Advances in Acute Stroke Recognition and Assessment Tools

Authors: Zuo Lin, Liu Ai, bright moon, Zhao Zitong, Zhao Lina, Zhang Ji

Date: 2024-09-13T00:00:00+00:00

Abstract

This article provides a detailed analysis of the research progress on acute stroke identification and assessment tools. It explores the current research status of clinical acute stroke identification and assessment tools, summarizes future research prospects, with the aim of promoting acute stroke research and providing references for accurate assessment of early stroke identification.

Full Text

Research Progress on Acute Stroke Recognition and Assessment Tools

Zuo Lin[1], Liu Ai[2], Ming Yue[3], Zhao Zitong[4], Zhao Lina[5], Zhang Ji[6]
(Beijing University of Chinese Medicine Third Affiliated Hospital, No. 51 Xiaoguan Street, Andingmenwai, Chaoyang District, Beijing 100029)

Abstract

This paper provides a comprehensive analysis of research progress on acute stroke recognition and assessment tools, examining the current state of clinical tool development and summarizing future prospects to advance stroke research and provide references for accurate early identification of acute stroke.

Keywords: acute stroke; recognition and assessment tools; research progress; future prospects

Acute stroke is a medical emergency caused by rupture or blockage of cerebral blood vessels, resulting in interruption of blood supply to brain tissue and subsequent ischemia and infarction. In recent years, the global incidence of stroke has continued to rise annually, accounting for over 10% of global deaths [1]. In China, the lifetime risk of stroke is 39.9%, the highest in the world [2], severely impacting patients' quality of life and survival. Stroke is typically

divided into two major categories: ischemic and hemorrhagic. Wan et al. [3] found through questionnaire surveys of 498 patients that some delayed seeking treatment because they could not recognize early stroke symptoms themselves. To rapidly and accurately identify acute stroke in clinical practice and improve public awareness of stroke symptoms, the medical community has proposed a series of assessment tools. These tools aim to assist clinical staff and the general public in preliminary stroke identification and assessment while providing guidance for further treatment. Based on this need, this article analyzes the current research status of acute stroke recognition and assessment tools, as summarized below.

1 Overview of Acute Ischemic Stroke

Acute ischemic stroke (AIS) refers to the pathological process of cerebral tissue ischemia, hypoxia, and cell death due to insufficient blood supply, accounting for 80% of all stroke types [4]. The main cause of AIS is cerebral vascular occlusion. Early clinical symptoms include severe headache, sudden facial palsy or limb weakness, language difficulties, visual impairment, and balance disorders. Peng et al. [5] found through investigation that the mortality rate within one month after onset is approximately 2.3%~3.2%, the one-year recurrence rate is 8.2%, and the one-year mortality/disability rate is 33.4%~33.8%. AIS is characterized by high incidence, high prevalence, high recurrence rate, high disability rate, and high mortality, with a trend toward younger onset, imposing a tremendous economic burden on patients, families, and society. The 2018 Guidelines for Early Management of Patients with Acute Ischemic Stroke [6] indicate that early rapid identification is the first step in initiating the acute stroke diagnosis and treatment process.

2.1 Cincinnati Prehospital Stroke Scale (CPSS)

The Cincinnati Prehospital Stroke Scale (CPSS) is a tool used by emergency medical personnel for prehospital identification of suspected stroke patients. CPSS was developed in 2015 by KATZ et al. [7] at the University of Cincinnati College of Medicine. It includes three items: gaze, consciousness disturbance, and upper limb motor function. If one of the three physical examination items is positive, the probability of stroke is approximately 72%, confirming the high sensitivity and universality of CPSS for stroke recognition. The 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care [8] recommend that all medical personnel learn and use effective, brief scales like CPSS to identify stroke. One abnormal sign indicates a 75% probability of stroke, while the simultaneous presence of all three signs indicates a stroke probability greater than 85%, demonstrating very high accuracy with a time consumption of only 30-60 seconds.

