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REHABILITATION OF PATIENTS WITH POST-STROKE SYNDROMES

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Annotation: Motor disorders are a common cause of disability after a stroke. Effective physical rehabilitation of stroke patients depends on the state of cognitive functions. The article discusses the main pathogenetic mechanisms of the development of motor and cognitive disorders after a stroke, as well as ways to correct them. The rationale for the use of drugs with a multimodal mechanism of action to increase brain plasticity and rehabilitation potential is given.

Keywords:stroke, motor disorders, cognitive impairment, neuronal plasticity, complex neurorehabilitation.

Stroke is one of the main causes of disability of the adult population in the world [4]. Common outcomes of stroke are motor and cognitive disorders that disrupt daily functioning and worsen the quality of life. About 25% of stroke patients have motor disorders, which lead to the inability to move and self-care and cause the need for physical assistance from others. However, cognitive impairments also affect independence, and they can be equal or even superior to a negative effect.
the influence that is caused by motor limitations [5, 6].
To date, the great importance of neurorehabilitation in reducing motor and cognitive impairments, the burden of disease and improving
the quality of life of stroke patients has been recognized [1]. However, the role of cognitive functions in motor recovery and general functioning after stroke it was determined relatively recently. Of course, the main cause of social and professional
maladjustment after a stroke is paralysis, therefore A huge amount of effort has been devoted to studying the mechanisms of movement restoration and to developing scientifically based rehabilitation methods. Nevertheless, this did not lead to fundamental changes in the paradigm of rehabilitation after stroke. Only an understanding of the modulating and coordinating role of higher mental functions in functional recovery allowed us to reconsider approaches to rehabilitation. A number of studies have convincingly shown that strength in a limb does not always correlate with functional capabilities. For example, walking is cramped It is associated not only with strength in the lower extremities, but also with the feeling of the body in space, postural stability. A common clinical manifestation of stroke is such a complex neuropsychiatric phenomenon as spatial neglect, or neglect, manifested in the inability to respond to stimuli presented from the opposite side to the affected hemisphere. It is spatial orientation combined with the strength, agility and endurance of the motor system that ensures the accuracy and correction of movements depending on changing conditions, environmental conditions. Therefore, spatial neglect and the accompanying visual and auditory attention disorders delay the recovery of motor functions after a stroke, despite adequately conducted physical therapy, and are a common cause of falls. Another example of the participation of higher mental functions in the formation of motor acts is the phenomenon of "non-use", or "non-use", first studied by Edward Taub in the 80s on primates . Violation of afferent connections as a result of damage to brain structures it leads to suppression of motor activity in the limb, and repeated attempts to move a deafferentiated limb are associated with various kinds of failures: pain, discoordination, falls and, as a result, the consolidation of negative emotional reactions associated with its use. As a result, attempts to move the affected limbs stop, the cortical representation of the limb decreases, compensatory
adaptive reactions of healthy limbs are developed, which It forms a vicious circle called the "nonuse" phenomenon, when movements in the affected limb are potentially possible, but they are not carried

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out. Understanding the pathogenetic mechanisms of this process formed the basis of Constraint-Induced Movement Therapy (CIMT), which is widely used in modern rehabilitation programs to overcome the phenomenon of "non-use".

Thus, optimal neurorehabilitation therapy should be considered in the context of complete a motor circuit that includes not only sensorimotor signals, but also interaction with cognitive operations such as movement planning, attention and motivation, which are mediators of motor learning [3]. In this regard, the preservation of cognitive functions after a stroke is essential for the restoration of movement and functioning of the patient as a whole. Cognitive functions determine the rehabilitation potential at all stages of rehabilitation. However, the 40-70% of stroke patients develop cognitive impairment is more common in the early recovery period of stroke, and often reaches a severe degree – dementia. What is

the cause of cognitive impairment after a stroke? There is no definite answer to this question, because there is a combination of different events: underlying primary neurodegeneration, vascular process and genetic factors leading to the development of cognitive impairment. Such cerebral comorbidity is more typical for the elderly population, and stroke in this pathogenetic chain appears only in the role of the catalyst. Post-stroke should be considered any cognitive impairment that has a temporary connection with stroke, i.e. it is detected during the first 3 months after the stroke or at a later date, but usually no later than a year after the stroke.

