Derivation and Validation of the Emergency Medical Stroke Assessment and Comparison of Large Vessel Occlusion Scales

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Background: This study aims to develop a simple scale to identify patients with prehospital stroke with large vessel occlusion (LVO), without losing sensitivity for other stroke types. *Methods:* The Emergency Medical Stroke Assessment (EMSA) was derived from the National Institutes of Health Stroke Scale (NIHSS) items and validated for prediction of LVO in a separate cohort. We compared the EMSA with the 3-item stroke scale (3I-SS), Cincinnati Prehospital Stroke Severity Scale (C-STAT), Rapid Arterial oCclusion Evaluation (RACE) scale, and Field Assessment Stroke Triage for Emergency Destination (FAST-ED) for prediction of LVO and stroke. We surveyed paramedics to assess ease of use and interpretation of scales. *Results:* The combination of gaze preference, facial asymmetry, asymmetrical arm and leg drift, and abnormal speech or language yielded the EMSA. An EMSA greater than or equal to 3, 75% sensitivity, and 50% specificity significantly reduced the likelihood of LVO (LR– = .489, 95% confidence interval .366-0.637) versus 3I-SS less than 4 (.866, .798-0.926). An EMSA greater than or equal to 1, 93% sensitivity, and 47% specificity significantly reduced the likelihood of stroke (LR– = .142, .068-0.299) versus 3I-SS (.476, .330-0.688) and C-STAT (.858, .717-1.028). EMSA was rated easy to perform by 72% (13 of 18) of paramedics versus 67% (12 of 18) for FAST-ED and 6% (1 of 18) for RACE ($\chi^2 = 27.25$, $P < .0001$), and easy to interpret by 94% (17 of 18) versus 56% (10 of 18) for FAST-ED and 11% (2 of 18) for RACE ($\chi^2 = 21.13$, $P < .0001$). *Conclusions:* The EMSA has

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superior abilities to identify LVO versus 3I-SS and stroke versus 3I-SS and C-STAT. The EMSA has similar ability to triage patients with stroke compared with the FAST-ED and RACE, but is simpler to perform and interpret. **Key Words:** Prehospital stroke care—emergency medical services—stroke scales—stroke systems of care.
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Introduction

Until recently, acute ischemic stroke care has focused on strategies designed to preserve viable brain tissue by improving access to treatment with intravenous tissue plasminogen activator (IV t-PA) within 4.5 hours of stroke symptom onset.[1] Prehospital stroke screens, including the Cincinnati Prehospital Stroke Scale and the Los Angeles Prehospital Stroke Screen, were developed to help distinguish stroke from stroke mimic.[2-6] Unfortunately, first-generation prehospital stroke screens have had limited accuracy when they have been tested in the field.[7-10] Recently completed randomized clinical trials have demonstrated the efficacy of endovascular therapy (ET) with stent retrievers versus IV t-PA alone in patients with large vessel occlusion (LVO) and salvageable tissue, generally in patients presenting with a National Institutes of Health Stroke Scale (NIHSS) greater than or equal to 6 with groin puncture less than 6 hours of ischemic stroke onset.[11-16] Thus, in addition to the need to improve access to IV t-PA, we must modify our current prehospital system of stroke care to facilitate access to ET.

A second generation of prehospital stroke scales, including the 3-item stroke scale (3I-SS),[17] Los Angeles Motor Scale (LAMS),[18] Cincinnati Prehospital Stroke Severity Scale (C-STAT),[19] the Rapid Arterial oCclusion Evaluation (RACE) scale,[20] and Field Assessment Stroke Triage for Emergency Destination (FAST-ED) scale,[21] have been developed to identify patients with LVO. A recent comparison of LVO scales and the NIHSS found that existing clinical scales, including the NIHSS, fail to reliably identify patients with LVO, and suggested that intracranial arterial imaging should be performed in all patients with acute ischemic stroke presenting within 6 hours of symptom onset.[22] This implies that prehospital scales should not be viewed as a definitive way to identify patients with LVO, and that a priority of prehospital stroke scales should be on stroke recognition to facilitate urgent vascular imaging. However, recent studies of prehospital scales have focused on predicting LVO or severe stroke, but there are almost no data regarding the ability of existing LVO scales to distinguish between stroke and stroke mimic. Additionally, most of the recent scales require a nuanced assessment of the patient. Accordingly, we aimed to develop a truly brief and simple prehospital stroke scale to improve identification of patients with LVO and all acute stroke.

Methods

Human Subject Committee Review

The study was approved by the SUNY Downstate Medical Center Institutional Review Board, the SUNY Downstate Medical Center Ethical Standards Committee, the Tulane University Biomedical Institutional Review Board, and the University of Alabama at Birmingham Institutional Review Board.

Development of Emergency Medical Stroke Assessment

We reviewed medical records of all patients with stroke code with complete NIHSS scores at SUNY Downstate Long Island College Hospital (LICH) during 2010. As shown in Table 1, to derive the Emergency Medical Stroke Assessment (EMSA) scale, NIHSS items for Best gaze and Facial palsy were dichotomized (0 versus ≥1), NIHSS Motor Arm and Leg items were scored as symmetric versus

Table 1. *EMSA items and NIHSS score equivalents*

NIHSS item (No.)	NIHSS score	EMSA item	EMSA score
Best gaze (2)	0	Eye movement	0
	1-2		1
Facial palsy (4)	0	Facial weakness	0
	1-3		1
Motor arm	5a = 5b	Arm weakness	0
left (5a), right (5b)	5a ≠ 5b		1
Motor leg	6a = 6b	Leg weakness	0
left (6a), right (6b)	6a ≠ 6b		1
Language (9) or dysarthria (10)	0	Slurred speech or aphasia	0
	9 plus 10 ≥ 1		2

Abbreviations: EMSA, Emergency Medical Stroke Assessment; NIHSS, National Institutes of Health Stroke Scale.[23,24]

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