Predictive Value of Modifications of the Prehospital RACE Scale for Large Vessel Occlusion in Acute Stroke Patients

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Running title: Prehospital scales for Large Vessel Occlusion

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Abstract

Background:

Prehospital clinical scales to identify acute stroke patients with a large vessel occlusion and direct them to an endovascular-capable stroke center are needed. We evaluated whether simplification of the RACE scale, a 5-item scale previously validated in the field, could maintain its high performance to identify patients with Large Vessel Occlusion.

Methods:

Using the original prospective validation cohort of the RACE, seven simpler versions of the RACE scale were designed and retrospectively recalculated for each patient. NIHSS score and proximal Large Vessel Occlusion were evaluated in hospital. Receiver-operating-characteristic analysis was performed to test performance of the simplified versions to identify Large Vessel Occlusion in suspected stroke patients. For each version, the threshold with sensitivity closest to the original scale (85%) was used and the variation in specificity and correct classification assessed.

Results:

The study included 341 suspected stroke patients, 20% had Large Vessel Occlusion. The seven simpler versions of the RACE scale had slightly lower area-under-curve for detecting Large Vessel Occlusion due to lower specificity at the chosen sensitivity level. Correct classification rate decreased 9% if facial palsy was simplified or if eye/gaze deviation was removed and decreased 4.5% if the aphasia/agnosia cortical sign was removed.

Conclusions:

We recommend the original RACE scale for prehospital assessment of patients with suspected stroke for its ease of use and its high performance to predict the presence of a Large Vessel Occlusion. Using simplified versions would reduce its predictive value.

Introduction

Mechanical thrombectomy substantially reduces disability in patients with large vessel occlusion (LVO) ischemic stroke in the anterior circulation (1-5). However, benefit declines with increasing time after symptom onset (6).Transferring patients from a Primary Stroke Center (PSC) to a Comprehensive Stroke Center (CSC) commonly delays endovascular treatment (7). A pre-hospital clinical tool to detect LVO patients and facilitate rapid transport directly to a CSC is therefore of crucial importance.

The National Institute of Health Stroke Scale (NIHSS) can identify patients with a LVO, but the optimal cut point is controversial, and it is too complex and time-consuming to be used by pre-hospital emergency medical services (EMS). Other scales may identify these patients, but have not been validated prospectively or in the field (8-12). The RACE scale is simple and specifically designed to identify anterior circulation LVO patients (Table 1). In prospective prehospital validation by EMS, a RACE scale score ≥5 had 85% sensitivity and 68% specificity for LVO (13). The RACE scale has been externally validated as one of the most accurate clinical scales to detect LVO (14).

Scoring RACE is easy and fast (13). However, it could be argued that it is more complex than other scales. We evaluated whether simplification of the RACE scale would maintain its high performance to predict LVO.

Methods

The RACE scale, NIHSS and the presence of LVO were assessed in a prospective cohort of patients admitted to the emergency department as detailed previously (11). RACE was assessed prehospital by EMS. NIHSS was evaluated by neurologists in hospital. LVO was defined as proximal middle cerebral artery, intracranial carotid or tandem (internal carotid and middle cerebral artery) occlusion or basilar occlusion on transcranial ultrasound, CT angiography, MR angiography and/or arteriography. Seven simpler versions of the RACE scale were designed and retrospectively recalculated for each patient. These simplifications included consolidating the “mild” and “moderate to severe” categories for "facial palsy" (so that facial weakness was scored as absent or present) and omitting the items "head and gaze deviation" and/or “aphasia/agnosia" (Table 1). The capacity of these simplified versions to predict LVO was assessed using receiver-operating-characteristic analysis and compared with the original RACE scale. For each version of the scale, the score threshold with sensitivity closest to the original RACE scale (85%) was chosen and the variation in specificity and correct classification rate determined. As the primary objective of a

prehospital scale is to detect as many patients with a LVO as possible avoiding false negatives, we decided to consider a sensitivity higher than 85%.

Results

During the study period, 357 patients with suspected stroke were attended by EMS and transferred to our hospital. The RACE scale score was not detailed item-by-item in 16 cases and therefore we studied 341 patients (53.4% men; age (mean±SD) 70±13 years; NIHSS score at admission (median [interquartile range] 8 [3-16]). The final diagnosis was ischemic stroke in 233 patients (68.3%), transient ischemic attack in 16 patients (4.7%), hemorrhagic stroke in 49 patients (14.4%) and stroke mimic in 43 patients (12.6%); 71 patients (20.8%) had LVO.