About 25% of stroke patients have motor disorders, which lead to the inability to move and self-care and cause the need for physical assistance from others.

The data available to date from clinical studies suggest that with properly selected timely treatment, the human brain is able to significantly restore their functions after a stroke [2], and at this stage sufficient clinical experience has been accumulated in practical the use of various medicinal and non-medicinal methods of regulating the process of neuronal repair. What is the basis for the effectiveness of these techniques? Up until the 60s, researchers believed that brain updates occurred only in infancy and childhood, and by the beginning of adulthood, it was believed that the physical structure of the brain was mostly constant.

Modern research has shown that the brain continues to create new neural pathways and modify existing ones in order to adapt to new conditions, learn and remember new information. The key to successful neurorehabilitation is two aspects: the state of neuroplasticity – the ability of the brain to recover from damage, and the ability of an individual to change behavioral reactions depending on changes in the external environment. The state of neuroplasticity depends on a number of factors: age, the cause of damage and the initial status, including the influence of the environment and genetic predisposition. Despite the methodological difficulties of studying neurogenesis It is known that natural neurogenesis fades with age, but unlike the low rate of neurogenesis in the olfactory bulb, the hippocampus of an adult synthesizes new neurons throughout life at the same rate with a slight decrease in old age. This fact gives hope that adult neurogenesis can be stimulated by enriching the external environment, training and treatment with drugs that improve neuronal plasticity, which creates the basis and determines the need for multimodal post-stroke neurorehabilitation using all mechanisms and pathways with the integrated application of technologies aimed at stimulating neuroplasticity. Neuroplasticity is associated not only with neurogenesis – sprouting, synapto- and angiogenesis. Functional mechanisms are also included in this process with the reorganization of the damaged functional center, the restructuring of the relationship between different stages of one system, the change in the structure and function of other systems involving the reserve capabilities of various functional brain systems.

It is known that all proven rehabilitation technologies included in the standards post-stroke rehabilitation treatment, aimed at afferent (measures of activating care,

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neurodynamic methods of treatment and physical rehabilitation with various methods of kinesiotherapy, verticalization, mechanotherapy, mirror therapy, CIMT, biofeedback technologies, botulinum therapy) or efferent (transcerebral magnetic stimulation) stimulation of brain plasticity. Therefore, the effectiveness of treatment is not achieved fragmented individual intervention by specialists of the multidisciplinary association of the stroke center, and a coordinated combination of therapeutic measures individually selected for each patient and corresponding to this stage of rehabilitation of a stroke patient. At the same time, clinical studies have shown that repeated repetitive task-oriented training causes cortical functional restructuring, increases cortical representation with further functional recovery, reflecting the inclusion of plasticity mechanisms, and they also reduce the risk of developing symptoms of depression, another negative factor in the post–stroke period that reduces motivation for rehabilitation and, accordingly, rehabilitation potential and is a risk factor for recurrent vascular events .

Methods of physical therapy within the framework of multimodal physical and rehabilitation medicine aimed at the effects of neuroplasticity used in the post-stroke period, taking into account the neurological status of the patient.

At the same time, it is necessary to understand that the key to the success of rehabilitation measures can only be the correct effect on the sanogenetic mechanisms that have been unfolding since the first days of stroke, which determines the need for the earliest possible connection of neurorehabilitation technologies. The essence of sanogenetic mechanisms is the focus on adaptation to the environment at a qualitatively new level in connection with the pathological process in the body.

A common clinical manifestation of stroke is such a complex neuropsychiatric phenomenon as spatial neglect, or neglect, manifested in the inability to respond to stimuli presented from the opposite side to the affected hemisphere

These are mechanisms of restitution – the process of restoring the activity of reversibly damaged structures, regeneration of structural and functional restoration of tissue integrity as a result of their damage or partial loss and compensation of the process combining various complex and diverse reactions for functional replacement or compensation for lost or insufficient functions. It has been shown that the success of neurorehabilitation is associated with early onset, immediately after the development of stroke, with a high level of evidence that the combination of intensive stroke therapy and early rehabilitation are associated with better outcomes.

