Combination of 24-Hour and 7-Day Relative Neurological Improvement Strongly Predicts 90-Day Functional Outcome of Endovascular Stroke Therapy

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Background and Purpose: Early judgment of long-term prognosis is the key to making medical decisions in acute anterior circulation large-vessel occlusion stroke (LVOS) after endovascular treatment (EVT). We aimed to investigate the relationship between the combination of 24-hour and 7-day relative neurological improvement (RNI) and 90-day functional outcome. *Methods:* We selected the target population from a multicenter ischemic stroke registry. The National Institutes of Health Stroke Scale (NIHSS) scores at baseline, 24 hours, and 7 days were collected. RNI was calculated by the following equation: (baseline NIHSS − 24-hour/7-day NIHSS)/baseline NIHSS × 100%. A modified Rankin Scale score of 0-2 at 90 days was defined as a favorable outcome. Multivariable logistic regression analysis was used to evaluate the relationship between RNI and 90-day outcome. Receiver operator characteristic curve analysis was performed to identify the predictive power and cutoff point of RNI for functional outcome. *Findings:* A total of 568 patients were enrolled. Both 24-hour and 7-day RNI were independent predictors of 90-day outcome. The best cutoff points of 24-hour and 7-day RNI were 28% and 42%, respectively. Compared with those with 24-hour RNI of less than 28% and 7-day RNI of less than 42%, patients with 24-hour RNI of 28% or greater and 7-day RNI of 42% or greater had a 39.595-fold (95% confidence interval 22.388-70.026)

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Received November 10, 2017; revision received November 20, 2017; accepted November 28, 2017.

Supported by the National Natural Science Foundation of China (81530038 and 81671172) and Jiangsu Provincial Special Program of Medical Science (BL2013025).

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1052-3057/$ - see front matter

https://doi.org/10.1016/j.jstrokecerebrovasdis.2017.11.042

increased probability of achieving 90-day favorable outcome. *Conclusions:* The combination of 24-hour and 7-day RNI very strongly predicts 90-day functional outcome in patients with acute anterior circulation LVOS who received EVT, and it can be used as an early accurate surrogate of long-term outcome. **Key Words:** Stroke—relative neurological improvement—endovascular treatment—outcome.

Introduction

Several randomized controlled trials published in 2015 have shown that endovascular treatment (EVT) bridging with intravenous thrombolysis (IVT) significantly improves the short- and long-term outcome of patients with acute anterior circulation large-vessel occlusion stroke (LVOS).[1-5] The ameliorative short-term outcome is reflected in the early neurological improvement (NI) in around 24 hours,[1,3-5] 3 days,[2] or 5-7 days,[1] and the long-term outcome is prevailingly represented by the modified Rankin Scale (mRS) at 90 days.

In the clinical practice of stroke management, early prediction of the patient's outcome is important for both the family and the patient because it will help neurologists make proper subsequent treatment strategies and discharge planning. Early NI in 24 hours (absolute reduction of National Institutes of Health Stroke Scale [NIHSS] score from baseline to 24 hours), in many published studies, has been confirmed to be independently associated with favorable long-term outcome of acute ischemic stroke (AIS) treated with IVT or EVT,[6-9] so it can be used as an early prognostic indicator of 90-day outcome. Other studies showed that, compared with absolute reduction of NIHSS score, relative NI (RNI) in 24 hours ([baseline NIHSS score – 24-hour NIHSS score]/baseline NIHSS score × 100%) more powerfully predicted long-term outcome of stroke.[10,11]

However, it should be insufficient to evaluate the 24-hour NIHSS score change alone because some pathophysiological alterations of ischemic stroke after IVT, EVT, or both are not yet evolved enough in the first 24 hours (e.g., cerebral edema, infarct expansion, vessel reocclusion, hemorrhagic transformation, and stroke-related complications), which will generally develop relatively completely in about 7 days. Therefore, it is also important to assess NI in 7 days, and comprehensive evaluation of 24-hour and 7-day NI may more fully reflect illness evolution. To our knowledge, there has been no published study with respect to the association between 7-day NI and long-term outcome until now. We, in a multicenter cohort of patients with anterior circulation LVOS receiving EVT, hypothesized that 7-day RNI was independently associated with long-term outcome and the combination of 24-hour and 7-day RNI more strongly predicted 90-day functional outcome.

Methods

Study Population

We retrospectively analyzed the consecutive patients from the Endovascular Treatment for Acute Anterior Circulation (ACTUAL) ischemic stroke registry, which retrospectively collected data of patients with acute anterior circulation LVOS undergoing EVT from 21 stroke centers in China between January 2014 and June 2016.[12] The inclusion criteria of this study were as follows: (1) age 18 years or older; (2) diagnosis of acute LVOS; (3) causative occlusion of internal carotid artery and the M1/M2 segments of middle cerebral artery verified by computed tomography angiography, magnetic resonance angiography, or digital subtracted angiography (DSA); and (4) patient undergoing EVT. We excluded patients with length of stay (LOS) of less than 5 days and with missing NIHSS scores. In addition, because of very small numbers, patients with anterior cerebral artery occlusion were also excluded.

Data Collection and Measurements

We collected the baseline and outcome data including demographics (age and sex), stroke-related medical history (coronary heart disease, atrial fibrillation, hypertension, diabetes, current smoking, previous stroke), clinical and laboratory characteristics (baseline systolic blood pressure, premorbid mRS score, and glucose), stroke characteristics (stroke etiology, proximal occlusion site, collateral circulation grading, stroke severity, and early ischemic alteration), procedure-related characteristics (with or without prior IVT, onset to groin puncture time, groin puncture to recanalization time, and recanalization grading), symptomatic intracranial hemorrhage (sICH), stroke-associated pneumonia (SAP), NIHSS scores at 24 ± 6 hours and 7 ± 2 days, and 90-day functional outcome. Stroke etiology consisted of atherosclerosis, cardioembolism, and others on the basis of the Trial of ORG 10172 in Acute Stroke Treatment classification.[13] Collateral circulation grading was assessed by the American Society of Interventional and Therapeutic Neuroradiology/Society of Interventional Radiology (ASITN/SIR) grading on DSA, which ranges from 0 (no collateral perfusion) to 4 (rapid and complete collateral perfusion to the ischemic area).[14] In our study population, there was no patient with ASITN/SIR grade 4 who generally did not undergo the EVT.