The original RACE scale had an area-under-the-curve of 0.82 for detecting LVO. A cut point≥5 had 85% sensitivity, 68% specificity and correctly classified 71% patients. The RACE and NIHSS scores were strongly correlated ($r=0.78$; $p<0.001$). The seven simpler RACE versions generated slightly lower area-under-the-curve for detecting LVO (Table 2). Using the score threshold chosen to maintain sensitivity at least as high as the original scale, the specificity and correct classification rate were significantly lower for all simplified versions (Table 2 and Figure 1). Simplifying the facial palsy scoring to 0 (absent) or 1 (present) was associated with an absolute reduction in the proportion correctly classified of 9%. Removing eye/gaze deviation also reduced the proportion correctly classified by 9%. Omitting the aphasia/agnosia item, with or without omitting eye/gaze deviation had less impact on accuracy, reducing correct classification by 4.5%.

Discussion

Simplifying the original RACE scale reduces its ability to predict LVO in suspected acute stroke patients. Although some simplified versions achieved higher sensitivity, the specificity and correct classification decreased significantly, increasing the rate of false positive patients. This would lead to unnecessary transfers to an endovascular center, potentially delaying thrombolysis compared to transport to the closest hospital and reducing the efficiency of the comprehensive center through excessive workload. The closest version to the original RACE omitted aphasia/agnosia, with a 5.6% decrease in specificity when maintaining the same sensitivity. A greater decrease in specificity and correct classification was observed when omitting eye/gaze deviation or simplifying scoring of facial palsy.

Few other prehospital scales have been explored for their capacity to identify patients with LVO (Table 3). The 3-Item Stroke Scale (3I-SS) aimed to assess stroke severity and predict LVO, but was designed based on an arbitrary selection and modification of three NIHSS items (8). The Los Angeles Motor Scale (LAMS) constitutes the motor examination portion of the Los Angeles Prehospital Stroke Screen (9). This was designed to identify stroke, rather than LVO specifically, and does not include any examination for cortical signs. The Cincinnati Prehospital Stroke Severity Scale (CPSSS) was recently created to identify patients with severe AIS and LVO on the basis of a reasoned selection and modification of four NIHSS items (10). The VAN score has been recently designed to detect LVO and includes three cortical items, visual field, aphasia and neglect, added to the motor function (11). None of these scales have been designed based on systematic analysis of the NIHSS items most associated with LVO except the recently published PASS scale that includes level of consciousness, gaze palsy/deviation and arm weakness (12). However, none of these scales have been prospectively validated using prehospital EMS assessment and their real accuracy to detect LVO stroke patients has not been explored. These two factors are strengths of the RACE scale. A limitation of this study is the inability to re-calculate the LAMS, 3I-SS or CPSSS scores in our prospective cohort since not all items required were available. Simultaneous prospective validation of all the scales would be needed to compare their accuracy to detect LVO.

Using some of the simplified versions or choosing a lower cut-off point of the original RACE scale could increase the sensitivity of the RACE scale beyond the current 85%. However, it would be punished by a lower specificity which would translate into an increase in false positives (that is patients with no LVO identified as having a LVO), and therefore, unnecessary transfers to an endovascular center. Moreover, patients with LVO not identified with the RACE scale are probably those with a low NIHSS, in which benefit of EVT has not been definitively demonstrated. We recognize that including items evaluating cortical signs as aphasia/agnosia or scoring facial palsy into 3 categories adds some complexity and evaluation of each specific item may be inaccurate in the prehospital setting. However, our data suggest their importance in distinguishing LVO from other stroke subtypes.

The RACE scale has been implemented throughout the entire territory of Catalonia, with up to 65% of Stroke Code patients being scored. Over the past year, >2800 EMS professionals have completed a 4-hour online course featuring essential knowledge about acute stroke, stroke code activation and RACE scale assessment using several real-world case videos with detailed and specific instructions to evaluate each item of the RACE scale. The time elapsed between EMS alert by patients or relatives and EMS hospital arrival has not increased following RACE implementation, and confidence and satisfaction of EMS technicians using this clinical tool is high

(13). In our experience, EVT is given to 17% of patients with a RACE ≥4 in contrast to 4% of patients with RACE<4, showing a high capacity to identify patients recieving EVT (AUC 0.70).

In conclusion, using simplified versions of the RACE reduces its predictive value to predict LVO in acute stroke patients. Thus, we recommend the original RACE scale for prehospital assessment of suspected acute stroke patients for its ease of use and high performance to predict LVO.

Disclosures

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