Impact of Establishing a Primary Stroke Center at a Community Hospital on the Use of Thrombolytic Therapy
The NINDS Suburban Hospital Stroke Center Experience

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Background and Purpose—To increase the proportion of ischemic stroke patients treated with thrombolytic therapy, the establishment of primary stroke centers in community hospitals has been advocated. We evaluated the use of thrombolytic therapy before and after institution of a primary stroke center in a community hospital.

Methods—The availability of an on-call stroke emergency response team was the only significant additional resource required for this hospital. All eligible patients were treated with intravenous tissue plasminogen activator (tPA). The number of patients with cerebrovascular disease, number and proportion of patients treated with tPA, times to treatment, and patient outcomes were recorded during the first 2 years of the stroke center.

Results—During the 12 months before institution of the stroke center, 3 ischemic stroke patients (1.5%) were treated with tPA. During the 2-year period of around-the-clock coverage, 44 of 420 ischemic stroke patients (10.5%) were treated with intravenous tPA, a significant increase in tPA use ($p<0.0001$).

Conclusions—Establishment of a primary stroke center at a community hospital resulted in a substantial increase in the proportion of patients receiving thrombolytic therapy for ischemic stroke. If this experience is generalized, the beneficial impact of primary stroke centers on stroke outcomes and costs to the healthcare system may be substantial. (Stroke. 2003;34:e55-e57.)

Key Words: emergency medical services ■ hospital planning ■ stroke units ■ stroke, acute ■ thrombolytic therapy

In June 1996, the US Food and Drug Administration approved the use of intravenous tissue-type plasminogen activator (tPA) for the treatment of acute ischemic stroke on the basis of results from the National Institute of Neurological Disorders and Stroke (NINDS) tPA Stroke Study Group confirming the efficacy of this thrombolytic therapy when started within 3 hours of stroke symptom onset.1 Despite its availability, <5% of stroke patients receive tPA,2–5 although the most experienced academic stroke centers have achieved much higher rates.6 One recommendation of the Brain Attack Coalition toward increasing the use of tPA has been the widespread creation of primary stroke centers, not limited to large, urban, or university-affiliated medical centers.5

Methods

A primary stroke center was established at Suburban Hospital, a private community hospital in Bethesda (Md), consistent with published recommendations.5 This hospital had existing neuroimaging, laboratory, and neurosurgical resources to support a primary stroke center, but it did not have an acute stroke emergency response team. There was not a stroke center at nearby hospitals, nor were there established policies within the emergency medical services (EMS) system for stroke triage, transfer, or preferential patient delivery to a stroke center, which was not permitted. A 4-month pilot phase during which the stroke critical care pathway was introduced into hospital practice began in September 1999. The pathway incorporated medical management for thrombolytic candidates and other stroke patients and emphasized immediate notification of the stroke team and initiation of urgent diagnostic tests. The stroke team consisted of neurologists and nurses specializing in cerebrovascular neurology who were on call for potential thrombolytic cases. During this pilot period, the stroke team was available on a limited basis, primarily weekdays during daytime hours. Efforts were made during this period to increase stroke education for emergency department personnel, the hospital’s physician and nursing staff, laboratory and radiology departments, the regional EMS, and the local community.

Around-the-clock coverage by the stroke team was initiated on January 3, 2000. According to the stroke critical care pathway, the team was to be paged for any patient identified with a suspected new stroke and persistent deficits of <6 hours in duration (initial screening criteria) to be evaluated for possible intravenous tPA.
therapy (up to 3 hours from onset). A cloned pager, carried by all members of the stroke team, was activated by the emergency department on recognition of possible stroke or on notification of a patient en route by EMS. In case of a suspected stroke within the hospital, the hospital operator activated the page. In both cases, a subsequent overhead intercom page, modeled after the hospital’s existing trauma response page, was made to heighten awareness throughout the hospital, particularly within the radiology and laboratory departments. Inclusion and exclusion criteria for treatment and medical management after tPA administration were based on established guidelines for thrombolytic therapy in acute stroke.\textsuperscript{8} Rapid recognition of stroke and initiation of stroke code were continually encouraged, and reports of time intervals and barriers to treatment were communicated to the emergency department staff on an ongoing basis.