The advantages of CPSS include its simplicity and ease of learning, allowing any emergency medical personnel to quickly master and use it. Additionally, CPSS

requires no special equipment and can be used on-site. Tan [9] confirmed that CPSS also has high specificity, helping to identify patients who may be experiencing stroke. Tang [10] proposed that CPSS has limitations in distinguishing different types of stroke, so it cannot determine the specific stroke type. Furthermore, some patients may score normally despite having brainstem or cerebellar strokes. Therefore, CPSS cannot provide information about strokes in multiple brain regions.

Multiple studies have demonstrated that using CPSS on-site can help emergency personnel quickly determine whether a patient may have stroke and make rapid treatment and transport decisions. This helps shorten the treatment time window for acute stroke patients and improves the likelihood of successful treatment.

2.2 NIH Stroke Scale (NIHSS)

In the early 1970s, the National Institutes of Health (NIH) created a stroke management program. Yuan [11] confirmed that this program improved the identification and treatment of stroke emergency patients. To achieve this goal, NIH developed an assessment tool called the NIH Stroke Scale (NIHSS). Geng [12] confirmed that this scale consists of a series of tests including consciousness level, attention, language, observation, and motor function to assess stroke symptom severity and functional status. Each item has corresponding scoring criteria, with score ranges from 0 to 4 or 0 to 3.

Zheng [13] confirmed that the NIHSS is a standardized assessment tool whose results can quantitatively reflect changes in patient condition and improvements or deterioration in prognosis. It is widely used in stroke clinical research and practice to help physicians develop treatment strategies, predict prognosis, and manage patients, and is considered a reliable predictive indicator. Ma and Zhao et al. [14][15] confirmed that the accuracy of NIHSS scoring for predicting intracerebral hemorrhage prognosis is 0.799. However, scoring results may be influenced by subjective factors of the evaluator. In clinical practice, prognosis cannot be determined by detailed neurological scoring alone and must be considered comprehensively with other factors.

In terms of clinical application effectiveness research, numerous studies have confirmed that NIHSS scores are closely related to clinical outcomes and prognosis in stroke patients. Meanwhile, NIHSS scores are also an important basis for emergency treatment and transport decisions in stroke.

2.3 Los Angeles Prehospital Stroke Screen (LAPSS)

The Los Angeles Prehospital Stroke Screen (LAPSS) [16] is recommended by the American Stroke Association and European Stroke Treatment Guidelines for prehospital screening of suspected stroke. The assessment includes five historical aspects (age >45 years, blood glucose level, no seizure-like episodes, no

bedridden or wheelchair use, symptom onset <24 hours) and three examination items (facial droop, limb motor impairment, grip strength weakness). Each item is scored according to specific criteria, with a maximum score of 6 points; lower scores indicate more severe symptoms.

Xie [17] proposed that the advantages of LAPSS include its simplicity and ease of implementation, requiring no special equipment, only observation and simple motor tests. Additionally, LAPSS scores are associated with stroke type and prognosis, providing important reference information. Chen et al. [18] proposed that the reliability and accuracy of LAPSS scoring are also influenced by physician skill and experience. It serves only as a screening tool and cannot be used directly for stroke diagnosis.

Yi et al. [19] compared research data showing that LAPSS demonstrated a stroke positive rate of 94% and a medical staff satisfaction survey ratio of 96.0%. Therefore, Wei and Zhang et al. [20][21] proposed that for patients with onset within 24 hours, when stroke patient symptoms are atypical and similar to other disease symptoms, the LAPSS scale is the optimal tool for triage and prehospital stroke assessment.

2.4 Melbourne Ambulance Stroke Scale (MASS)

The Melbourne Ambulance Stroke Scale (MASS) is a tool used to assess stroke symptom severity in ambulance settings. MASS was first developed in 1995 by physicians at the University of Melbourne. MASS evaluates stroke symptom severity through patient observation and inquiry. The scoring system includes four items: facial palsy, upper limb paralysis, lower limb paralysis, and language problems. Each item is divided into three levels: “0,” “1,” and “2,” representing no symptoms, mild symptoms, and severe symptoms, respectively. The total score ranges from 0-8 points.

