Endovascular Treatment of Stroke

Current Efforts and Considerations

By Paul Singh, MD, MPH

With the well-known doctrine of “time is brain,” the last few years have shown that rapid access to the tools to salvage brain, such as intravenous thrombolytic therapy and endovascular therapies, is just as important. With biotechnology and stroke research accelerating at a rapid pace, the options for stroke treatment have improved dramatically over the last 20 years. Not all health care facilities provide the same options for stroke treatment, and for this reason, several federal and state designations have been instituted to delineate levels of care, similar to trauma medicine. Patients, first responders, and emergency health care providers need to be cognizant of these designations to ensure individuals with the signs and symptoms of stroke are ultimately given the best chance for a good recovery. The doctrine will change to “time to treatment is brain.” Several efforts are underway to ensure that emergency medical services (EMS) providers can better triage patients to appropriate hospitals for individualized, cutting-edge stroke care, which should lead to better patient outcomes.

Clinical Factors When Selecting Patients for Endovascular Treatment

Traditionally, the duration of clinical symptoms has been the most important factor in deciding upon endovascular treatment. Time is a simple parameter used in an attempt to approximate the progression of cerebral ischemia. The probability that the volume of salvageable penumbral tissue generally decreases with time makes this a logical conclusion. Not all patients, however, have the same functional anatomy, and collateral blood flow to at-risk brain tissue can be highly variable. Lack of adequate collateral blood flow can lead to rapid ischemia in less than 3 hours, whereas robust collateralization can yield viable cerebral penumbra for even greater than 24 hours. For this reason, radiographic imaging with CT or MRI that demonstrates a small area of core infarction, evidence of an emergent large vessel occlusion (ELVO), and either clinical symptoms or radiographic evidence of a larger territory at risk are generally accepted parameters for intervention. Clinical symptoms are objectively graded in severity with a National Institutes of Health Stroke Scale (NIHSS). Radiographic tools, such as perfusion imaging, can also demonstrate at-risk tissue. Recent trials support that some patients presenting as long as 24 hours from their symptom onset can still benefit from urgent endovascular therapy.

Environmental Factors Affecting Care and Treatment Selection

Stroke systems are highly variable with respect to access in urban versus rural areas. Urban areas have the benefit of multiple centers in close proximity to patients with multiple providers at each hospital. The limiting factor in more congested urban environments is transportation to these centers. For example, ambulances in Manhattan have to maneuver through heavy traffic, where vehicles do not have the ability to clear paths for EMS. This can impair timely patient evaluation, transport, and transfers between hospitals.
In rural areas, a different problem exists where advanced stroke centers may not be easily accessible, and dissemination of EMS to patients as well as transportation to the appropriate facility can lead to extended delays. The patient may be taken to the closest hospital, but the center may not have advanced stroke care, such as endovascular therapy. This will ultimately require a time delay due to an additional transfer to an endovascular site. Several organizations have suggested implementing a protocol where it may be prudent to bypass hospitals without advanced stroke capabilities to expedite treatment to more comprehensive centers in these time-sensitive patients. The patient may be taken to the closest hospital, but the center may not have advanced stroke care, such as endovascular therapy. This will ultimately require a time delay due to an additional transfer to an endovascular site. Several organizations have suggested implementing a protocol where it may be prudent to bypass hospitals without advanced stroke capabilities to expedite treatment to more comprehensive centers in these time-sensitive patients. The Joint Commission, as well as several other state/regional organizations, has delineated requirements to hospitals to allow them to designate themselves within a specific tier, (eg, Comprehensive Stroke Centers, Primary Stroke Centers, or Stroke Ready Hospitals), which can aid EMS in the triage of stroke patients in these environments.

Early Steps in Stroke Management and Triage

Potential stroke patients can arrive to an emergency department (ED) from several routes. The most common arrival modes are either EMS transporting the patient from the site at which he or she was discovered or from another ED via transfer. A smaller percentage of patients are brought in by themselves, a friend, or family member. Patients can also sustain strokes while being treated in the hospital for other comorbid conditions.

