

STUDY OF THE PATHOGENESIS OF ISCHEMIC AND HEMORRHAGIC STROKE AND IMPROVEMENT OF TREATMENT STRATEGIES: SPECIFIC FEATURES OF STROKE DEVELOPMENT IN YOUNG AND ELDERLY PATIENTS

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Abstract:

This scientific article analyzes the pathogenesis, developmental mechanisms, and specific clinical features of ischemic and hemorrhagic strokes in young and elderly patients. The study highlights, based on scientific literature, the main etiological factors leading to acute cerebrovascular disorders, including the roles of arterial hypertension, atherosclerosis, cardiovascular diseases, and metabolic disorders. Furthermore, the clinical manifestations, diagnostic approaches, treatment principles, and rehabilitation issues of stroke are discussed.

Keywords: Ischemic and hemorrhagic stroke, pathogenesis, arterial hypertension, diabetes mellitus, atherosclerosis, cardiogenic factors, rehabilitation.

Introduction

Stroke is defined as an acute disturbance of cerebral blood circulation. Ischemic, hemorrhagic, and mixed types of stroke are distinguished. Ischemic stroke is a clinical syndrome that develops as a result of a sharp reduction or complete cessation of blood circulation in a specific area of the brain, with the resulting neurological deficits persisting for more than 24 hours. It occurs predominantly in elderly individuals, especially after the age of 45–50 years. The main causes of this disease are associated with the narrowing of cerebral blood vessels, namely cerebral angiospasm. Various hemodynamic changes and psychological stress can lead to constriction of cerebral vessels, resulting in reduced blood flow through them. Consequently, softening and ischemic damage of brain tissue develop. Another important mechanism is thrombus formation within blood vessels. Due to the slowing of cerebral blood circulation, the formed elements of blood begin to deposit on the vascular wall, eventually leading to thrombus formation. Biochemical alterations in the blood, particularly disorders of blood coagulation, also contribute to thrombogenesis. In addition, atherosclerosis of extracranial and intracranial blood vessels, cardiogenic factors (myocardial infarction, valvular heart insufficiency, and atrial fibrillation), diabetes mellitus, and vasculitis are significant risk factors contributing to the development of ischemic stroke. In nearly 70% of cases, the middle cerebral artery is affected, whereas the anterior and posterior cerebral arteries are involved less frequently. Arterial hypertension, characterized by increased pressure within the arteries, is considered one of the leading etiological

factors in the development of ischemic stroke. There is a direct relationship between the level of arterial blood pressure and the risk of stroke development.

The prevalence of arterial hypertension increases with age. According to data from the Framingham Research Center, arterial hypertension is detected in 45% of individuals aged 50 years, 60% of those aged 60 years, and 70% of individuals aged 70 years in developed countries. Individuals with arterial blood pressure exceeding 139/89 mmHg belong to the high-risk group and should remain under continuous medical supervision. Atherosclerosis also becomes more common with advancing age; therefore, the incidence of stroke correspondingly increases. However, the age at which atherosclerosis begins to develop largely depends on an individual's lifestyle. Many people believe that atherosclerosis occurs only in individuals with high blood pressure. Although hypertension accelerates the progression of atherosclerosis, the disease may also develop in individuals with normal or low blood pressure. This is because atherosclerosis is also associated with excessive consumption of fatty foods, inadequate intake of fruits and vegetables, physical inactivity, and chronic psycho-emotional stress. From a medical perspective, atherosclerosis is a pathological process characterized by the accumulation of lipids within the inner arterial wall, accompanied by the formation of fibrous tissue and atherosclerotic plaques, ultimately leading to arterial stenosis and deformation. Atherosclerosis is most commonly observed in the aorta, carotid arteries (particularly at the bifurcation), intracerebral arteries, and coronary arteries. Similar to arterial hypertension, atherosclerosis is one of the major etiological factors of ischemic stroke. Hyperlipidemia, physical inactivity, smoking, arterial hypertension, and diabetes mellitus are considered the principal risk factors contributing to the development of atherosclerosis. Atherosclerosis is also a sex-related disease and occurs more frequently in men.