The advantages of MASS include: Mansour A [22] confirmed that MASS uses a visual and intuitive scoring method, enabling emergency personnel to quickly and accurately assess patient symptom severity and provide timely preliminary diagnosis and intervention. The disadvantages include: MASS can only be used to evaluate stroke patients and may not be applicable to other emergency conditions. Although MASS has advantages in early stroke identification, its relationship with specific stroke types, prognosis, and treatment effects remains unclear. At the current stage, Chen et al. [23] confirmed that MASS has been widely applied in clinical practice, and some studies have evaluated its effectiveness.

These studies indicate that MASS demonstrates good accuracy and sensitivity, helping emergency personnel quickly identify stroke patients and prompting early intervention. However, further research is needed to confirm MASS’s impact on treatment and transport of stroke patients and its comparison with other assessment tools.

2.5 Face Arm Speech Test (FAST)

The Face Arm Speech Test (FAST) is a standard commonly used for rapid assessment of stroke severity in stroke patients. Zhang et al. [24] confirmed that FAST was developed by improving upon CPSS, with content including facial droop/corner of mouth deviation, limb weakness, speech difficulty, and rapid help-seeking. The modified FAST is easy to understand and aligns with the concept of "fast." El Ammar F et al. [25] confirmed that the sensitivity of the FAST scale in screening for anterior circulation acute ischemic stroke patients is 91.7%. Hu et al. [26] confirmed that it can be used for preliminary patient screening to determine whether further imaging examinations and treatment are needed.

Hu [27] studied FAST's main advantages: it only requires simple observation and recording without complex equipment or procedures; FAST scoring can be completed in a short time to quickly determine whether a patient needs emergency diagnosis and treatment; and not only physicians but even non-medical personnel can easily master the FAST scoring method.

However, FAST is only a preliminary assessment standard and cannot replace detailed neurological examination or imaging studies. Jiang et al. [28] studied that FAST is mainly used to evaluate stroke patients, and its effectiveness in assessing other types of stroke or other neurological diseases has not been clarified. Yi et al. [19] compared research data showing that FAST had a positive rate of 85% and an average time consumption of 3.11 minutes, demonstrating short duration. The assessment content is typical and precise, enabling triage nurses to evaluate whether a patient has acute stroke in the shortest time possible, buying more treatment time for patients. At present, multiple studies have confirmed FAST's reliability and accuracy. Jing et al. [29] studied that FAST scores have good consistency and predictive value with imaging examination results. Other studies have shown that FAST scores are also effective in distinguishing stroke patients from patients with other neurological diseases.

2.6 Recognition Of Stroke In the Emergency Room (ROSIER)

ROSIER is a recognition scale designed by Nor in 2005 for use in prehospital emergency care, in-hospital triage, and emergency treatment. It is a rapid stroke recognition assessment tool recommended in the UK [30]. According to the Expert Consensus on Prehospital Stroke Emergency Care [31], this scale has a sensitivity of 80%, specificity of 79%, positive predictive value of 59%, and negative predictive value of 91%.

The scale focuses on patient blood glucose levels, history of consciousness disturbance or syncope, and history of seizure-like episodes, and evaluates five aspects (facial asymmetry, unilateral upper limb weakness, unilateral lower limb weakness, speech disorder, and visual field defects). The total score ranges from -2

to +5 points. A score >0 indicates a stroke probability of over 90%; a score $ $0 indicates a lower probability of stroke, but stroke cannot be completely excluded and requires further examination for confirmation.

Wan and Fu [32] studied that the advantages of the ROSIER scale include simplicity, ease of operation, and rapid, accurate identification of potential stroke patients. It is widely used in emergency departments to help better distinguish stroke from other diseases with similar symptoms. Purrucker J C [33] confirmed that ROSIER has high accuracy and reliability in acute stroke identification and can help physicians quickly make treatment decisions. Li et al. [34] confirmed that ROSIER assessment can significantly shorten the time for patients to receive specialized treatment and can improve clinical prognosis to some extent.

However, Ji [35] studied that the ROSIER scale can only be used for preliminary screening in emergency environments and cannot serve as the sole basis for stroke diagnosis. Second, the ROSIER scale may not be sensitive enough, potentially leading to missed or misdiagnosis. Huang [36] confirmed that ROSIER can better identify acute ischemic stroke patients in emergency environments, with sensitivity of 91% and specificity of 82%. Chen [37] confirmed that ROSIER still requires comprehensive evaluation combined with other clinical information and screening methods in clinical application.

