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ORIGINAL ARTICLE

Time cost of a nonclosing intravenous thrombolysis service for acute ischemic stroke

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Abstract *Background/Purpose:* Intravenous thrombolysis for ischemic stroke saves societal costs. The aim of this study was to investigate the cost burden that hospitals may shoulder.
Methods: Stroke code activations between May 2009 and April 2011 were recorded and divided into groups based on work and duty time, as well as the period of the day or season. "Time cost of nonclosing service" (TCNS) per stroke code activation or intravenous thrombolysis treatment was calculated by dividing the time by the number of activations or thrombolysis treatments during that period. Comparisons were made among groups.
Results: There were a total of 634 stroke code activations in a period of 2 years, and intravenous thrombolysis was used in 132 (20.8%) of these cases. The rates of thrombolysis were not statistically different between the groups. Overall, the average TCNS for the stroke team was 27.6 hours per code activation and 132.7 hours per thrombolysis treatment. The TCNS during duty time was 1.38 times that during work time per stroke code activation and 1.46 times per thrombolysis treatment. In summer, the TCNS was 1.6 times that in winter per code activation and 2.2 times per thrombolysis treatment. During the late night hours, the TCNS was four times that of early night hours per code activation and 9.8 times per thrombolysis treatment.
Conclusion: Our results demonstrate a large variation in the time cost of a nonclosing service for intravenous thrombolysis. Payment based on piece-rate compensation may not be appropriate and requires improvement.

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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Introduction

Intravenous thrombolysis with tissue-type plasminogen activator for acute ischemic stroke has been shown to be effective and is recommended by stroke guidelines.[1] However, the benefits of treatment are highly time dependent.[2] A stroke team offering a nonclosing service, 24 hours a day and 7 days a week, is required to implement this treatment. Health care cost analysis has shown that quality-adjusted life years gained, overall management costs including on-call neurologists, immediate access to brain imaging, and increased nursing for a short period are important issues.[3,4] In the United States (US), an economically favorable cost—reimbursement ratio for hospitals was established after the creation of diagnosis-related group 559. The US Centers for Medicare and Medicaid Services pay hospitals approximately US$6000 more per case when thrombolysis is administered.[5] Because intravenous thrombolysis requires a nonclosing service, payment on a piece-rate compensation basis in which reimbursement is only based on the number of patients treated may not be appropriate if the cost of maintaining an on-call team is not included. A lack of economic incentive for hospitals may be a reason for the underutilization of such treatment, especially in developing countries.[6]

A "time cost of nonclosing service" (TCNS) per stroke team activation or thrombolysis treatment can be calculated by dividing the time by the number of activations or thrombolysis treatments during that period. In this study, we analyzed our TCNS per stroke team activation and per intravenous thrombolysis treatment.

Methods

Changhua Christian Hospital (CCH) is a medical center in western Taiwan, in an area with a population of ~1.3 million. CCH participates in the Taiwan Stroke Registry, which enrolls acute stroke patients within 10 days after symptom onset.[7] The Institutional Review Board at CCH approved this study for human volunteers. Data on prehospitalization status, hospitalization, discharge information, and follow-up status were collected prospectively, and written informed consent was obtained from each participant.[7]

A standardized stroke pathway (code stroke) is used in CCH to provide intravenous thrombolysis treatment 24 hours a day, 7 days a week for patients, with acute ischemic stroke. Code stroke was activated at the emergency department triage by senior nursing staff based on the following: (1) the Cincinnati Prehospital Stroke Scale; (2) onset time within 3 hours; and (3) advanced screening with seven exclusion criteria (major surgery or significant trauma in the past 14 days; bleeding in the gastrointestinal tract or urinary tract in the past 21 days; myocardial infarction in the past 3 months; significant head trauma in the past 3 months; prior stroke within the past 3 months; and a history of intracranial hemorrhage and severe diseases such as active malignancy, severe liver or renal disease, severe heart failure, or severe dementia). On code activation, an electronic record was generated. In-hospital stroke case managers reviewed the treatment process and collected data for analysis. The treatment protocol was largely based on the National Institute of Neurological Disorders and Stroke (NINDS) trial,[8] and the criteria for thrombolysis were based on the guidelines of the Taiwan Stroke Society, which are similar to the NINDS criteria.[9] If the treatment criteria were met and informed consent was obtained, the patient was immediately given 0.9 mg/kg of tissue-type plasminogen activator intravenously, unless discontinued by the treating neurologist. If the treatment criteria were not fully met, the reasons for exclusion had to be documented.

Code stroke activations between May 2009 and April 2011 were collected and analyzed statistically. The patients were grouped according to work time and duty time. Work time was defined as 8:00—17:30 from Monday to Friday, and 8:00—12:00 on Saturday. Other times of the week were defined as duty time. Holidays were defined according to the CCH official schedule and were included in duty time.

For the analysis of daily distribution and characteristics of code activation, the patients were grouped according to the time of code activation into: (1) Morning group (6:00—11:59); (2) Afternoon group (12:00—17:59); (3) Early night group (18:00—23:59); and (4) Late night group (24:00—5:59). For the analysis of seasonal distribution and characteristics, the patients were classified into four groups: (1) Spring group (March—May); (2) Summer group (June—August); (3) Fall group (September—November); and (4) Winter group (December—February).

TCNS per code activation or thrombolysis treatment was defined as the total number of hours used during a specific length of time divided by the total number of code activations or thrombolysis treatments during that period. TCNS per code activation and thrombolysis treatment was calculated for each group. Comparisons were made between groups for age, sex, final diagnosis, rate of thrombolysis, and reasons for exclusion from thrombolysis. All statistical analyses were performed using SPSS for Windows, version 13.0 (SPSS Inc., Chicago, IL, USA). The statistical significance of intergroup differences was assessed using the χ^2 test for categorical variables, and unpaired two-tailed t tests were used to compare the continuous variables. A p value < 0.05 was considered statistically significant.

Results

Between May 2009 and April 2011, there was a total of 634 code stroke activations. During this period, a total of 2350 patients with acute ischemic stroke or transient ischemic attack were admitted to our hospital. The rate of intravenous thrombolysis treatment for all ischemic stroke and transient ischemic attack patients was 5.6%. Table 1 shows the characteristics of all cases with code stroke activation and by work and duty times. For all cases, the mean age was 68 $\pm$ 13 years, and there were more men (62.1%) than women. One hundred and thirty-two (20.8%) patients received intravenous thrombolysis treatment, and these patients were significantly older than those who did not receive thrombolysis treatment (71 $\pm$ 12 years vs. 67 $\pm$ 14 years, $p = 0.002$). Eighty-five (13.4%) patients did