Cost Burden of Stroke Mimics and Transient Ischemic Attack after Intravenous Tissue Plasminogen Activator Treatment

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Background: Treatment decisions for patients with acute stroke symptoms are based on pertinent history, neurologic examination, laboratory studies, and head computed tomography. In this setting, patients with stroke mimic (SM) may mistakenly receive intravenous tissue plasminogen activator (IV-rtPA). The goal of this study was to investigate the excess direct/indirect hospital costs among patients who received IV-rtPA when final diagnosis was not ischemic stroke. *Methods:* We reviewed the records of 535 IV-rtPA–treated patients who presented to our primary stroke centers. The diagnosis of SM or transient ischemic attack (TIA) was based on patient presentation, hospital course, electroencephalography, and negative neuroimaging studies. The excess cost analysis compared actual direct and indirect hospital costs of a patient to what their direct and indirect hospital costs would have been had they primarily been diagnosed with mimic or TIA. *Results:* Seventy-four patients post–IV-rtPA treatment had final diagnosis of SM; 21 had TIAs. The excess direct and indirect hospital costs for mimics were $257,975 and $152,813, respectively. The median excess cost was $5401 per admission. The excess total cost for TIAs was $85,026 with a median of $3407 per admission. *Conclusions:* Administration of IV-rtPA to patients with SMs remains prevalent and costly. Certain clinical or radiographic characteristics can help diagnose mimics; however, more studies need to be done to determine the feasibility and effectiveness of further clinical investigations among suspected SM patients who are within the thrombolysis treatment window. **Key Words:** Stroke—cost burden—stroke mimics—TIA—intravenous thrombolysis.

Introduction

In the setting of acute stroke, the decision to administer intravenous recombinant tissue plasminogen activator (IV-rtPA) is typically made after the physician obtains a brief pertinent history, performs a neurologic examination, and receives the results of urgent laboratory studies and head noncontrast computed tomography (NCCT). Because "time is brain," the evaluation is typically done quickly, the diagnosis is sometimes in error, and a stroke mimic (SM) receives thrombolytic treatment. The diagnostic accuracy for ischemic stroke varies with patient age, clinical presentation, and physician clinical skill.[1,2] Several studies have demonstrated that 5%-31% of all patients given the diagnosis of ischemic stroke in the emergency departments (EDs) turn out to have a different diagnosis.[3-7] Disparities on the definition of the

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term SM (ie, clinical and/or radiological definition) may play a role in this wide range.

All patients who receive IV-rtPA require hospital admission and higher level of care at least for the first 24 hours. That also involves patients with the final diagnosis of SM or transient ischemic attack (TIA). Although the diagnosis of SM or TIA is usually made shortly after the admission and is associated with a significant shorter hospital stay,[8] administration of IV-rtPA to patients with SM remains unnecessary. To our knowledge, there has been no published study investigating the cost burden of SMs and TIAs after IV thrombolysis. Therefore, the main goal of this study was to investigate the excess direct and indirect hospital costs among patients who received IV-rtPA when the final diagnosis was not ischemic stroke.

Methods

We reviewed the medical records and neuroimaging studies of all IV-rtPA treated patients (N = 538) who presented to one of our 4 primary stroke centers located in Memphis, Germantown, and Bartlett, TN, from January 2009 to September 2013; 23 patients who could not have a post-thrombolysis magnetic resonance imaging were excluded from the study. All patients presented to the emergency room with acute stroke symptoms and had head NCCT with basic laboratory studies. The decision to administer IV-rtPA was made either directly by one of our vascular neurologist or the ED physician after a phone consultation with the on-call vascular neurologist. All patients post–IV-rtPA treatment were monitored in neurointensive care or step-down unit for at least 24 hours.

The diagnosis of SM or TIA was based on the consensus among 3 physicians, including 2 vascular neurologists. The diagnosis was made after considering the patient's presentation, medical history, hospital course, resolution of symptoms, negative NCCT head, electroencephalography (if available), in addition to a negative post-thrombolysis diffusion-weighted images (DWIs), apparent diffusion coefficient, and fluid-attenuated inversion recovery for an acute ischemic lesion. We also examined head magnetic resonance angiography or head computed tomography angiography for any acute large-vessel thrombosis. Every patient included in our study had a post-thrombolysis magnetic resonance imaging within the first 24 hours of admission. For the purpose of this study, we used the American Heart Association and American Stroke Association, definition for TIA: "a transient episode of neurologic dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction."[9] Although in some cases it was challenging to differentiate SMs from TIA, we made our best judgment based on specific clinical presentations that go with TIA (typically TIA start suddenly within seconds to minutes and do not progress further), patient's age and risk factors, hospital course, and exclusion of other conditions (eg, seizure, migraine).

The excess cost analysis compared the actual direct and indirect hospital costs of an individual patient (ie, the "actual cost") to what their direct and indirect hospital costs would have been (ie, the "calculated cost") had they primarily been diagnosed with SM or TIA. For that purpose, we obtained the actual and itemized direct and indirect hospital costs of each patient who had a diagnosis of SM or TIA from the billing departments of each respective hospital. Direct hospital cost refers to the opportunity costs of resources used to treat patients. It reflects the actual cost of medical care and includes medications, food, consultations, treatments, devices, supplies, and clinical studies. Indirect cost includes the overhead cost (eg, utilities, facilities, and labor). An important consideration for our study was distinguishing between actual costs (ie, the expenditures the hospital makes for goods and services) and charges (ie, what the hospital charges the patient). Actual cost provides more precise estimates of the economic value of the resources used in hospital care; however, the prospective payment system currently used by the Centers for Medicare and Medicaid Services and other third-party payers to set reimbursement rates for hospitals for their services can lead to distortions in patient costs. Thus, the use of hospital charges to reflect the costs of patient care can overestimate the actual costs of resources consumed.[10,11]

We determined the calculated cost for each patient based on the projected direct and indirect hospital costs associated with each patient's actual diagnosis, symptoms, severity of disease, other active clinical problems, hospital course, complications, projected length of stay (LOS), department individual, and hospital overhead.

We assumed that early diagnosis of SM by careful neurologic examination and more advanced imaging studies could have prevented administration of IV-rtPA and changed the management plan. For instance, a patient with migraine with aura could have been treated in the ED and would have been discharged; however, a patient with hypertensive encephalopathy should be admitted to intensive care unit. A patient with TIA could have been admitted to a telemetry observation unit and would have required additional workup. Therefore, in the majority of patients, the excess hospital cost included the cost of IV-rtPA, unnecessary intensive care unit/step-down unit/hospital stay, excessive laboratory works, and indirect charges related to an inpatient admission. Although excess costs were assessed on a case-by-case basis, Table 1 provides a summary of itemized charges and hospital costs that we considered as excess cost among our SM and TIA patients.

For statistical analysis, we used the Student t test, Mann–Whitney U test, and chi-square test. A P value less than .05 was considered statistically significant. The statistical analysis was performed using SPSS, v.17.0.1 (SPSS Inc., Chicago, IL). The study was approved by the