Yi et al. [19] compared research data showing that the ROSIER scale has more comprehensive content but is somewhat cumbersome and complicated in use, with an average time consumption of 3.45 minutes, making it time-consuming. Therefore, ROSIER had the lowest satisfaction, with only 73.0% reporting very satisfied or satisfied. In practice, ROSIER is not the best choice for triage nurses.

3 Other Assessment Tools

3.1 “Stroke 1-2-0”

“Stroke 1-2-0” is a mnemonic for rapid stroke recognition developed by Chinese scholars based on the “FAST” mnemonic, adapted to Chinese sociocultural context. Common stroke warning signs are described as “1,” “2,” and “0,” where “1” means look at one face: asymmetry, corner of mouth deviation; “2” means check two arms: raise them parallel, unilateral weakness; “0” means listen to speech: slurred speech, difficulty expressing; any of these symptoms requires immediate dialing of “120” [38][39].

By popularizing the “Stroke 1-2-0” mnemonic among the public, awareness and recognition of acute stroke can be improved. The research team established a dedicated website (www.stroke120.org) and a social media WeChat public account (name: zf120, WeChat ID: chinastroke120) to provide free educational materials to the public, including a series of “Stroke 1-2-0” posters and 1-minute “Stroke 1-2-0” videos translated into 22 different dialects [40]. Huang et al. [41] pointed out that “Stroke 1-2-0” is significant in reducing prehospital delay time,

lowering stroke disability and mortality rates, and improving patient prognosis and quality of life, though current research reports on “Stroke 1-2-0” are relatively rare.

3.2 Novel Smartphone APP-FAST.AI

FAST.AI [42] is a novel smartphone application for acute stroke recognition and assessment based on advanced machine learning algorithms. FAST.AI can quickly and accurately capture stroke characteristics based on user age, gender, medical history, and other information, providing timely recognition results. It includes reminders to call emergency services, informing users to seek medical help while providing emergency measures and methods for emergency situations. FAST.AI features data tracking and reporting capabilities, recording user symptom information, medical history, and diagnostic results. This data can be used for physician diagnosis and research while helping users understand their own health status.

FAST.AI features a simple and intuitive user interface, providing multi-language support and customizable settings to meet different user needs. As a novel smartphone application, FAST.AI has the potential to become an important tool for stroke emergency education. Currently, most stroke recognition and assessment tools used clinically were developed by foreign scholars, and each scale has shortcomings. Some scales have inconsistent validation dimensions across different populations, and most scale assessments are influenced by evaluator subjective factors. Therefore, Chinese medical staff should select assessment tools with good reliability and validity that have been validated multiple times when evaluating acute stroke symptoms; for tools with average specificity, they can be used in combination with other assessment tools. Although intelligent stroke assessment tools have been developed clinically, they have not yet been introduced domestically. Therefore, future development can draw on foreign assessment tools combined with China’s medical environment, cultural characteristics, and clinical case features to translate or develop stroke recognition and assessment tools suitable for Chinese acute stroke patients.

In summary, with the development of mobile medical technology, relevant assessment tools can be applied in smartphone applications or online platforms, such as smartphone apps and telemedicine. Through this approach, people can access information about stroke symptoms and emergency care anytime and anywhere, improving public emergency response capabilities. This provides more effective treatment methods for stroke patients, improving stroke treatment outcomes and patients’ quality of life. Meanwhile, by absorbing the advantages of foreign assessment tools, accurate and reliable acute stroke recognition and assessment tools that conform to China’s national conditions and cultural background can be developed to improve the efficiency of acute stroke recognition and assessment.