Contemporaneously, the stroke team began broad-scale community education offered at the hospital and local community centers, particularly those with large senior citizen populations, to increase public awareness of stroke symptoms and advances in treatment. This was accomplished through lectures and stroke risk assessment screenings arranged by members of the stroke team, the hospital’s Community Outreach Department, and the local Operation Stroke of the American Stroke Association. These lectures emphasized the symptoms of acute stroke and the need for rapid response by activation of the EMS system.

Prospectively acquired data on all patients evaluated by the stroke team included demographic information, presentation times, treatment times or reasons for nontreatment, radiological times and findings, stroke scale results, and disposition. Patients’ pretreatment clinical severity was measured by the National Institutes of Health (NIH) Stroke Scale. Clinical outcome was assessed by the modified Rankin Scale (mRS) at discharge and, if obtainable, at 3 months. Symptomatic intracerebral hemorrhage was defined as clinical worsening associated with a parenchymal hematoma on brain CT or MRI within 36 hours of initiation of treatment.

Measured time intervals to action (in minutes) were computed as a running 2-month average. Results were compared with benchmarks from the Standard Treatment With Alteplase to Reverse Stroke (STARS) study, a postmarketing multicenter study of tPA in the most experienced centers.\textsuperscript{8} In STARS, the median time from stroke onset to tPA treatment was 2 hours 44 minutes; the median time from patient arrival at hospital (triage) to paging of the stroke team decreased from a median of 28 to 6 minutes. Time of triage to time of screening brain scan decreased from a median of 52 to 42 minutes.

During the 12 months before the stroke center pilot period, only 3 patients (1.5%; 95% CI, 0.5 to 4.2) were treated with tPA at this hospital. Of 420 patients diagnosed with ischemic stroke during the 2-year study period, 44 patients (10.5%; 95% CI, 7.8 to 13.9) were treated with intravenous tPA (the Figure). In the first 6 months of the study period, 8 patients were treated. Of patients arriving at the hospital within 3 hours from symptom onset, 16.2% (95% CI, 12.2 to 21.3) were treated with intravenous tPA. The increase in rate of tPA use with the establishment of the stroke center was highly significant ($P<0.0001$ by Fisher’s exact test). During the 4-month pilot period, 4 of 117 ischemic stroke patients (3.4%) were treated with tPA (the Figure).

The median time to treatment with tPA from onset was 134 minutes, and the median door-to-needle time was 88 minutes. The median age of the treated patient was 76 years (range, 27 to 95 years). Twenty-one of the treated patients were female. The median NIH Stroke Scale score for patients treated with tPA was 13.

Sixteen patients (36%; 95% CI, 24 to 51) had a very favorable recovery (mRS $\leq$1), and 20 (45%; 95% CI, 31 to 61) recovered functional independence (mRS $\leq$2). Symptomatic intracerebral hemorrhage occurred in 3 (6.8%) of the 44 patients treated with tPA.

**Discussion**

A 7-fold increase in the proportion of stroke patients treated with tPA was observed in the first 24 months after the establishment of the primary stroke center. Forty-four patients were treated with tPA, 10.5% of all ischemic strokes and 16.2% of those presenting to the hospital within 3 hours of symptom onset. This rate of tPA use is several times the national average and approaches that of the most successful academic medical centers.\textsuperscript{6} Clinical outcomes and times to treatment were similar to those of STARS.\textsuperscript{8}
Our experience may be generalizable to other community hospitals. The only significant additional resource required for the primary stroke center was the availability of a committed on-call acute stroke team. The constraints on our EMS system eliminated the possibility of preferential delivery of tPA candidates to our center as an explanation for this increased rate. The proportion of patients presenting within 3 hours in our sample was similar to those reported for other communities in the United States\(^9,10\); thus, our experience is not attributable to an unachievable rate of early presentation to the hospital. A 5% increase in tPA use nationwide would mean that \(\approx 30,000\) additional patients per year would be treated, \(\approx 4000\) of those patients would be spared long-term disability, and the net cost savings to the healthcare system would exceed \(100\) million dollars annually.\(^11\) If our experience does generalize to other hospitals, then the beneficial impact on stroke outcomes and costs to the healthcare system could be substantial.

**References**

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