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Original Contributions

IS THE DRIP-AND-SHIP APPROACH TO DELIVERING THROMBOLYSIS FOR ACUTE ISCHEMIC STROKE SAFE?

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□ **Abstract—Background: The drip-and-ship method of treating stroke patients may increase the use of tissue plasminogen activator (t-PA) in community hospitals. Objective: The safety and early outcomes of patients treated with t-PA for acute ischemic stroke (AIS) by the drip-and-ship method were compared to patients directly treated at a stroke center. Methods: The charts of all patients who were treated with intravenous (i.v.) t-PA at outside hospitals under the remote guidance of our stroke team and were then transferred to our facility were reviewed. Baseline NIHSS (National Institutes of Health Stroke Scale) scores, onset-to-treatment (OTT), and arrival-to-treatment (ATT) times were abstracted. The rates of in-hospital mortality, symptomatic hemorrhage (sICH), early excellent outcome (modified Rankin Scale [mRS] ≤ 1), and early good outcome (discharge home or to inpatient rehabilitation) were determined. Results: One hundred sixteen patients met inclusion criteria. Eighty-four (72.4%) were treated within 3 h of symptom onset. The median estimated NIHSS score was 9.5 (range 3–27). The median OTT time was 150 min, and the median ATT was 85 min. These patients had an in-hospital mortality rate of 10.7% and sICH rate of 6%. Thirty percent of patients had an early excellent outcome and 75% were discharged to home or inpatient rehabilitation. When these outcome rates were compared with those observed in patients treated directly at our stroke center, there were no statistical differences. Conclusions: In this small retrospective study, drip-and-ship management of delivering i.v. t-PA for AIS patients did not seem to compromise safety. However, a large prospective study comparing drip-and-ship management to routine care is needed to validate the safety of this approach to treatment. © 2011 Elsevier Inc.**

□ **Keywords—stroke; thrombolysis; health care; safety; outcomes**

INTRODUCTION

Intravenous tissue plasminogen activator (t-PA) given within 3 h of symptom onset remains the only proven treatment for acute ischemic stroke (AIS), yet national rates of t-PA use among eligible patients remain < 5% (1,2). Many emergency physicians are concerned about administering t-PA in a setting without a stroke team or appropriate neurological and neurosurgical resources equipped to handle the complications of t-PA (3). The reluctance to treat patients in community hospitals is due in part to a lack of adequate intensive care services or Neurology and Neurosurgery coverage (3). Many hospi-

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tals, even those in small cities that neighbor large academic centers, do not have direct access to neurologists around the clock and do not have experience delivering t-PA for AIS. Other hospitals have emergency systems in place to access and consult a neurologist for patients with possible AIS via telephone or videotelemedicine (VTM) consults. When treatment with intravenous (i.v.) t-PA is recommended, the patients are initially treated at the outside hospital (OSH) and then transferred to a facility with Neurology and Neurosurgery staff available for continuation of care. This method of delivering t-PA to stroke patients has been termed "drip-and-ship."

When the consultation for treatment recommendations is made by telephone, the neurologist cannot normally examine the patient or review the patient's neuroimaging studies. Although studies have demonstrated that emergency physicians can accurately diagnose stroke and some feel comfortable treating stroke with t-PA without a neurologist being present, there is little evidence about the safety of treating patients with t-PA at a community hospital in consultation with a neurologist at a stroke center (3–5). To date, two groups have presented their experience with the feasibility of the drip-and-ship method in a total of 86 patients, collectively (6,7). To our knowledge, no previous studies have examined the safety and outcome of drip-and-ship patients in routine clinical practice compared with patients who present directly to and receive acute thrombolytic therapy at a stroke center. Despite a paucity of data on the safety of drip and ship, community hospitals across the United States are being encouraged to form relationships with stroke centers to increase the number of stroke patients treated by the drip-and-ship method (8).

Evidence that the drip-and-ship approach to delivering standard-dose i.v. t-PA is safe, especially when compared to routine treatments provided in a stroke center, may lead to increased physician comfort and higher treatment rates at community hospitals. The primary objective of this study was, therefore, to determine the safety and early outcomes of i.v. t-PA in patients treated at an OSH and transferred to our facility for further care. The t-PA treatment times, hemorrhagic complications, and early outcomes among patients treated with the drip-and-ship approach were compared with those who presented directly to our facility and received i.v. t-PA.

METHODS

Study Design

A retrospective study was developed to determine the safety and early outcomes of i.v. t-PA patients treated at an OSH and then transferred to our facility. This project was approved by the University of Texas–Houston Health Science Center Institutional Review Board.

Selection of Participants

All patients who presented to an OSH with AIS symptoms and were treated with i.v. t-PA and then transferred to our stroke center from January 2004 through November 2007 were identified. Patients were included if onset and treatment times were documented and if there was evidence that the decision to treat was made after consultation with our stroke team. All AIS patients treated with i.v. t-PA within 3 h during the same time frame at our facility were identified to compare safety and early outcomes with the subset of patients treated within 3 h at OSH by the drip-and-ship method.

Setting

Our center, located in downtown Houston, serves as a hub for emergency departments (EDs) covering a radius of more than 100 miles. Our stroke team is available 24 h per day for telephone consultation on acute stroke patients and for VTM consultation at three regional hospitals. These forms of consultation are part of our routine clinical practice.

Methods of Measurement, Data Collection, and Processing

The medical records from the referring hospital were reviewed. The abstractors (SMS, HH, and AA) recorded onset, arrival, and t-PA bolus times and calculated pretreatment National Institutes of Health Stroke Scale (NIHSS) scores on a standardized abstraction form (9). The three NIHSS abstractors are certified in the NIHSS examination. Any part of the neurological examination not described by the emergency physicians was assumed to be normal. In cases where there was discrepancy between the times recorded at the OSH and our admission notes, the symptom-onset time recorded in our admission notes was considered the correct time, as this history was elicited by a stroke team member at the receiving hospital. The time of OSH arrival and t-PA bolus times recorded in the OSH medical records were considered the correct times. All other reported data, including adverse events and outcomes, were obtained from our prospective stroke registry. Our registry data were acquired prospectively by trained abstractors who had a detailed code book that defines each variable. We have an ongoing quality control program to monitor the

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