

Algorithms and Scales for The Prehospital Diagnosis of Acute Cerebrovascular Accident

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Abstract

The article presents an analysis of current approaches to the prehospital diagnosis of acute cerebrovascular accident. The main algorithms and clinical scales used for the early recognition of stroke are reviewed, including FAST, CPSS and NIHSS, as well as specialized scales for detecting large vessel occlusion (LAMS, RACE, FAST-ED). Issues of diagnostic accuracy, the limitations of the prehospital stage and the role of telemedicine technologies are discussed. It is shown that the use of standardized algorithms and scales makes it possible to increase diagnostic accuracy, reduce the rate of diagnostic errors and optimize patient routing. It is concluded that an algorithm-based approach plays a key role in improving the effectiveness of medical care for patients with stroke.

Keywords: Acute cerebrovascular accident, stroke, prehospital diagnosis, algorithms, FAST, NIHSS, CPSS, routing, stroke scales, thrombectomy.

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1. Introduction

Acute cerebrovascular accident (ACVA) remains one of the leading causes of mortality, disability and long-term loss of working capacity worldwide. Despite significant progress in the diagnosis and treatment of cerebrovascular diseases, stroke continues to rank among the leading causes of death and is one of the main causes of persistent neurological disability in adult patients. Current data indicate that the effectiveness of stroke treatment is determined not only by the capabilities of the specialized hospital but also by the quality of organization of the prehospital stage of medical care.

The “Time is Brain” concept is now generally accepted; according to it, every minute of delay during a stroke is accompanied by the irreversible death of neurons and a worsening of the functional prognosis. For this reason, early recognition of stroke symptoms, timely activation of the emergency medical service and rapid transport of the patient to a specialized stroke center become critically important.

Prehospital diagnosis plays a special role in modern stroke care. It is at this stage that the initial assessment of the patient's condition, identification of stroke signs, determination of the severity of neurological deficit and the routing decision take place. Recent studies show that

the use of standardized diagnostic algorithms can significantly increase the accuracy of stroke recognition and shorten the time to the start of specialized treatment.

To improve the effectiveness of prehospital diagnosis, a number of clinical scales have been developed, the most widely used of which are FAST (Face–Arm–Speech–Time), the Cincinnati Prehospital Stroke Scale (CPSS), the NIHSS (National Institutes of Health Stroke Scale), and modern scales for detecting large vessel occlusion — LAMS, RACE and FAST-ED. Their use makes it possible to objectify the patient's neurological status, increase diagnostic accuracy and optimize the choice of treatment strategy.

With the development of endovascular treatment methods, the problem of correct patient routing has become particularly relevant. Modern stroke systems of care involve a differentiated approach to patient transport depending on stroke severity and the likelihood of large cerebral vessel occlusion. The use of specialized triage algorithms makes it possible to direct patients straight to centers capable of performing mechanical thrombectomy, which helps improve clinical outcomes.

In recent years, innovative areas of prehospital care have been developing actively, including telemedicine technologies, mobile stroke units, digital clinical decision support systems and artificial intelligence technologies. Their implementation helps improve the quality of diagnosis, strengthen coordination between the prehospital and hospital stages and reduce time delays.

Despite the progress achieved, many regions continue to face problems of late presentation by patients, diagnostic errors, insufficient training of medical personnel and routing failures, which limit the possibilities for applying modern stroke treatment methods. Therefore, improving algorithms for the prehospital diagnosis and routing of patients with ACVA remains one of the most pressing tasks of modern stroke medicine.

The aim of this review is to analyze current approaches to the prehospital diagnosis and routing of patients with acute cerebrovascular accident and to identify promising directions for improving stroke care at the prehospital stage.

Review. Timely and accurate diagnosis of acute cerebrovascular accident at the prehospital stage is one of the key factors determining the effectiveness of subsequent treatment and the prognosis. As noted by Kamchatnov P.R. (2020), early diagnosis of stroke can

substantially shorten the time to the start of specialized therapy (3).

In recent years, standardized diagnostic algorithms aimed at the rapid detection of stroke signs by emergency medical personnel have become particularly important. According to the clinical guidelines (2024), the use of unified diagnostic approaches makes it possible to increase the accuracy of ACVA recognition and reduce the rate of diagnostic errors (5).

Scales for assessing neurological deficit are among the most widely used tools for prehospital diagnosis. Shamalov N.A. and Kulesh A.A. (2021) emphasize that the use of scales makes it possible to objectify the patient's neurological status and standardize clinical decision-making (6). Yusupov E.U. (2021) notes that the introduction of stroke assessment scales significantly improves the quality of diagnosis at early stages (7).

The most widely used scales include FAST (Face–Arm–Speech–Time), the Cincinnati Prehospital Stroke Scale (CPSS), and more complex scales aimed at detecting large vessel occlusion. Harbison J. et al. demonstrated the high sensitivity of the FAST scale in the prehospital setting (8). Kothari R.U. et al. confirmed the reliability of the CPSS for the initial diagnosis of stroke (9).