When EMS transports a stroke patient to a hospital, ideally, they will give a prenotification to the in-house ED physician that an acute stroke patient is en route. Because time is of the essence, the majority of stroke centers announce or page a “stroke alert” to notify a multidisciplinary team of ED physicians, neurologists, neurointerventionalists (when appropriate), critical care/ED nursing, phlebotomists, radiology technicians, and pharmacists. This alert allows the rapid allocation of resources to occur, and the patient can receive a quick clinical examination for stability and stroke severity, laboratory draws, and expedited imaging prior to intravenous/endovascular therapies. These teams are often aided by stroke-specialized nurse practitioners, physician assistants, residents, and fellows, although not all facilities have equivalent resources during stroke alerts. The faster imaging can be obtained, the faster the decision for treatment can be made, and the better the patient outcome.

Challenges to and Tools for Identifying Candidates for Endovascular Therapy

Until 2015, there were limited randomized controlled trial data to support the benefit of endovascular therapy in acute stroke, although it was evident from nonrandomized studies that certain patients clearly benefited from intervention. After the results of multiple successful randomized controlled trials were released in 2015, education of acute care practitioners, particularly EMS, ED physicians, and neurologists, helped identify more potential candidates for treatment. The American Heart Association also supported that there was level I evidence in favor of neuroendovascular treatment of acute stroke. Ongoing education is necessary to ensure that providers are aware that endovascular treatment is not only available, but that it is now the standard of care.

Although time thresholds have been traditionally used (eg, therapy within 8 hours), it is worth noting that time is a surrogate for approximating likely salvageable penumbral tissue. A variety of imaging tools have been used to assess whether patients are candidates for endovascular therapy. Initial assessment of the degree of core infarction via analysis of a noncontrast head CT, diminution of cerebral blood flow and volume on CT/MR perfusion studies, or restricted diffusion on an MRI can include or exclude patients. With respect to vessel imaging, at a minimum, it is recommended that noninvasive imaging, such as a CT angiogram or MR angiogram, demonstrates an ELVO prior to intervention. Lack of this vascular imaging was a contributing factor as to why several studies deemed endovascular therapy noninferior to intravenous thrombolytic therapy prior to 2015. Although not required, multimodality imaging for assessment of collateral blood flow or perfusion mismatch can also be used to identify whether patients may potentially benefit from endovascular therapy. Perfusion studies have been helpful in extending the window for treatment of patients with a delayed presentation, such as wake-up strokes. Accurate interpretation of these imaging studies can improve overall selection of endovascular stroke candidates.

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The Neurologist’s Role in Endovascular Treatment

Ideally, the neurologist should be involved as soon as there is suspicion of an acute stroke. Treatment usually occurs in concert with an ED physician. Neurologists are experts in clinical localization, which aids them in teasing out stroke mimics as well as assisting in the triage of the appropriate stroke therapy by accurately predicting affected vascular territories. For this reason, it is also important to have access to a subspecialty stroke neurologist when possible given that stroke is a rapidly changing field. After the decision to perform endovascular therapy has been made, the neurologist has a vital role in neuromonitoring during the hospitalization and in performing an intensive workup for the diagnosis and long-term treatment of stroke.

Evolution of Stroke Care and Treatment Outcomes

With over 800,000 strokes affecting Americans yearly and substantial evidence now supporting new treatments for acute stroke—specifically, endovascular therapy—more resources will need to be allocated for treatment of stroke patients. We need to ensure that there is an increase in access to stroke centers that have interventional capabilities. It will also be necessary to have sufficient numbers of well-trained stroke neurologists and neurointerventionalists to treat these patients as the patient population continues to age. Inevitably, education of patients on the urgency of time in stroke will likely increase the number of patients presenting to EDs within a window for acute treatment, which will ultimately lead to decreased long-term stroke morbidity upon successful recanalization.

Discussion

In stroke, “time is brain.” Endovascular therapy can help improve long-term outcomes in patients presenting early with emergent large vessel occlusions. With increasingly more tools in our armamentarium, it is important that we educate not only patients, but colleagues, of the advances in stroke interventions and the importance of urgent time to treatment. Stroke systems of care are rapidly changing to allow for easier access to appropriate stroke centers, and it is vital that we adapt our resources and modify hospital protocols to ensure that stroke patients receive the optimal chance for a successful recovery.

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