During early neurorehabilitation, it is important to understand that there are two types of brain plasticity: the structural ability of the brain to actually change its structure as a result of learning, and functional plasticity – the ability of the brain to move functions from a damaged area to other intact areas. It is known that brain functions are localized and integrative at the same time. If the brain function were more scattered, it would suffer less from various injuries. For example, the speech zones in the brain are quite clearly marked, and yet the function of speech is much more scattered throughout the cortex than was thought by classical neurologists. Nevertheless, there are limits to the dispersion of functions, especially in sensory systems. Therefore, the degree of localization of functionally significant areas of the brain limits the possible degree of functional plasticity, but the multiple cortical
representation of individual functions contributes to the reorganization of neuronal networks and functional improvement.

In addition to neurons, glial cells and vascular cells of the brain are involved in the process of neuroplasticity, forming a "neurovascular unit", whose work implements the phenomenon of working hyperemia of functionally significant areas of the brain, including "strategic" ones in cognitive terms. This mechanism, shown in Alzheimer's disease and more characteristic of chronic cerebral ischemia, also occurs in stroke. Reduction of cerebral perfusion reserve and disruption of the "neurovascular unit" probably plays a crucial role in the realization of clinical symptoms in cerebrovascular disease.

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Understanding the pathogenesis of cognitive and motor disorders in stroke at the level of neurons and neurotransmitters is the basis for the development of pharmacological therapy for these conditions, defining the basics of pharmacological effects on neuroplasticity. Modern methods of treatment of post-stroke disorders focus on eliminating the dysfunction of neurotransmitter systems and reducing the effect of ischemia. However less underlying pathology, especially cognitive impairment, is also a violation of the synthesis and transport of neurotrophic factors such as Neurotrophic Growth Factor (NGF), Brain–Derived neurotrophic Factor (BDNF) and insulin-like growth factor (Insulin–like Growth Factor-1 – IGF-1). In animal experiments, NGF and BDNF have been shown to prevent amyloidogenic cleavage of amyloid precursor protein (ARP) and apoptotic death of neurons through signaling molecules of tropomyosine kinase (Trk) , expression of BDNF prevents neurodegeneration in various animal models of Alzheimer's disease; IGF-1 reduces amyloid accumulation in the brains of transgenic mice. However, it is BDNF that is responsible for the state of neuronal plasticity and synaptogenesis in the hippocampus. Thus, the effect on neurotrophic factors, the processes of neurogenesis and neuron survival opens up additional possibilities for the treatment of cognitive impairment and associated motor disorders, primarily post-stroke. In this regard, interest in drugs has increased in recent years, It has a multimodal mechanism of action: metabolic, vasoactive and neuroprotective.

Thus, it was found that citicoline, along with known neuroprotective properties, enhances the synthesis of neuroplasticity markers in the model of experimental stroke in rats, increases the expression of pERK1/2 and increases the activity of IRS-1 in experimental cerebral infarction and, along with neurogenesis, enhances the processes of angiogenesis, including various mechanisms of its activation. The multidimensional effect of the drug made it possible to use it in early neurorehabilitation with the formation of a good evidence base.

There are a number of studies that have shown an improvement in cognitive functions and a decrease in cognitive decline with prolonged (up to 6-9-12 months) administration of the drug, starting with the neuro-intensive care unit, and data have been obtained on the possible mechanisms of the effect of citicoline on memory. The use of citicoline in geriatric patients, including those with vascular pathology of the brain, showed not only an improvement in cognitive function, but also a slowdown in the progression of cognitive and behavioral disorders, which made it possible to reduce doses of psychoactive drugs. At the same time There is evidence of the effect of CDP-choline (the basis of citicoline) on the functional recovery of patients with hemiplegia and the effect on rehabilitation processes, in particular the functional outcome.

Conclusion. Thus, the recovery process after a stroke is influenced not only by the severity of motor disorders, but also by the state of cognitive functions, the level of motivation and determination of the patient, as well as the quality and scope of the rehabilitation program [1]. Modern neurorehabilitation programs should use an integrated approach in the treatment of post-stroke syndromes, in which, in addition to non-drug methods of multimodal effects on the process of neuronal plasticity and synaptogenesis, they must necessarily medications with proven efficacy and having the property of influencing neuronal plasticity and angiogenesis can be used. The multimodal approach is a new paradigm of modern post–stroke neurorehabilitation.

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