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Elements of a Stroke Center

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The past decade has ushered in a refined understanding of—and commitment to—objective evidence-based practice of stroke management. Responding to the need for universal protocol-driven guidelines for stroke care, the Brain Attack Coalition published consensus statements with recommendations for primary stroke centers (Alberts MJ, et al, JAMA 283:3102-3109, 2000) and comprehensive stroke centers (Alberts MJ, et al, Stroke 36: 1597-1616, 2005) in 2000 and 2005, respectively. These benchmark publications helped to define a new "standard of care" for stroke patients and laid the groundwork to establish formal certification for stroke centers. Although large randomized controlled trials evaluating the efficacy of these guidelines are currently underway, several recent reports suggest that stroke center certification may improve outcomes in patients with acute ischemic stroke. In this article, the authors briefly discuss the status of stroke center certification and the evolution of stroke systems of care.
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Background and Significance

Stroke is now the fourth leading cause of death in the United States and a significant cause of long-term disability.[1] Every year, approximately 795,000 individuals experience a new or recurrent stroke.[2] The majority of these episodes represent initial attacks (610,000 patients), whereas the minority represent recurrent attacks (185,000 patients). The risk of stroke is higher in men than women, in blacks than whites, and in older than in younger individuals. Strokes may be classified as ischemic (87%), hemorrhagic (10%), or subarachnoid hemorrhage (3%). The distinction between these stroke subtypes is paramount, given the distinctly different preventative measures, diagnostic imaging modalities, and treatment paradigms used in their management. Stroke imparts a tremendous medical, emotional, and fiscal burden to society. Annual costs for stroke care in the United States alone exceed 73 billion dollars.[3] Clearly, improvements in stroke care may abrogate not only the morbidity and mortality of this devastating disease but also the significant financial cost as well.

Substantial efforts on the part of those committed to optimizing stroke care have led to the development of hierarchical organizations facilitating the care of stroke patients. Collectively, these initiatives provide a rich framework for improving the care of stroke patients through evidence-based practice, standardized treatment paradigms, and quality-based metrics for continual reassessment and appraisal. The Brain Attack Coalition (BAC)—organized by the National Institute of Neurological Disorders and Stroke and comprised of members from the American Heart Association, the Center for Disease Control, as well as professionals from the fields of neurological surgery, neurology, diagnostic and interventional neuroradiology, and emergency medicine—critically appraised the literature regarding stroke management and instituted recommendations for the primary stroke center (PSC) and comprehensive stroke center (CSC). Essentially, the PSC contains the necessary personnel, infrastructure, and programs to treat and stabilize most stroke patients. The CSC provides care to high-acuity stroke patients who require advanced diagnostic imaging, highly trained spe-

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cialty physicians, and complex treatment programs. The relationship between PSC, CSC, and the broader community represents the "stroke systems of care." Development of these systems continues to evolve.[4] This dynamic model affords the expeditious transport of stroke patients to the appropriate medical facility and meliorates their overall care. In the following section, we discuss the fundamental distinctions between the PSC and CSC.

Primary Stroke Center

The principal goal of PSC certification was to improve the outcome of stroke patients by facilitating the appropriate use of intravenous tissue plasminogen activator (tPA) and standardizing stroke medical management. The fundamental requirements for a PSC include 24-hour availability of personnel trained in acute stroke care, rapid access to neuroimaging, standardized treatment protocols, integration with an emergency medical service (EMS) and emergency department, a dedicated stroke unit, and the necessary infrastructure to report patient outcomes and perform quality improvement analyses (Table 1).[5] In addition, neurosurgery services should be available either on-site or accessible within a 2-hour period. These core criteria serve as a scaffold upon which to build and optimize the care of patients with acute stroke. In addition to these original criteria, the BAC published a more recent summary statement in an effort to further improve patient care at a PSC.[6] In particular, emphasis was placed on (1) the importance of acute stroke teams, (2) the importance of stroke units with telemetry monitoring, (3) performance of brain imaging with magnetic resonance imaging and diffusion-weighted sequences, (4) assessment of cerebral vasculature with magnetic resonance angiography or computed tomography angiography, (5) diagnostic cardiac imaging, (6) early initiation of rehabilitation services, and (7) formal certification by an independent body, including site visits and quality performance measures. After the institution of the PSC model, The Joint Commission (TJC) began a formal certification for PSC in the United States in 2003. Quality assurance metrics were subsequently established to monitor PSC performance, many of which have since been further refined. To date, >800 Joint Commission-certified PSC exist and another 200-250 such medical programs have been accredited by state-based agencies and organizations.

Comprehensive Stroke Center

The majority of stroke patients are effectively managed at a PSC. However, a minority of patients necessitate a higher-acuity medical setting with specialized personnel providing complex diagnostic and treatment modalities. In 2005, the BAC published a set of guidelines outlining the fundamental components of a CSC.[7] The CSC provides care to individuals with large or complex strokes, those with hemorrhagic strokes, those requiring treatment by highly trained subspecialists (eg, endovascular intervention, neurosurgery), and those with multisystem involvement. These facilities are typically high-volume tertiary care centers with access to complex neuroimaging 24 h/d, 7 d/wk. Moreover, these programs harbor a specialized infrastructure with programmatic elements (eg, intensive care unit, stroke registry) and have substantial expertise in the diagnosis and treatment of pa-

Table 1 Major Elements of a Primary Stroke Center (PSC)

Patient care areas
Acute stroke team; at least 2 members (at bedside within 15 min)
Written care protocols (evidence-based and updated)
Emergency medical services; transport patient to nearest PSC (integrated with stroke center)
Emergency department; monitoring protocol for patients, vital signs, and neurological status (familiar with protocols and team activation)
Stroke unit; multichannel telemetry; clinical monitoring protocol (staffed by personnel with training in expertise with stroke)[a]
Neurosurgical services (available within 2 h)
Neuroimaging services; MRI, MRA, or CTA, and cardiac imaging; may not apply to all patients; not required in acute setting
Performed within 6 h; read within 2 h of completion (CT or MRI available 24/7)
Laboratory services; HIV testing; toxicology screening (available 24/7)
Rehabilitation services; early assessment and initiation (if clinically stable)
Support services
Institutional commitment and support
Dedicated stroke director (reimbursement for call)
Stroke registry with outcome and quality improvement activities (database and quality improvement program)
Continuing medical education; public and professional (ongoing staff and public educational program)
Administrative support; on-call pay consideration (may improve acute response)
Center certification; independent organization; performance measures (self-certification not recommended)
Participation in stroke system of care

MRI, magnetic resonance imaging; MRA, magnetic resonance angiography; CTA, computed tomography angiography; CT, computed tomography; PSC, primary stroke center.

Modified from Alberts et al[5] and Alberts et al.[6]

[a]A stroke unit is only required for those PSCs that will provide ongoing in-hospital care for patients with stoke.