ORIGINAL ARTICLES

ROSIER scale is useful in an emergency medical service transfer protocol for acute stroke patients in primary care center: A southern China study

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Abstract

Objective: The aim of the study is to validate whether the Recognition Of Stroke In the Emergency Room (ROSIER) scale can be used by general practitioners (GPs) in an emergency medical service (EMS) protocol to transfer stroke patients from primary care center to advanced hospital with acute stroke center. *Methods:* GPs prospectively performed the ROSIER scale and the Cincinnati Prehospital Stroke Scale (CPSS) on suspected stroke patients as a transfer protocol. All patients were immediately transferred to the Level-II hospital for further treatment. *Results:* 468 of the 512 suspected stroke patients met the inclusion criteria in this study. The ROSIER scale showed a diagnostic sensitivity of 83.13% (95% confidence intervals [CI] 79.74-86.52%) and specificity of 80.88% (95% CI 77.32-84.44%). The CPSS showed a diagnostic sensitivity of 78.01% (95% CI 74.26-81.76%) and specificity of 70.59% (95% CI 66.46-74.72%). The Kappa statistic value of the ROSIER scale and the CPSS were 0.601 and 0.454, respectively. The area under the curve (AUC) of ROSIER scale was large than the CPSS (AUC 0.855 vs. 0.791). However, the difference was not significantly different. *Conclusions:* This study suggest that ROSIER and CPSS could be used in an EMS protocol to transfer stroke patients from a primary care center to an advanced hospital offering thrombolysis service

Key words: Stroke; General practitioner; Emergency Department; Community Health Service; Primary care; Transfer protocol

INTRODUCTION

Stroke is the leading cause of death in Chinese urban communities. It affect about 2,000,000 people of all ages in China, with 1,500,000 stroke-related deaths occurring each year.[1] Most stroke events occur at home and general practitioners (GPs) play an important role in the initial assessment and management of suspected stroke patients who visit or call primary care center for medical help.[2-6] Currently in China, upon the recognition of suspected stroke, the patient will be transferred by emergency medical system (EMS) to an rt-PA-offering hospital immediately. However, most GPs do not have sufficient knowledge or awareness of the urgent treatment of acute stroke. This is one of the weak links in

the chain of stroke care and can cause delay.[3-6] For promoting rapid triage of stroke, numerous stroke recognition tools have been designed, such as the Cincinnati Prehospital Stroke Scale (CPSS), Los Angeles Prehospital Stroke Screen (LAPSS), and the Recognition of Stroke in the Emergency Room (ROSIER) scale.[7-11] The CPSS and LAPSS are adopted worldwide, but their sensitivity and effectiveness are still uncertain.[12-13] The ROSIER scale was recently developed for use by emergency physicians and proven to be much better than the CPSS and LAPSS.[11] However, the performance of the ROSIER scale used by GPs is unknown. Here we conduct a prospective study to validate whether the ROSIER scale can be used by GPs in an EMS protocol to transfer stroke patients from primary care center to advanced hospital with acute stroke service in southern China.

METHODS

This study was conducted from August 2012 to January 2016 in the Luocun Community Health Service Center (LCHSC) of Nanhai District and Zhangcha Community Health Service Center (ZCHSC) of Chancheng District, Foshan City. Both LCHSC and ZCHSC provide primary care to local residents and treat about 710,000 patients per year. LCHSC is affiliated with the Nanhai Hi-Tech Industrial Zone Hospital (NHIZH) of Foshan, a Level-II hospital with the capability of managing acute stroke. ZCHSC is affiliated with the Foshan Hospital of Traditional Chinese Medicine (FSTCM), a tertiary care teaching hospital with acute stroke center. There is a combined police-fire-EMS dispatch center in Foshan City. In these two communities, patients meeting admission criteria would be advised and transferred by physician-staffed ambulances to these two hospitals for further treatment immediately.[14]

