Intravenous Thrombolysis for Stroke Increases Over Time at Primary Stroke Centers

Shyam Prabhakaran, MD, MS; Maggie McNulty, MD; Kathleen O’Neill, MHA; Bichun Ouyang, PhD

Background and Purpose—We evaluated the impact that duration as a primary stroke center (PSC) had on tissue-type plasminogen activator (tPA) utilization for acute ischemic stroke.

Methods—A retrospective analysis of the Illinois Hospital Association CompData was performed identifying those patients with primary discharge diagnosis of acute ischemic stroke based on International Classification of Diseases version 9 codes. We assessed utilization of tPA by International Classification of Diseases version 9 procedure code (99.10). We categorized patients as cared for at non-PSC, PSC > 1 year before, ≤ 1 year before, ≤ 1 year after, and > 1 year after certification. We used generalized estimating equations to calculate adjusted odds ratios for tPA utilization by PSC category.

Results—Among 119,539 acute ischemic stroke patients (mean age, 72 years; 55.2% women), tPA use was 1.9% but increased with duration of PSC certification. Rather than waning or stagnating, tPA utilization increases at PSC from the earliest phases of preparation through certification and subsequent maintenance.

Conclusions—Although increasing over time, stroke thrombolysis is strongly impacted by the PSC certification process.

Key Words: certification ■ quality improvement ■ tissue-type plasminogen activator

Intravenous tissue-type plasminogen activator (tPA) utilization for acute ischemic stroke remains low nationwide.1,2 The establishment of stroke systems of care including primary stroke centers (PSC) is expected to increase tPA utilization and improve outcomes after stroke.3,4 A previous study5 noted that performance improvement may be evident even in advance of PSC certification. However, it is not known whether PSC continue to increase tPA use over time, or whether there is an immediate effect with a subsequent plateau or decline. We hypothesized that utilization of tPA increases with duration of time as a certified PSC.

Materials and Methods

With institutional board review, a retrospective analysis of the Illinois Hospital Association COMPdata was performed. The Illinois Hospital Association includes > 200 hospitals and health systems within the state. The available patient level data (Table 1) are typical of administrative databases but do not contain stroke-specific variables such as time of onset, severity (ie, National Institutes of Health Stroke Severity score), imaging results, or complications of therapy.

In addition, we used the Joint Commission Web site (accessed September 14, 2010, http://www.qualitycheck.org/consumer/searchQCR.aspx) to determine date of initial PSC certification. For 2 hospitals that were not certified by the Joint Commission, we obtained date of PSC certification directly from the institutions. We categorized each patient as having been cared for at non-PSC hospitals (as of September 2010, 1 year after the study period), hospitals > 1 year before PSC certification, ≤ 1 year before PSC certification, ≤ 1 year after PSC certification, and > 1 year after PSC certification.

From the COMPdata database, we identified acute ischemic stroke patients by discharge International Classification of Diseases version 9 codes (433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, or 436) and defined intravenous thrombolysis by International Classification of Diseases version 9 procedure code (99.10). We performed trend analyses, univariable tests, and a multivariable analysis using a general estimating equations approach to assess the impact of PSC certification on tPA utilization. All analyses were performed in SAS 9.1 (SAS Institute).

Results

Between January 2003 and September 2009, there were 119,539 acute ischemic stroke discharges from 193 Illinois hospitals. Baseline characteristics are shown in Table 1. The number of PSC increased over time, totaling 52 as of September 2010: 2 in 2004, 5 in 2005, 6 in 2006, 8 in 2007, 6 in 2008, 13 in 2009, and 12 in the first 9 months of 2010. Regional locations were Cook County (24), Northern (14), North-Central (5), Central (8), and Southern (1). Care was provided at PSC in 14.7% of patients during the study period.

Overall, the proportion of tPA use was 5.7% among acute ischemic stroke patients treated at PSC, compared to 1.2% at non-PSC (P < 0.001), but with differing temporal trends (Figure A). Within the categories of PSC status, there was a strong relationship (P < 0.001) between increasing tPA use
and hospital-specific time epoch along the PSC certification process (Figure B). In multivariable analysis (Table 2), the odds of tPA use increased with advancing PSC status.

**Discussion**

Although increasing over time, stroke thrombolysis is strongly impacted by the PSC certification process. Rather than waning or stagnating, PSC increase tPA utilization from the earliest phases of preparation through certification and subsequent maintenance. These results add to previous reports that PSC show improvements in performance metrics, such as tPA utilization, and outcomes even before formal certification. The efforts to initiate and maintain certification often require significant planning, quality-improvement initiatives, data collection, protocol development, and education well in advance of and after certification. The temporal increase in tPA use at non-PSC that we observed may be partly explained as an effect of PSC certification process initiation at some centers that later became PSC.

There are several limitations to our study, including reliance on International Classification of Diseases version 9 codes. Because the registry consists of hospitalized patients, we also cannot identify “drip and ship” tPA patients, which might underestimate non-PSC tPA utilization. We cannot account for important eligibility criteria such as time of onset, severity of symptoms, or imaging findings. The impact of prehospital notification or triage of eligible patients to PSC could not account for our results. Illinois House Bill 2244, advocating for the development of PSC and improving access to them, passed in August 2009. Our findings, therefore, reflect the utilization of tPA before the implementation of prehospital routing policies in Illinois. However, we cannot exclude the possibility that PSC certification promoted local community education and informal emergency medical service preferences to take eligible patients to PSC.

**Disclosures**

None.

**References**


---

**Figure.** Tissue-type plasminogen activator (tPA) utilization (A) increased at nonprimary stroke centers ($P<0.001$) but was unchanged at primary stroke centers annually ($P=0.371$) and (B) increased with each stage along the primary stroke center process ($P<0.001$). PSC indicates primary stroke center.
Intravenous Thrombolysis for Stroke Increases Over Time at Primary Stroke Centers
Shyam Prabhakaran, Maggie McNulty, Kathleen O'Neill and Bichun Ouyang

Stroke. 2012;43:875-877; originally published online December 1, 2011;
doi: 10.1161/STRK.111.640060
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2011 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://stroke.ahajournals.org/content/43/3/875

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/