The Finnish Prehospital Stroke Scale Detects Thrombectomy and Thrombolysis Candidates—A Propensity Score-Matched Study

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Background: Prehospital stroke triage is challenged by endovascular treatment for large vessel occlusion (LVO) being available only in major stroke centers. Conjugate eye deviation (CED) is closely related to LVO, whereas common stroke signs (face-arm-leg-speech-visual) screen stroke. We hypothesized that combining CED with common stroke signs would yield a prehospital stroke scale for identifying both LVO and stroke in general. *Methods and Results:* We retrospectively analyzed consecutive patients (n = 856) with prehospital Code Stroke (recanalization candidate). The National Institutes of Health Stroke Scale (NIHSS) and computed tomography were administered to patients on arrival. Computed tomography angiography was performed on patients with NIHSS score of 8 or greater and considered to benefit from endovascular treatment. With random forest analysis and deviance analysis of the general linear model we confirmed the superiority of the NIHSS "Best Gaze" over other NIHSS items in detecting LVO. Based on this and commonly used stroke signs we presented the Finnish Prehospital Stroke Scale (FPSS) including dichotomized face drooping, extremity weakness, speech difficulty, visual disturbance, and CED. FPSS detected LVO with a sensitivity of 54%, specificity of 91%, positive predictive value of 48%, negative predictive value of 93%, and likelihood ratio of 6.2. *Conclusions:* Based on CED and universally used stroke signs, FPSS recognizes stroke in general and additionally, LVO as a stroke subtype comparably to other scales intended to detect LVO only. As the FPSS items are dichotomized, it is likely to be easy for emergency medical services to implement. **Key Words:** Conjugate eye deviation—ischemic stroke—large vessel occlusion—endovascular treatment—prehospital stroke scale.

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Introduction

The major predictor of recovery in cases of acute ischemic stroke is the time elapsing between onset of symptoms and recanalization of the artery.[1] Along with public awareness, the first contacts with emergency response centers (ERCs) and emergency medical services (EMSs) are crucial. Stroke triage is based on the use of prehospital stroke scales enabling early identification of recanalization candidates (Code Stroke).

Use of intravenous tissue plasminogen activator available in primary stroke centers is efficacious in occlusions of small- and medium-sized vessels (non-large vessel occlusion [non-LVO]), whereas endovascular treatment (EVT), more efficacious than tissue plasminogen activator alone in LVO, is only available in major stroke centers, capable of providing EVT.[2] The different approaches in treating these 2 entities highlight the importance of the primary triage. Prehospital recognition of LVO is essential for direct transport to major stroke centers.[3]

Early stroke recognition scores like the Cincinnati Prehospital Stroke Scale and its modification, the Face Arm Speech Test (FAST), are highly sensitive and moderately specific.[4,5] Containing dichotomized items (i.e., "yes" or "no" answers) for facial, upper extremity, and speech function, they are easy to remember and performed in a minute. Designed to detect strokes of the anterior circulation, they are not sensitive to strokes of the posterior circulation.[6]

A number of stroke scales have been proposed to detect LVO: the 3-Item Stroke Scale (3I-SS),[7] the Los Angeles Motor Scale (LAMS),[8] the Cincinnati Stroke Triage Assessment Tool (C-STAT) (first introduced as the Cincinnati Prehospital Stroke Severity Scale),[9,10] the Prehospital Acute Stroke Severity Scale (PASS),[11] the Rapid Arterial oCclusion Evaluation Scale (RACE)[12] Stroke vision, aphasia, neglect assessment (VAN),[13] the Field Assessment Stroke Triage for Emergency Destination (FAST-ED),[14] the Face Arm Speech Test with Gaze Deviation (G-FAST),[15] and shortened versions of the NIHSS[16] like the National Institutions of Health Stroke Scale-8 (NIHSS-8).[17] All except the LAMS include conjugated eye deviation (CED).

A thrombus of the first segment (M1) of the middle cerebral artery is by far the most common target for EVT.[18] Regions participating in visual horizontal spatial attention are cortical Brodmann 8 and 40 and subcortical nuclei putamen and caudate. Damage to any of the regions may cause CED (usually accompanied by head turning), but the likelihood is greatest if all the regions are involved.[19] This is logically followed by an M1 thrombus, feeding all the regions, likely causing the characteristic sign, horizontal CED away from hemiparesis. It is regularly also seen in hemorrhagic stroke,[20] but predicts a greater likelihood of ischemic stroke which is 10-fold more frequent.[21] In epilepsy, CED or head turning is usually in the opposite direction, toward the symptomatic side of the body.[22]

In the recognition of stroke in general, the "Face Arm Speech Test"[5,6] is improved when combined with the "leg" and "visual symptoms."[23] We hypothesized that CED together with 1 or more symptoms of contralateral hemiparesis is sufficient to predict the M1 thrombus, thereby releasing the rest of the score items to assist in non-LVO stroke recognition.

Methods

Patients

We analyzed a retrospective cohort of 856 consecutive patients with prehospital Code Stroke in 2 Finnish hospitals within a 4.5-hour time window (Tampere University Hospital and Central Finland Central Hospital from January 1, 2014 to March 31, 2015 (study cohort, Table 1). The Code Stroke was assigned during prenotification from EMS to emergency department (ED) physician in patients considered eligible for thrombolysis treatment, having any of the symptoms used by Finnish EMSs in stroke recognition: face (1-sided facial weakness), extremity (arm or leg weakness), speech (slurring, wrong words, or unable

Table 1. *Study cohort of consecutive patients arriving to hospital with Code Stroke (n = 856), Tampere University Hospital and Central Hospital of Finland (January 1, 2014 to March 31, 2015)*

	Stroke	Stroke mimics
Age (standard deviation)	65 (16.0)	
Gender (% male)	52	
Discharge diagnosis		
Ischemic stroke	462	
Hemorrhagic stroke	108	
Seizure		38
Migraine		36
Syncope, presyncope, or hypotension		25
Intoxication		24
Dissociative disorder or simulation		22
Old deficit		18
Muskuloskeletal symptom		18
Hypoglycemia		16
Otogenic vertigo		13
Infection		13
Metabolic, other than hypoglycemia		10
Chronic subdural hematoma		9
Acute brain trauma		8
Subarachnoidal hemorrhage	7	
Peripheral neuropathy		7
Brain tumor without seizure		4
Other or unknown		18
Total	577	279