Inclusion criteria

Stroke was defined as a focal or global neurological deficit with symptoms lasting for 24 h and due to a vascular cause after investigation. Transient ischemic attack (TIA) was defined as a clinical syndrome, characterized by an acute loss of focal cerebral or monocular function with symptoms lasting less than 24 hours, and caused by inadequate blood supply as a result of thrombosis or embolism.[11] All patients older than 18 years with suspected stroke or TIA and with symptoms or signs observed by GPs in LCHSC and ZCHSC were included in this study. According to the

American Institute of Neurological Disorders and Stroke guidelines, acute stroke or TIA was confirmed with the presence of one or more of the following clinical signs: numbness or weakness in the face, arms or legs (especially on one side of the body); confusion, difficulty in speaking or understanding speech; vision disturbance in one or both eyes; dizziness, walking difficulties, loss of balance or coordination; severe headache without known cause.[15]

Exclusion criteria

Patients with (1) head trauma or surgery in recent months; (2) previous stroke with neurologic deficits; (3) incomplete medical testing were excluded from this study.

Design

Sixteen GPs were trained by emergency physicians on the use of the ROSIER scale and CPSS for 10 hours before the study, and performed them on suspected stroke patients in LCHSC and ZCHSC. All suspected stroke patients were advised and transferred by physician-staffed ambulances to the emergency department (ED) and received an emergency computed tomography (CT) scan of the brain immediately. At the same time, the stroke team was activated and assessed patients by neurologic screening. Then the neurologists, without prior information of the ROSIER scale or CPSS results, conducted further consultations and provided treatment. According to the American Heart Association (AHA) and American Stroke Association (ASA) guidelines, patients' blood samples were tested and 12-lead electrocardiography (ECG) was performed in the ED. Other examinations such as continuous ECG monitoring, 24-hour Holter ECG, duplex carotid and cardiac ultrasound, trans-cranial Doppler (TCD), magnetic resonance imaging (MRI) or magnetic resonance angiography (MRA), and conventional cerebral angiography were performed as requested by the neurologists in the neurology ward when necessary. Patients with potential indications for surgery were admitted to the neurosurgery department. The final discharge diagnosis of stroke or TIA made by the neurologists was used as the reference standard for diagnosis.[2,14,16]

Ethics approval

All procedures performed in this study were in accordance with the ethical standards of the

Table1: Results of the use of the ROSIER scale in suspected stroke patients assessed by GPs (n=468)

ROSIER	Final discharge diagnosis		
	Stroke	Nonstroke	Total
Suspected	276	26	302
Nonsuspected	56	110	166
Total	332	136	468

institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants in the study.

Statistical analysis

Data were entered into a Microsoft Excel database and analyzed by SPSS 13.0 (SPSS, Chicago, IL, USA). The results of the CPSS and ROSIER scale, the CT and MRI scan, and the final discharge diagnosis were all recorded. We calculated sensitivity (Se), specificity (Sp), false positive rate (Fpr), false negative rate (Fnr), positive predictive value (PPV) and negative predictive value (NPV). Compared with the final discharge diagnosis, statistical analysis was performed using the Pearson chi-square test, Kappa analysis and receiver operating characteristic (ROC) curves on evaluation of these two scales. The McNemar test was used to test whether their positive rates were significantly different or not. $P < 0.05$ was considered significant. Kappa statistic value was defined as follows: 0-0.20= poor; 0.21-0.40= fair; 0.41-0.60= moderate; 0.61-0.80= good; 0.81-1.00= excellent agreement.

RESULTS

From August 2013 to January 2016, 512 suspected stroke patients were assessed by GPs in LCHSC and ZCHSC, of which 468 met the study criteria [mean age 67.54±12.66 years, 192 (41.03%) females]. Of the 468 patients, 332 (70.94%) had a final discharge diagnosis stroke or TIA [mean age 71.32±11.50 years, 168 (50.60%) females, 240

(72.29%) ischemic stroke/TIA and 92 (27.71%) hemorrhagic stroke] and 136 patients were "stroke mimics" (45 syncope, 28 seizure, 26 vertigo, 10 hypoglycemia, 8 hypokalemia, 5 sepsis, 4 brain tumor, 3 hysteria, 2 alcohol intoxication, 2 hepatic encephalopathy, 2 Meniere's syndrome and 1 demyelination).