Clinical scales for the early recognition of stroke

Several scales have now been developed for use at the prehospital stage. The most widely used are FAST, BE-FAST, CPSS and NIHSS.

The FAST scale (Face–Arm–Speech–Time). The FAST scale is the most common tool for initial stroke screening and is used both by healthcare workers and by the general public. It includes an assessment of facial asymmetry, arm weakness and speech disturbance. Studies show that the FAST scale can detect stroke with a sensitivity of up to 79–85%, making it a convenient tool for rapid decision-making at the prehospital stage (8,9).

The BE-FAST scale. The modified version of the FAST scale, BE-FAST, additionally includes an assessment of balance (Balance) and vision (Eyes) disturbances. This increases diagnostic sensitivity, especially in posterior circulation strokes. Recent studies show that BE-FAST outperforms FAST in diagnostic accuracy and reduces the likelihood of a missed stroke (8,9).

Cincinnati Prehospital Stroke Scale (CPSS). The CPSS is one of the first scales introduced into emergency

medical service practice. It includes three main components similar to those of FAST and is widely used in emergency medicine. The use of the CPSS makes it possible to increase the accuracy of prehospital stroke diagnosis and improve coordination between emergency services (8,9).

In recent years, specialized scales have been developed to detect severe forms of stroke and large vessel occlusion, such as LAMS, RACE and FAST-ED. Katz B.S. et al. showed the effectiveness of the LAMS scale in predicting stroke severity (10). Perez de la Ossa N. et al. developed the RACE scale, which makes it possible to detect large vessel occlusion with high accuracy (11). Lima F.O. et al. proposed the FAST-ED scale, which is aimed at optimizing patient routing (12).

An important aspect is the comparison of different scales and the selection of the optimal tool for specific settings. Brandler E.S. et al. note that the use of several scales increases diagnostic accuracy but requires additional staff training (13). In a systematic review, Zhelev Z. et al. showed that none of the scales has absolute accuracy, which calls for a comprehensive approach to diagnosis (14).

Methods for remote assessment of the patient's condition play an additional role in diagnosis. Audebert H.J. and Saver J.L. emphasize that telemedicine technologies can improve stroke diagnosis in resource-limited settings (1). Noorian A.R. et al. showed the effectiveness of telemedicine in improving the accuracy of prehospital diagnosis (15).

It should be noted that diagnostic accuracy depends not only on the scales used but also on the qualifications of medical personnel. Nor A.M. et al. demonstrated high agreement in the assessment of neurological status between physicians and paramedics using standardized scales (16). Oostema J.A. et al. identified factors affecting the accuracy of prehospital stroke recognition (17).

Particular attention is paid to the differential diagnosis between stroke and so-called "stroke mimics". Hand P.J. et al. note that a considerable proportion of patients with suspected stroke have other conditions, which requires careful clinical assessment (18). Rajajee V. et al. emphasize the importance of early detection of lacunar infarcts (19).

In the current setting, stroke diagnosis is closely linked to the subsequent routing of the patient. Scheitz J.F. et al.

note that the use of stroke severity scales makes it possible to direct patients to specialized centers (20). Zhao H. et al. showed that the use of scales for detecting large vessel occlusion helps increase the number of patients referred for thrombectomy (21).

Thus, analysis of the literature indicates that the use of standardized algorithms and scales for the prehospital diagnosis of ACVA is an essential component of the modern system of care. Their use makes it possible to increase diagnostic accuracy, optimize patient routing and shorten the time to the start of specialized treatment.

2. Conclusions

- The prehospital stage of medical care plays a key role in the management of patients with acute cerebrovascular accident, determining the timeliness of the start of specialized treatment and the clinical outcomes of the disease.
- The use of standardized clinical scales (FAST, CPSS, NIHSS, etc.) is an effective tool for the early recognition of stroke and makes it possible to increase diagnostic accuracy at the prehospital stage.
- The use of specialized scales for detecting large vessel occlusion (LAMS, RACE, FAST-ED) contributes to more accurate patient stratification and optimized routing to specialized stroke centers.
- The implementation of algorithm-based approaches to prehospital diagnosis makes it possible to unify the actions of medical personnel, reduce the rate of diagnostic errors and shorten the time to the start of treatment.
- Rational routing of patients with stroke, based on the principles of stroke systems of care, improves access to reperfusion therapy and leads to better clinical outcomes.
- Despite the progress achieved, significant problems remain at the prehospital stage, including late presentation by patients, diagnostic errors and organizational and logistical constraints, all of which require further improvement.
- Promising directions for the development of prehospital care include the introduction of telemedicine technologies and digital decision support algorithms, as well as the integration of the prehospital and hospital stages of medical care.

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