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ORIGINAL ARTICLE

Code stroke: A mismatch between number of activation and number of thrombolysis



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Background/Purpose: Code stroke systems are widely implemented to expedite acute stroke treatment. Although this system requires considerable resources, so far no reimbursement has been provided by the Bureau of National Health Insurance (BNHI) in Taiwan. We investigated how often a code stroke was initiated and the percentage of patients treated with intravenous (IV) tissue plasminogen activator, and draw attention to the resulting mismatch.

Methods: From January 2010 to September 2011, we prospectively registered all consecutive code stroke patients. Patient characteristics, including demographic data, medical history, comorbidity conditions, treatments, and discharge diagnosis were collected, together with the exact time of onset (or last known normal time) and management. The eligibility of thrombolysis for each patient recorded originally on the chart was reviewed retrospectively on the basis of two sets of criteria, namely, the BNHI reimbursement criteria and the Taiwan Stroke Society (TSS) guideline.

Results: During the study period, code strokes were activated for 419 patients at an average of around 20 patients per month. About 57% of code strokes were initiated outside of office hours. Stroke was diagnosed in 377 (90%) patients and 304 (73%) patients had ischemic stroke or transient ischemic attack. A total of 42 (10%) patients according to the BNHI reimbursement criteria and 101 (24%) patients by the TSS guideline were eligible for IV thrombolytic therapy. Of all the code stroke patients, only 49 (12%) were actually treated. Before each additional patient was thrombolysed, about eight patients had been evaluated and excluded from treatment.

Conclusion: The majority of code stroke patients were stroke patients; however, most of them could not be treated with thrombolytic therapy. These findings underscore the need for further support from the BNHI in order for health-care providers to implement the code stroke systems successfully.

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Introduction

Because the effectiveness of intravenous (IV) tissue plasminogen activator (tPA) in acute stroke treatment is time-dependent,¹ it is advised to minimize the symptoms to needle time so as to improve treatment outcomes. Many factors, at both the prehospital and hospital levels, are associated with delays of thrombolytic therapy in stroke patients. Code stroke systems are commonly implemented to shorten the hospital delay in the emergency department (ED).^{2–4} However, lack of in-hospital stroke code protocol might cause up to 18% of eligible stroke patients not receiving tPA because of an avoidable cause.⁵ Overall, implementation of code stroke systems requires considerable logistic and human resources.^{6,7}

IV tPA treatment for acute ischemic stroke was approved in Taiwan in November 2002. In July 2003, the Taiwan Stroke Society (TSS) released a guideline regarding the use of IV tPA for acute ischemic stroke in which the exclusion criteria were modified from the National Institute of Neurological Disorders and Stroke (NINDS) tPA trial.⁸ Based on the guideline, the Bureau of National Health Insurance (BNHI) started the reimbursement of tPA for acute stroke treatment in 2004. Data from the Taiwan Stroke Registry, a nationwide registry enrolling stroke patients from 2006 to 2008, showed that only 1.5% of patients with ischemic stroke received IV tPA treatment.⁹ A less restrictive TSS guideline regarding thrombolytic therapy was released in 2008 to respond to new evidence.¹⁰ This updated TSS guideline expands the patient population suitable for thrombolytic therapy.

A mismatch between the risks and benefits of managing acute IV tPA treatment in an emergency setting may threaten the IV tPA treatment for acute ischemic stroke in Taiwan. The greatest concern is legal liability that can arise from negative patient outcomes, especially when the rate of symptomatic intracerebral hemorrhage after using IV tPA has been found as high as 10.4% among the Chinese-Taiwanese people.¹¹ Moreover, failures in identifying thrombolysis candidates at an earlier stage or treating eligible patients have also led to medical malpractice lawsuits.¹² Additionally, up to date, the BNHI does not provide financial benefits to physicians performing IV tPA therapy nor offer any financial incentives to hospitals implementing code stroke systems. This may partially explain why IV tPA therapy for acute ischemic stroke remains underused.¹³

The primary objective of this study was to explore the therapeutic yield of an in-hospital code stroke system in a community hospital by examining how often a code stroke was initiated and the percentage of patients treated with IV tPA. Our secondary objective was to underscore the workload of neurologists caused by the code stroke protocol.

Patients and methods

The study hospital is a community hospital with an ED volume of 100,000 patient visits per year. In October 2009, the ED started a thrombolysis protocol (code stroke) to guide the evaluation and management of patients

suspected of having a stroke.¹⁴ The protocol is activated by triage nurses or ED physicians when a patient with suspected stroke was identified within 3 hours of onset. The code stroke activities include establishment of an IV line, immediate blood testing (complete blood counts, biochemistries, prothrombin, and activated partial thromboplastin times), 12-lead electrocardiography, noncontrast head computed tomography (CT), determination of blood pressure in both arms, measurement of body weight, and notification of the on-call neurologist. A nurse practitioner on the acute stroke team is responsible for the evaluation of the National Institutes of Health Stroke Scale (NIHSS) and assessment of the eligibility for IV tPA treatment. An on-call neurologist has to examine each patient in person before the decision to administer thrombolytic therapy.

From January 2010 to September 2011, we prospectively registered all consecutive patients for whom a code stroke was activated. Patient characteristics, including demographic data, medical history, comorbidity conditions, treatments, discharge diagnosis, and outcomes were collected following the identical registry protocol as the nationwide Taiwan Stroke Registry.⁹ The diagnosis was made by the treating physicians, based on a clinical assessment, radiologic findings, and other laboratory tests as considered relevant by the clinician in charge of the treatment. Acute stroke was defined as rapid onset of focal neurological deficits, lasting longer than 24 hours, with no apparent cause other than vascular origin. Transient ischemic attack (TIA) required full resolution of symptoms within 24 hours and no evidence of acute infarct on neuroimaging studies. A stroke mimic was diagnosed when the clinical details did not indicate a vascular etiology, and an alternate convincing explanation for the symptoms was established. The exact time of onset (or last known normal time), arrival at ED, ordering of CT and laboratory tests, evaluation by neurologists, start of CT scanning, availability of coagulation results, thrombolysis, and admission to the intensive care unit (if applicable) were recorded. Eligibility of thrombolysis for each patient recorded originally on the chart was reviewed retrospectively according to the BNHI reimbursement criteria and the 2008 TSS guideline. The data collection had been approved by the hospital's Institutional Review Board.

Median values and interquartile ranges (IQRs) of the time intervals were used for descriptive statistics because of their non-normal distributions. While making comparisons, we used χ^2 or Fisher exact test for categorical variables and *t* test or the Wilcoxon rank-sum test for continuous or ordinal measures. A value of $p < 0.05$ (two-sided) was considered statistically significant.

Results

From January 2010 to September 2011, 419 patients were prospectively accrued to this study through the code stroke protocol, with an average of around 20 patients per month. More than half of code stroke patients (239 or 57%) were initiated outside the office hours. Stroke was diagnosed in 377 (90%) patients and 304 (73%) patients had ischemic stroke or TIA. Demographic and clinical characteristics for

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