The interval from stroke onset to the arrival at primary care center was 8.12±6.25 (median 6.6, range 0.5-32) hours. The median stay in primary care center was 0.6 (range 0.5-1) hours.

Both the ROSIER and CPSS are significantly associated with the final discharge diagnosis ($P < 0.05$) (Tables 1 and 2). The ROSIER scale was superior to the CPSS (Se 83.13% vs. 78.01%, Sp 80.88% vs. 70.59%, Fpr 19.12% vs. 29.41%, Fnr 16.87% vs. 21.99%, PPV 91.39% vs. 86.62%, and NPV 66.27% vs. 56.80%). The ROSIER correlated better to final diagnosis than CPSS (Kappa value =0.601 vs. 0.454) (Table 3). The area under the curve (AUC) of the ROSIER scale was large than CPSS (0.855 vs. 0.791) (Figure 1). However, there was no statistical difference in the positive rate between the ROSIER and CPSS ($P > 0.05$).

DISCUSSION

As "time is brain", early administration (especially within 90 min of onset) of thrombolytic therapy in selected patients with acute ischemic stroke increases the likelihood of a favorable outcome.[2] To further reduce the burden of stroke, healthcare providers, EMS, hospitals, and communities should review their systems to improve the efficiency and effectiveness of stroke care.[2] In the AHA guidelines, the "D's of Stroke Care" remain

Table 2: Results of the use of the CPSS in suspected stroke patients assessed by GPs (n=468)

CPSS	Final discharge diagnosis		
	Stroke	Nonstroke	Total
Suspected	259	40	299
Nonsuspected	73	96	169
Total	332	136	468

Table 3: The individual analysis of the ROSIER scale and CPSS (n=468)

	ROSIER	CPSS
P-value	<0.05	<0.05
Accuracy	82.48%	75.85%
Kappa value	0.601	0.454
Se（95%CI）	83.13(79.74-86.52)	78.01(74.26-81.76)
Sp（95%CI）	80.88(77.32-84.44)	70.59(66.46-74.72)
Fpr（95%CI）	19.12(15.56-22.68)	29.41(25.28-33.54)
Fnr（95%CI）	16.87(13.48-20.26)	21.99(18.24-25.74)
PPV（95%CI）	91.39(88.85-93.93)	86.62(83.54-89.70)
NPV（95%CI）	66.27(61.99-70.55)	56.80(52.31-61.29)

the major steps in diagnosis and treatment of stroke and in identifying key points where delays can occur. The first "D" is "Detection" which means rapid recognition of stroke symptoms.[2] Since more and more patients receive primary care in community health service centers in China, GPs play an important role as the health guardian of community residents. However, most GPs do not have sufficient knowledge or clinical experience in stroke. They may fail to detect acute stroke, which result in delay of treatment.[17,18] Thus, an effective stroke recognition tool is needed for GPs to differentiate stroke mimics and to recognize suitable candidates for thrombolytic therapy.

Among a series of stroke recognition tools used worldwide, the ROSIER scale is the latest and is increasingly popular. In 2005, Nor *et al*. developed and validated the ROSIER scale.[11]