[References] [1] GBD Mortality and Causes of Death Collaborators. Global, re-

gional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015[J]. Lancet, 2016, 388(10053): 1459-1544. [2] Writing Group of the "China Stroke Prevention and Treatment Report". Summary of the "China Stroke Prevention and Treatment Report 2019"[J]. Chinese Journal of Cerebrovascular Diseases, 2020, (175): 136-144. [3] Wan T, Pan J, Jiang Z. Analysis of prehospital delay factors in patients with acute ischemic stroke[J]. Trauma and Critical Care Medicine, 2020, 8(2): 69-71. [4] Powers WJ, Rabinstein AA, Ackerson T, et al. 2018 guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association[J]. Stroke, 2018, 49(3): e46-e110. [5] Peng B, Wu B. Chinese Guidelines for Diagnosis and Treatment of Acute Ischemic Stroke 2018[J]. Chinese Journal of Neurology, 2018, 51(09): 666-682. [6] Powers WJ, Rabinstein AA, Ackerson T, et al. 2018 guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American heart association/American stroke association [J]. Stroke, 2018, 49(3): e46-e110. [7] KATZ BS, MCMULLAN JT, SUCHAREW H, et al. Design and validation of a prehospital scale to predict stroke severity: cincinati prehospital stroke severity scale [J]. Stroke, 2015, 46(6): 1508-1512. [8] American Heart Association. 2010 American Heart Association Guidelines for CPR and ECC[J]. Circulation, 2010(122): S818-S828. [9] Tan R. Application study of a prehospital assessment scale combining CPSS and FAST-ED in intravenous thrombolytic therapy for acute ischemic stroke[J]. China Medical Engineering, 2021, 29(10): 20-22. [10] Tang L. Study on the effect of community health management based on interRAI assessment tools for stroke patients[D]. Kunming Medical University, 2021. [11] Yuan L, Zhang J, Wang S, et al. Predictive value of admission NIHSS combined with serum hs-CRP for prognosis of ischemic stroke[J]. Chinese Journal of Contemporary Neurology and Neurosurgery, 2022, 22(07): 615-620. [12] Geng H, Gao Y, Jiang J, et al. Overview of research on risk assessment tools and prediction models for ischemic stroke recurrence[J]. Contemporary Medicine, 2022, 28(19): 186-190. [13] Zheng Z. Reliability and validity test of interRAI-PAC assessment tool in stroke patients[D]. Kunming Medical University, 2021. [14] Ma Q, Hong G, Luo R, et al. Study on the impact of Cincinnati Stroke Scale combined with case training on prehospital stroke recognition[J]. Aerospace Medicine, 2019, 30(12): 1458-1460. [15] Zhao X, Li Q, Liu Y, et al. Correlation between NIHSS score and prognosis in patients with cerebral hemorrhage[J]. Chinese Journal of Clinicians, 2019, 47(6): 712-714. [16] Pan X, Wang L, Zhang Y, et al. Research progress on stroke assessment scales[J]. Chinese Journal of Critical Care Medicine (Electronic Edition), 2016, 9(3): 205-207. [17] Xie L. Correlation study between serum trimethylamine N-oxide and its metabolic precursors and risk of first-ever stroke in Chinese hypertensive patients[D]. Southern Medical University, 2019. [18] Chen J, He W, Li J, et al. Comparative study on the application value of modified Los Angeles Prehospital Stroke Screen and Cincinnati Prehospital Stroke Scale in prehospital emergency care[J]. China Medicine and Pharmacy, 2018, 8(21): 139-142. [19] Yi Y, Chen J, Chen Q, Xie H. Discussion on the appli-

