Collaborative Interventions Reduce Time-to-Thrombolysis for Acute Ischemic Stroke in a Public Safety Net Hospital

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Background and Purpose: Shorter time-to-thrombolysis in acute ischemic stroke (AIS) is associated with improved functional outcome and reduced morbidity. We evaluate the effect of several interventions to reduce time-to-thrombolysis at an urban, public safety net hospital. *Methods:* All patients treated with tissue plasminogen activator for AIS at our institution between 2008 and 2015 were included in a retrospective analysis of door-to-needle (DTN) time and associated factors. Between 2011 and 2014, we implemented 11 distinct interventions to reduce DTN time. Here, we assess the relative impact of each intervention on DTN time. *Results:* The median DTN time pre- and postintervention decreased from 87 (interquartile range: 68-109) minutes to 49 (interquartile range: 39-63) minutes. The reduction was comprised primarily of a decrease in median time from computed tomography scan order to interpretation. The goal DTN time of 60 minutes or less was achieved in 9% (95% confidence interval: 5%-22%) of cases preintervention, compared with 70% (58%-81%) postintervention. Interventions with the greatest impact on DTN time included the implementation of a stroke group paging system, dedicated emergency department stroke pharmacists, and the development of a stroke code supply box. *Conclusions:* Multidisciplinary, collaborative interventions are associated with a significant and substantial reduction in time-to-thrombolysis. Such targeted interventions are efficient and achievable in resource-limited settings, where they are most needed. **Key Words:** Stroke—cerebrovascular disorders—thrombolytic therapy—safety net hospital.

Introduction

Although its associated mortality is declining, stroke remains among the leading causes of long-term disability in the United States.[1,2] Additionally, stroke remains the fifth leading cause of death.[3] Thrombolysis with intravenous tissue plasminogen activator (tPA) has revolutionized the treatment of acute ischemic stroke (AIS), bestowing significant improvement in mortality and functional outcome when administered acutely.[4-6] The benefit is markedly time-dependent and wanes within hours of stroke ictus, reflecting a progression of irreparable core infarction and increasing the risk of hemorrhagic transformation.[7-10]

The American Heart Association/American Stroke Association (AHA/ASA) guidelines for early management

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Received February 24, 2017; accepted March 3, 2017.

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1052-3057/$ - see front matter

http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2017.03.004

of AIS reflect the central importance of early thrombolysis; tPA administration is recommended within 4.5 hours of symptom onset and within 1 hour of arrival at a hospital.[11] Although early thrombolysis is clearly beneficial, practical challenges persist such that the majority of stroke victims who are eligible for tPA do not receive it within the recommended times.[12,13]

Despite the clear benefits of early thrombolysis, delays in stroke recognition, hospital arrival, emergency department (ED) triage, imaging, neurology consultation, and treatment preparation and delivery impede the achievement of recommended door-to-needle (DTN) times of less than 60 minutes.[14,15] Accordingly, there exists substantial interest in targeted, effective interventions to reduce these times. Numerous studies have examined various targeted interventions to this end, including a systematic quality improvement study conducted as part of the original National Institutes of Neurologic Disorders and Stroke-sponsored trial showing benefit with tPA. In the context of this initiative, specific interventions were developed to target identified delays, and included, for example, prehospital notification by emergency medical services, use of a stroke code pager system, notification of pharmacy about potential imminent tPA use, and arrangement of expedited computed tomography (CT) scanning as part of an optimized stroke workflow.[16] Other quality improvement initiatives, including the national "Get With The Guidelines-Stroke" initiative, have demonstrated similar success.[17,18]

Interventions aimed at reducing time-to-thrombolysis are less well studied and may be more difficult to implement in public safety net hospitals. Such institutions face unique challenges related to reduced funding levels and care provision for larger proportions of socioeconomically disadvantaged patients, underinsured patients, and ethnic minorities. These patients have less access to healthcare and are less likely to receive tPA, despite having more frequent and more severe strokes.[19-24]

We present our implementation of 11 multidisciplinary, collaborative, targeted interventions to reduce DTN time in a large, urban, public safety net hospital. We analyzed DTN times before and after each intervention with the goal of understanding the combined and individual effects of our interventions on DTN time. We further subdivided DTN time into 4 components to better assess the nature and timing of treatment delays. We also sought to demonstrate the effectiveness and feasibility of implementation of such interventions in the unique setting of a public safety net hospital.

Materials and Methods

Study Design

We present an observational, retrospective study of patients diagnosed with AIS who received tPA. DTN times and their constituents are compared before and after targeted interventions using descriptive statistical methods. The study was approved by the local institutional review board. Informed consent was waived due to the retrospective, observational study design.

Study Population

The study included all patients who were judged eligible for and received intravenous tPA for AIS in the ED at our institution between 2008 and 2015, inclusively. Using a clinical electronic database, we abstracted last known well time, National Institutes of Health Stroke Scale (NIHSS) score at presentation, baseline demographic characteristics, relevant medical history, length of stay, discharge disposition, as well as times of specific ED treatment milestones: patient arrival in ED, ED physician arrival at bedside, neurologist arrival at bedside, initial laboratory test order, laboratory test result, head CT order, head CT result, and tPA administration. We also reviewed paper charts for missing data, and to confirm time intervals where there was ambiguity.

Our institution is an academic, tertiary care, urban, public safety net hospital serving 2.5 million patients annually. The center has remained continuously certified by the Joint Commission as a Primary Stroke Center since 2006. The population served is ethnically diverse, comprised nearly equal proportions of Asian, African–American, Hispanic, and Caucasian individuals, and is also largely underinsured. Additionally, our institution is growing as a referral center for patients with complex conditions requiring increasingly sophisticated care.

Interventions

Between 2011 and 2014, 11 targeted interventions were sequentially implemented in an effort to reduce DTN time (Table 1). A standardized stroke protocol CT was implemented in 2011, incorporating non-contrast head CT, CT perfusion, and CT angiography of the head and neck. Later in 2011, a dedicated stroke performance improvement coordinator was hired, who worked closely with the senior stroke coordinator to spearhead many subsequent interventions. Arrangements were made for administration of tPA in the CT scanner (typically after the non-contrast scan and prior to perfusion and angiographic imaging). A stroke code activation system was implemented in 2012, constituting pager notification of the ED attending, neurocritical care attending and fellow, neurology resident, neuroradiologist, radiology technician, pharmacist, stroke coordinator, and admission officer on duty. Concurrently, designated ED pharmacists for stroke patients were established. Monthly multidisciplinary stroke case peer review meetings were initiated, with attendance by neurocritical care attendings and fellows, neuroradiologists, neurointerventionalists, vascular neurosurgeons, and the stroke coordinator. A mobile "clot box" with tPA, labetalol,