In their study, early use of ROSIER has very promising results (Se 93%, Sp 83%), which is much better than CPSS, FAST and LAPSS.[11] Our previous studies also show that the ROSIER scale can be used by emergency physicians as an effective stroke recognition tool in the prehospital setting (Se 89.97%, Sp 83.23%).[19-22] The English vesion of ROSIER scale has been translated into Chinese and shown to be implemented well by emergency physicians after training.[19,20] Currently, the ROSIER scale is included in the medical files, is an important part of initial evaluations of suspected stroke patients in Foshan EMS and EDs.[19-23] However, its sensitivity and effectiveness are still uncertain and need further validation.[24,25] ROSIER was developed in the ED setting and designed for use by emergency physicians. It had not yet been studied whether the ROSIER scale
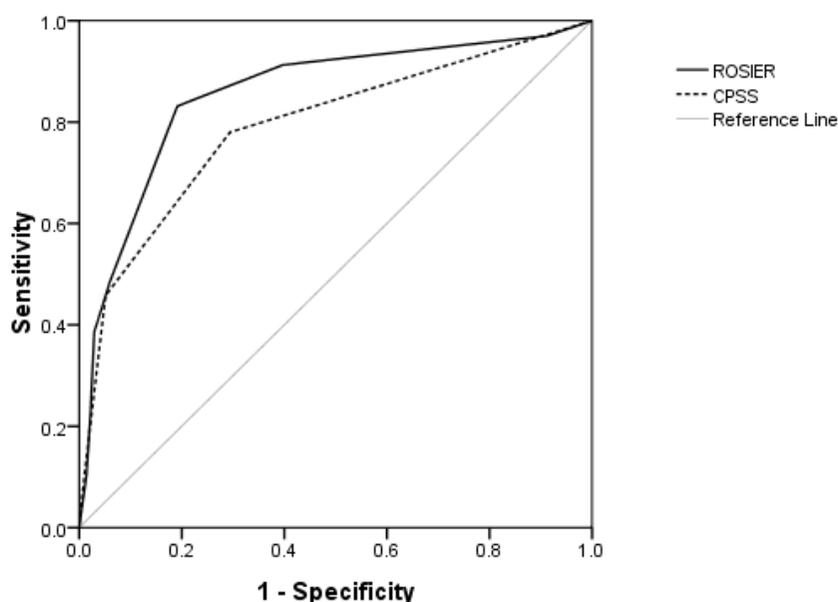

Figure 1: ROC Curve for the ROSIER scale and CPSS.

is suitable for use by GPs in assessing suspected stroke in Chinese community.

In this study, we found that GPs were able to perform the ROSIER scale and CPSS very well after training. Both scales correspond to final diagnosis of stroke in Chinese patients, indicating the ROSIER and CPSS could be used in an EMS transfer protocol. Compared to CPSS, the ROSIER scale incorporates visual field assessment and more specific examinations of face arm and leg asymmetry. Based on the logistic regression model of Nor's study to identify independent predictors of stroke occurrence and clinical experiences, the final version of ROSIER scale is concise with high sensitivity and specificity.[11] Since the ROSIER scale includes not only the three main items of CPSS but also more independent predictors of acute stroke, it explains why the ROSIER scale is better than CPSS as a stroke recognition tool.

We suggest GPs perform the ROSIER scale initially on the suspected stroke patients. Since CPSS is easier to use and has a similar positive rate as ROSIER, CPSS could be a replacement when it is difficult to perform ROSIER. In this study, the interval from stroke onset to arrival at primary care center was 8.12±6.25 [median 6.6, range 0.5-32] hours. Thus, the majority of acute ischemic stroke patients arrived in the hospital several hours after the time window for thrombolysis We suggest strengthening public health education in the community to make the public more aware of acute stroke symptoms and treatment.

Our study is limited by the small sample size and the localized recruitment, and cannot represent the entire Chinese population. The differences in stroke knowledge and experience between GPs could also be bias to perform the ROSIER scale or CPSS.

In conclusion, we suggest ROSIER scale and CPSS could be used by GPs in an EMS protocol to transfer stroke patients from primary care center to advanced hospital with acute stroke center. The GPs could perform ROSIER first on the suspected stroke patients in primary care center. When it is difficult to perform ROSIER, it could be replaced by CPSS.

ACKNOWLEDGEMENTS

DISCLOSURE

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