Cardiac diseases, including valvular insufficiency, atrial fibrillation, endocarditis, and recent myocardial infarction, are regarded as the primary causes of cardioembolic stroke. Cardioembolic strokes account for approximately 15–30% of all ischemic strokes. Their high prevalence is associated with the widespread occurrence of cardiovascular diseases. In addition, artificial heart valves are also considered important etiological factors. These diseases and pathological conditions contribute to the formation of small thrombi on the heart valves. These thrombi may subsequently travel through the bloodstream to the cerebral vessels, causing vascular occlusion. Atrial fibrillation, in particular, significantly accelerates thromboembolism. Diabetes mellitus increases the risk of ischemic stroke by approximately 2–4 times. Diabetes mellitus also plays a significant role in the development of atherosclerosis. Cerebral microangiopathy associated with diabetes mellitus leads to chronic insufficiency of cerebral blood circulation. Furthermore, atherosclerosis of the extra- and intracerebral arteries, together with cerebral microangiopathy observed in diabetic patients, disrupts collateral cerebral circulation. The dysmetabolic processes characteristic of diabetes mellitus are also reflected in brain tissues. Frequent episodes of hypo- and hyperglycemia contribute to the development of both acute and chronic cerebral

ischemia. Therefore, patients with diabetes mellitus have a significantly increased risk of developing ischemic stroke, as well as a higher risk of disability and mortality following stroke. There are also less common factors involved in the development of ischemic stroke. These include cranio-cerebral injuries, fibromuscular dysplasia, Moyamoya syndrome, migraine, infections, drug abuse, metabolic syndrome, surgical interventions, intoxications, tumors, and genetic factors.

Smoking is another harmful factor that almost doubles the risk of stroke development. This has been scientifically proven. Why is smoking harmful? Because it adversely affects the blood vessels supplying the brain and, consequently, specific brain structures associated with emotional regulation and mood. Smoking enhances blood coagulation, accelerates thrombus formation, and damages the inner vascular wall. As a result, the blood vessels become narrowed, and cerebral blood flow progressively decreases. Several signs and symptoms may appear weeks or months before the development of ischemic stroke. These include dizziness, transient loss of consciousness, temporary visual darkening, general weakness, transient paresthesia, and paresis of the extremities. The disease usually develops gradually and often occurs during the night or in the early morning hours. Upon awakening, patients may notice paralysis affecting one side of the body or speech disturbances. In many cases, patients do not lose consciousness or experience only a brief loss of consciousness. The manifestation of clinical symptoms depends on the artery affected by thrombosis. In thrombosis of the internal carotid artery, the stroke usually has a severe course, characterized by profound paralysis, sensory disturbances, and speech impairment. States of stupor and coma may also occur. Damage to the posterior cerebral artery primarily results in visual disturbances, while paralysis is usually absent. Stroke occurring in the vertebrobasilar territory is characterized by dizziness, nausea, vomiting, nystagmus, and ataxia. Patients may also develop bulbar syndrome, manifested by impaired swallowing and speech, as well as decreased voice intensity.

Immediately after the onset of stroke, the patient should be urgently transported to a hospital, and medical and psychological care should be initiated as early as possible. Qualified medical assistance provided within the first 3–6 hours after stroke onset plays a crucial role in achieving complete recovery, preventing the progression of paralysis, and preserving the patient's life. Recently, numerous reports have indicated that stroke is becoming increasingly prevalent among younger individuals. Currently, stroke is also being observed in people aged 30–40 years. It is particularly concerning that approximately 20% of all stroke cases occur in individuals younger than 50 years of age. In this population, the most severe type of stroke, namely intracerebral hemorrhage, is encountered more frequently. The second major type of stroke is hemorrhagic stroke. Hemorrhagic stroke, in other words, refers to bleeding into the brain. The principal etiological factors include arterial hypertension, cerebral atherosclerosis, the coexistence of these conditions, cerebral aneurysms, and traumatic brain injuries. There are two main mechanisms responsible for intracerebral hemorrhage. The first is rupture

of blood vessels, while the second is increased vascular permeability. In the latter case, the blood vessels do not rupture.

