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ORIGINAL ARTICLE

Improved performance of new prenotification criteria for acute stroke patients



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KEYWORDS

emergency medical services;
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Background/purpose: We aim to evaluate the accuracy of the new prehospital notification criteria for patients with potential acute stroke in the prehospital setting.

Methods: We conducted a retrospective observational study from March 2011 to February 2013 of potential acute stroke patients prenotified using the new criteria which were: (1) positive Cincinnati Prehospital Stroke Scale (CPSS); (2) symptom onset within 3 hours; and (3) blood glucose level > 60 mg/dL. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the new criteria were calculated and outcomes of acute stroke patients were reported. Data of all patients with stroke or transient ischemic attack (TIA) transported to the destination hospital were also obtained to evaluate the compliance of emergency medical technicians.

Results: There were 2888 patients suspected of stroke by emergency medical technicians and 221 patients prenotified due to meeting the criteria. The PPV, NPV, sensitivity, and specificity of the new criteria were 76.9%, 96.6%, 64.9%, and 98.1%, respectively. Onset time > 3 hours (24/51, 47.1%) and seizure (27.5%) were the two most common conditions leading to false prenotification. Of all prenotified patients, 23.1% (51/221) received thrombolytic therapy. Hemorrhagic stroke or ischemic stroke with hemorrhagic transformation (53.8%) and minor

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symptoms or rapid recovery (26.9%) were the most common reasons excluding correctly prenotified patients from thrombolytic therapy.

Conclusion: The accuracy of the new prehospital stroke criteria has higher PPV and specificity compared to previous CPSS validation studies.

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Introduction

Stroke is the third leading cause of mortality and is the leading cause of long-term disability in adults worldwide.^{1–3} Intravenous thrombolytic therapy with tissue plasminogen activator (tPA) has proven to improve the functional outcome of ischemic stroke patients, but can only be given within 3–4.5 hours after symptom onset.^{4,5} It was reported in the literature that only 3.4–6.0% of ischemic stroke patients received thrombolytic therapy.^{6,7} In Taiwan, this number is even lower: only 1.5% of ischemic stroke patients receive intravenous thrombolytic therapy.⁸ Both prehospital and in-hospital delay may exclude the patients from this therapy.^{9,10} The utilization of emergency medical services (EMS), especially to aid in the prenotification of hospitals, has been reported to significantly reduce delay and increase eligible patients to be treated with tPA.^{11–16} The guidelines by the American Heart Association (AHA) and American Stroke Association emphasize the importance of EMS utilization in hyperacute stroke care.⁵

Only recently has a close collaboration formed between EMS systems and hospitals for acute stroke care and prenotification in Taiwan. The Cincinnati Prehospital Stroke Scale (CPSS) is an easy method for emergency medical technicians (EMTs) to perform and diagnose possible acute stroke.¹⁷ However, the positive predictive values (PPVs) of CPSS to identify stroke patients are low, ranging from 40% to 56%.^{18–20} This is problematic as emergency department (ED) overcrowding in Taiwan is as serious as that in other countries and such situations sometimes exhaust ED staff. In order to alleviate the stress and workload of ED staff caused by EMS prenotification, it is necessary to build a more accurate prenotification rule for acute stroke patients. Thus the new prenotification criteria, which combines CPSS with symptom onset time and blood glucose level, were used in our EMS system. Although the CPSS has been validated in a few studies,^{17–21} no study showed the accuracy of the prenotification criteria which combined CPSS, within 3 hours of symptom onset, and normal blood glucose level in clinical practice. Therefore, the aim of the present study was to understand the accuracy of new prenotification criteria in prehospital settings.

Materials and methods

Study setting

The study was performed at the National Taiwan University Hospital (NTUH) and 12 neighboring EMS brigades of Taipei

city from March 1, 2011 to February 28, 2013. The area of responsibility of these brigades was around 21 km², and ~400,000 residents lived in the area. NTUH is a tertiary teaching hospital in Taipei city, with 110,000–120,000 annual visits to the ED. NTUH has comprehensive stroke care capabilities, including thrombolytic therapy. It is also the base hospital of the neighboring EMS system. The EMS system neighboring our hospital is a mixed one-tier and two-tier fire-based system.²² Approximately 30% of patients with acute stroke utilize the EMS system at our hospital.²³

From December 1, 2010 to February 29, 2011, EMTs from the participating brigades participated in a stroke education program, including symptom identification and care skills. During the 2-hour education course, EMTs were taught how to perform the CPSS and check blood glucose level using the pinprick test on presumed stroke patients. We taught the same method to perform CPSS as in the original study.¹⁷ In addition, the skills of querying time of symptom onset were also taught and practiced during the course. Participants were taught that if the patient was found to have symptom onset within 3 hours before EMTs arrived at the scene, with positive CPSS and normal blood glucose level (> 60 mg/dL) according to the pinprick test, prenotification ought to be performed. EMTs were also introduced to how to prenotify the destination hospital.

The reason why blood glucose level was added into our prenotification criteria was because hypoglycemia is one of the most common stroke mimics, and thus hypoglycemia ought to be ruled out before thrombolytic therapy was given.²⁴ In addition, there was intravenous glucose water prepared in the ambulances of the EMS brigades of Taipei city, and thus glucose water could be administered immediately once hypoglycemia was found to avoid irreversible brain damage. The EMTs were asked to query the onset time because AHA guidelines suggested it ought to be performed in prehospital settings.⁵ The education courses were held four times for different brigades. This study was approved by the institutional review board of the NTUH.

Study population

After the education programs were completed, a stroke system with prenotification by EMTs was launched on March 1, 2011. If a patient was suspected of having a stroke by EMTs at the scene, the patient would be examined to see whether he/she met the criteria. Although we encouraged EMTs to utilize the prenotification criteria for all patients whose complaints included any of the warning signs of stroke recommended by the guidelines,⁵ whether or not the prenotification criteria was used for someone still depended on the EMTs' discretion. We included all patients sent

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