cation value of four assessment scales in early identification of stroke patients[J]. General Nursing, 2020, 18(28): 3779-3781. [20] Wei Y, Zhang W, Wang X, et al. Clinical characteristics and related risk factors of first symptomatic acute stroke in patients with silent cerebral infarction[J]. Journal of Brain and Neurological Diseases, 2016, 24(11): 681-684. [21] Zhang Y, Han Y, Dong W, et al. Common stroke mimics and their differentiation from emergency stroke[J]. Journal of Clinical Neurology, 2018, 31(6): 472-473. [22] Mansour A, Rais K, Ulvi B. The secretome of endothelial progenitor cells: a potential therapeutic strategy for ischemic stroke[J]. Neural Regeneration Research, 2021, 16(8). [23] Chen Y, Zhou H, Peng H, et al. Application study of Los Angeles Prehospital Stroke Screen in prehospital stroke[J]. Journal of Brain and Neurological Diseases, 2012, 20(04): 258-260. [24] Zhang H. Tea after stroke–Ford's "rapid diagnosis-FAST" changed the stroke world[J]. Chinese Journal of Stroke, 2018, 13(6): 606-611. [25] El Ammar F, Ardelt A, Del Brutto VJ, et al. BE-FAST: a sensitive screening tool to identify In-hospital acute ischemic stroke[J]. J Stroke Cerebrovasc Dis, 2020, 29(7): 104821. [26] Hu M. Value of heart rate variability indices from dynamic electrocardiogram in evaluating cardiac autonomic function and prognosis in patients with acute stroke[J]. Medical Theory and Practice, 2019, 32(11): 1746-1747. [27] Hu P. Construction and evaluation of a short-term prognosis prediction scoring system for acute stroke based on MEWS[D]. Guangxi Medical University, 2019. [28] Jiang L, Zhang X, Ji Y, et al. Effectiveness analysis of Cincinnati Prehospital Stroke Scale in acute stroke triage[J]. China Continuing Medical Education, 2018, 10(21): 150-152. [29] Jing S, Liu C, Ren Q, et al. Evaluation value of ASPECTS score in mechanical thrombectomy for acute stroke with unknown onset time[J]. Journal of Clinical Radiology, 2022, 41(02): 246-250. [30] Yu M, Liu P, Ma L, et al. Study on the application value of ROSIER and CPSS scales in acute stroke emergency evaluation[J]. Chinese and Foreign Women's Health Research, 2018(07): 58-59. [31] Emergency Medicine Branch of Chinese Stroke Association. Expert consensus on prehospital stroke emergency care[J]. Chinese Journal of Emergency Medicine, 2017, 26(10): 1107-1114. [32] Wan D, Fu X. Research progress on rapid identification of stroke mimics[J]. Northwest National Defense Medicine, 2017, 38(10): 698-700. [33] Purrucker JC, Hametner C, Engelbrecht A, et al. Comparison of stroke recognition and stroke severity scores for stroke detection in a single cohort[J]. Journal of Neurology Neurosurgery & Psychiatry, 2015, 86(9): 1021. [34] Li T, He W, Xu L. Application value of emergency stroke identification scoring scale in prehospital identification and transport of patients with acute ischemic stroke[J]. Bethune Medical Journal, 2020, 18(4): 320-323. [35] Ji H. Application study of two screening scales in early identification of acute stroke patients during emergency triage[J]. World Latest Medicine Information, 2017, 17(62): 50. [36] Huang J. Research progress on prehospital emergency identification tools for acute stroke[J]. China Contemporary Medicine, 2016, 23(19): 16-18-22. [37] Chen D, Wu J, Han X, et al. Application of vascular ultrasound combined with serum CatS/CysC levels in evaluating thrombolytic efficacy in patients with acute stroke[J]. Journal of Hunan Normal University (Medical Edition), 2022, 19(05): 80-84. [38] ZHAO J, LIU R. Stroke 1-2-0: a rapid response programme

for stroke in China [J]. Lancet Neurol, 2017, 16(1): 27-28. [39] Feng Z. “Stroke 120” creates a “time window” for ischemic stroke patients[J]. Family Medicine, 2018, 31(1): 20-21. DOI:10.3969/j.issn.1001-0203.2018.01.018. [40] ZHAO J, LI X, LIU X, et al. Changing the strategy and culture of stroke awareness education in China: implementing Stroke 1-2-0[J]. Stroke Vasc Neurol, 2020, 5(4): 374-380. [41] Huang J, Zhan J, Wang Z, Qin F, Tan Y. Qualitative study on community residents’ cognition of “Stroke 120”[J]. Chinese General Practice, 2021, 24(27): 3501-3505. [42] Radoslav I Raychev et al, WMP120-Development Of Smartphone Enabled Machine Learning Algorithms For Autonomous Stroke Detection. ISC 2023.

Note: Figure translations are in progress. See original paper for figures.