The following types of hemorrhagic stroke are distinguished:

1. Subarachnoid hemorrhage – bleeding into the subarachnoid space;
2. Parenchymal hemorrhage – bleeding into the brain tissue;
3. Intraventricular hemorrhage – bleeding into the cerebral ventricles.

In addition, mixed forms such as subarachnoid-parenchymal, parenchymal-subarachnoid, and parenchymal-ventricular hemorrhages are also recognized. Parenchymal hemorrhages are further classified according to the specific region of the brain in which the hemorrhage occurs. Among young individuals, the major etiological factors contributing to hemorrhagic stroke include congenital vascular abnormalities, particularly arteriovenous malformations, cavernous angiomas, and hereditary vasculopathies associated with genetic predisposition. Furthermore, early-onset arterial hypertension, traumatic injuries, hematological disorders, and the use of illicit psychoactive substances are considered important risk factors. In elderly individuals, the principal causes of hemorrhagic stroke include microangiopathy developing on the background of long-standing arterial hypertension, degenerative changes of cerebral blood vessels, and cerebral amyloid angiopathy. In this age group, vascular wall elasticity decreases, endothelial dysfunction develops, and hemodynamic instability increases. Consequently, even minor fluctuations in blood pressure may result in vascular rupture. Moreover, prolonged use of anticoagulant and antiplatelet medications significantly increases the risk of hemorrhagic complications.

The clinical presentation of hemorrhagic stroke has distinctive characteristics. The disease usually develops acutely during daytime activities or work. In most cases, it begins suddenly without any prodromal or warning symptoms, and the patient rapidly loses consciousness. Several minutes or hours before the onset of hemorrhagic stroke, patients may experience a severe headache. An unconscious patient does not respond to external stimuli, does not perceive pain, and remains with closed eyes. These manifestations indicate the development of com. In hemorrhagic stroke, stupor and coma develop rapidly; however, in subarachnoid hemorrhage, loss of consciousness is usually brief. Respiratory and cardiovascular functions are also impaired. Patients exhibit deep and noisy breathing, and frothy secretions may emerge from the mouth. Repeated vomiting is frequently observed. The pulse is typically strong, and tachycardia develops. Arterial blood pressure is markedly elevated and, in most cases, exceeds 200/100 mmHg. Body temperature may rise above 40°C. In unconscious patients, the face often appears cyanotic-reddish, edematous, and the neck veins become distended. The patient's head is usually turned to one side and slightly extended backward. The eyes may be closed or partially open in a semilunar shape. When the upper eyelids are passively elevated, conjunctival hyperemia and pendular movements of the eyeballs can be observed. This phenomenon is referred to as the “floating eyes” sign. The pendular movement of the eyes is associated with irritation of the posterior longitudinal fasciculus located within the brainstem. When the passively elevated upper eyelid is

released, the eye on the side of hemiplegia closes more slowly. Hemostatic therapy constitutes an important component of hemorrhagic stroke management and is aimed at normalizing the coagulation system. In patients receiving anticoagulant or antiplatelet therapy, reversal of their pharmacological effects is necessary. Administration of coagulation factors, fresh frozen plasma, or platelet concentrates may be indicated. The rehabilitation phase is an integral part of hemorrhagic stroke treatment and is directed toward restoring the patient's functional status. Early rehabilitation, including physiotherapy, speech therapy, and neuropsychological support, plays a crucial role in reducing neurological deficits and improving functional outcomes.

Conclusion

The conducted analysis demonstrates that although ischemic and hemorrhagic strokes differ in their etiology and pathogenesis, they share several common risk factors, including arterial hypertension, atherosclerosis, cardiovascular diseases, and metabolic disorders, all of which play a leading role in their development. In ischemic stroke, hypoxia and necrotic changes in brain tissues develop as a result of narrowing or occlusion of the vascular lumen. In contrast, the principal pathogenetic mechanism of hemorrhagic stroke is the rupture of the vascular wall, leading to intracerebral bleeding and increased intracranial pressure. Preventive measures, early diagnosis, and comprehensive treatment strategies based on an individualized approach serve as crucial factors in reducing the consequences of stroke and improving patients' quality of life.

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