical care fellowship, or a cardiology fellowship to solidify these skills. The combination of medical neurology and functional knowledge of critical care is most effective when treating the stroke patient population. If this stroke practitioner can also safely provide

intra-arterial catheter-based therapies, this trifecta of skills is most desirable (ie, neurology, critical care, endovascular catheter skills). Treating acute stroke patients requires managing acute exacerbations of medical comorbidities, and this skill is tantamount to maximize outcome in acute stroke patients.

### Interpretation and Diagnosis

Stroke physicians who use endovascular techniques for revascularization must be well versed in all aspects of diagnostic cerebral angiography and interpretations of images. They must be able to perform brachiocephalic and cerebral vessel revascularization. It is possible to obtain catheter skills to treat ischemic stroke without gaining skills to treat cerebral aneurysms, AVMs, or fistulas. The reverse is also possible. Regardless, these stroke physicians must be neuroimaging experts, understanding and being able to interpret computed tomography (CT), MR, and angiographic imaging for rapid diagnosis, triage, and intervention.

### Neurohospitalists

Successful stroke inpatient services have a high volume of admissions with fast and efficient hospital stays. Rapid acquisition of diagnostic tests is critical to reducing length of stay for mild to moderate stroke patients. This can help maximize the contribution margin from diagnosis-related group–based reimbursement. Stroke physicians who can deliver fast and efficient care that enables patients to move from acute care to rehabilitation or home are extremely valuable to any hospital system. Utilization of hospital outpatient diagnostic imaging and laboratory facilities also helps the hospital system's profitability. Lastly, these physicians must be dynamic political and social entities enabling interactions with patients, families, allied health professionals, hospital administrators, and the community at large. An endovascular stroke therapist who can rapidly diagnose and treat acute stroke patients in a cost-effective, efficient manner will always be in demand.

Hyperacute and acute care of the stroke patient requires management skills most closely in keeping with neurocritical care or neurosurgery training, especially in patients with hemorrhagic stroke. However, the rapid control of airway and blood pressure required in acute stroke care eclipses all other requirements.

Rapid interpretation of CT results, which may include angiography and perfusion CT sequences, requires a thorough knowledge of axial coronal and sagittal vascular anatomy. When MR imaging is required, knowledge of all imaging sequences used in stroke must be mastered. During the night or on weekends, radiographic interpreta-

tion of acute stroke imaging can impart unwanted delay in diagnosis and treatment. Therefore, the stroke professional must be facile in all aspects of image interpretation.

### Knowledge of Cerebrovascular Disease

All stroke physicians must have a complete understanding of cerebrovascular disease and general neurologic disease. The role of an experienced stroke neurologist focuses on marrying the neurologic exam with imaging while weeding out stroke mimics. Differentiation among acute stroke, multiple sclerosis, seizures, brain tumors, intracranial hemorrhage, and other neurologic disorders requires a seasoned knowledge of neurologic disease and its management, which can only be gained through experience.

### Emergency Department Dedication

In addition, a neurologist with experience in cerebrovascular disease who is willing to cover an emergency department for acute stroke is a priceless commodity. Due to the fact that so few neurologists will participate in stroke emergency department coverage, most stroke neurologists are overburdened with the emergency department and hospital calls. Their dedication to acute stroke care delivery is the epicenter of any good stroke program. The more knowledge the endovascular therapist has about differentiating among neurologic disorders, the more value he or she may impart to the stroke team. As a result, the more neurologic and cerebrovascular knowledge the endovascular stroke therapist has, the more valuable he or she will be to the stroke team and the patient. Endovascular stroke therapists that participate in emergency department stroke call will always have direct access to patients.

### Knowledge of the Cardiovascular System

The cardiovascular system plays a large role as the origin of pathology causing stroke. Cerebrovascular disease occurs in concert with cardiovascular and peripheral vascular disease, and, as a result, a working knowledge of cardiology and cardiovascular disease is highly desirable for the stroke therapist. Management of blood pressure is a mandatory skill for all endovascular stroke therapists. In addition, an understanding of valvular disease, patients with low ejection fraction, patent foramen ovale, and congestive heart failure are only the cardiologic ante needed to participate in stroke care. The critical care skills and catheter skills of interventional cardiologists are extremely valuable in acute stroke care. As a result, the marriage of interventional cardiology and neurology training are extremely desirable for the care of the acute stroke patient.

### CONCLUSION

The role of the endovascular therapist is critical in managing and treating patients with hemorrhagic stroke caused by a cerebral aneurysm, AVM, or fistulas. Although outcomes continue to improve with endovascular therapy for ischemic stroke, a combination of less-invasive therapies could approach outcomes presently achieved after endovascular revascularization. As a result, patient management skills will help secure the role of the endovascular therapist in stroke care. The practice model used by many interventional radiologists was procedure-centric and has not stood the test of time. By extricating themselves from patient management, interventional radiologists have sacrificed patient ownership. Careful surveillance of acute stroke patients in the perioperative period is required to prevent recurrent in-hospital strokes.

Other specialties have stepped in to provide comprehensive patient care in the perioperative period in addition to performing the catheter-based intervention. The endovascular therapist can play an ever-increasing role in the care of the acute stroke patient by providing catheter expertise, as well as delivering valuable patient management services. Although patient management is labor intensive, it is rewarding when good outcomes can be repeatedly achieved. Endovascular stroke therapists who participate in the management of acute stroke patients, in addition to performing catheter-based therapies, will have an endless supply of work for decades. ■

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