Stroke Systems of Care

The benefits of mandatory EMS transport of stroke patients to designated centers.

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The treatment of patients with acute ischemic stroke in the United States has undergone a considerable evolution during the past decade, and even more dramatic changes will occur in the decade to come. In this article, we summarize this evolution and what the future may hold, as well as the scientific, political, and financial factors involved in this journey. The coming decade will see the transition from primary stroke centers (PSCs) as the focus of regional emergency medical services (EMS) to a more complex "hub-and-spoke" model that involves comprehensive stroke centers (CSCs) at their nexus. These developments are of interest to the endovascular community, because neuroendovascular expertise is required at the CSC level for the endovascular treatment of both ischemic and hemorrhagic (brain aneurysm) stroke.

BACKGROUND

Stroke is a major public health issue in the United States, affecting an estimated 700,000 people each year. Approximately 80% of strokes are ischemic, and the remaining 20% are hemorrhagic. Of these patients, 80% survive, and many are left with major disabilities.

The primary impetus driving the development of stroke centers and stroke systems of care during the past decade was the pivotal NINDS (National Institute of Neurological Disorders and Stroke) rt-PA trial that was published in 1996.[1] At present, this therapy remains the only proven effective intervention for acute ischemic stroke (level 1, class A American Heart Association [AHA] recommendation).[2,3] Eligible patients who receive intravenous (IV) tissue plasminogen activator (tPA) in the first 4.5 hours after symptom onset have a much better chance of a favorable outcome.

These positive data for early recognition and intervention led directly to endorsement of PSCs by the Brain Attack Coalition and AHA.[4] Subsequently, the Joint Commission developed an accreditation process for PSCs that has been widely adopted. PSCs are essentially tPA-capable facilities with no requirements for more advanced interventions. Key elements of a PSC include written protocols for the care of patients presenting with acute ischemic stroke, EMS integration, and monitoring of tPA utilization. Many states have adopted legislation or regulations for state certification of PSCs and the creation of EMS systems of care mandating transportation of suspected stroke patients to PSCs. Finally, as a financial incentive to increase IV tPA usage, the Centers for Medicare and Medicaid Services increased the reimbursement to hospitals for ischemic stroke patients treated with IV tPA.

EFFORTS TO IMPROVE LOCAL SYSTEMS OF CARE

Local stroke systems of care have been developed that preferentially transport stroke patients to tPA-capable centers.[5] The STOP (Stroke Treatment and Ongoing Prevention) Stroke Act, if passed, will allocate funds and resources for implementing stroke systems of care. The AHA white paper on stroke systems of care laid out four elements that have been widely adopted in state regulations.[5] One element is to ensure rapid access to EMS and to institute processes to develop, maintain, and measure these efforts. Formal education and testing of first responders and 911 operators on the signs and symptoms of stroke is one example of such a process. Another element is to require integration and communication between EMS and the triage mechanisms of PSCs. Suspected stroke patients generally bypass the usual triage mechanisms in an emergency department. This allows notification of the stroke team, pharmacy personnel, and scanner technologists before the arrival of a stroke patient.

These efforts have been very successful in promoting the use of IV tPA in the United States. Lattimore and colleagues[6] at Suburban Hospital in Bethesda, Maryland, evaluated the

use of thrombolytic therapy before and after the creation of a PSC. The primary new element was an on-call stroke team. In the year before having an on-call service, three (1.5%) of 200 ischemic stroke patients were treated with tPA. During the following 2-year period, 44 of 420 ischemic stroke patients (10.5%) were treated with IV tPA ($P < .0001$). Douglas et al[7] correlated the 11 PSC criteria that had been recommended by the Brain Attack Coalition with IV tPA usage at 34 academic medical centers. Four elements strongly predicted increased tPA use: (1) written care protocols, (2) integrated EMS, (3) organized emergency departments, and (4) continuing medical/public education in stroke awareness. Nonsignificant trends for increased use of tPA were seen at centers with an acute stroke team, stroke unit, and rapid neuroimaging. In addition, the more elements that were present at a given institution, the more frequent the use of IV tPA.

Against this backdrop of ongoing and evolving efforts to create tPA-capable PSCs and local EMS guidelines for stroke recognition and triage, there is growing interest in formal recognition of CSCs.[8] These centers are high-volume, tertiary care facilities with expertise in the care of patients with all forms of stroke and cerebrovascular disease. From the endovascular perspective, this expertise includes the ability to treat patients with intracranial aneurysms, subarachnoid hemorrhage-induced vasospasm, brain arteriovenous malformations, and ischemic stroke. Other important required elements of these centers are neurosurgical expertise, dedicated intensive care units, and 24/7 access to advanced neuroimaging. The rationale for CSCs is strong and is based on the success of similar models for trauma. There is pending or passed legislation or regulations in nearly 10 states now that endorse a tiered approach to stroke care with CSC recognition. There is no Joint Commission certification for CSCs as of yet. A major financial incentive for the creation of a CSC from a hospital's point of view is favorable hospital reimbursement for both hemorrhagic and ischemic stroke patients, particularly for those treated with endovascular techniques.

CHALLENGES FOR INTEGRATING CSCs

One obstacle is the incorporation of CSCs into networks with PSCs or other, less capable, facilities. The AHA is in the process of developing recommendations for CSCs, including metrics for monitoring their performance and their relationship with PSCs. Joint Commission certification will likely be based on these recommendations. One area of clear benefit of this model is for facilities that are willing and able to administer tPA but are not capable of monitoring or dealing with complications of the treatment (primarily brain hemorrhage). Many tertiary care facilities have developed relationships with community hospitals to allow "drip and ship." Telemedicine is emerging as an enabling technology for this treatment paradigm. The transfer of patients with hemorrhage to CSCs also fits well into a hub-and-spoke model.

The two thorny issues for integration of CSCs relate to EMS rules for transportation of acute stroke patients to different tiers and the rules for the role of intra-arterial intervention. EMS rules generally mandate that the patient be taken to the nearest, closest, center. The problem with this rule is that patients are not guaranteed to be taken to high-volume, higher-level centers where they will be more likely to receive IV tPA and to get it faster. It is highly likely that intra-arterial intervention will be proven effective for selected patients with acute ischemic stroke. There are ongoing clinical trials, including the Interventional Management of Stroke III trial, directly comparing IV tPA alone to an IV/intra-arterial approach. If these trials are positive, transfer and triage rules will need to be revisited.

CONCLUSION

In summary, organized, statewide systems for improving the early recognition and treatment of patients with acute stroke have been widely and successfully implemented. The PSC designation has been a major driver in this effort. These initiatives have resulted in dramatic increases in the use of IV tPA. Comprehensive stroke centers and more complex, tiered models of stroke care delivery are currently being developed. These systems will foster the use of endovascular intervention for ischemic and hemorrhagic stroke. ■

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