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Neurorehabilitation: Sanogenetic and pathogenetic foundations of innovative directions

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The processes of sanogenesis and pathogenesis in patients with acute cerebrovascular accident occur simultaneously, starting with the acute period of stroke. In most cases, this is a single process viewed from different perspectives. Modern innovative areas of neurorehabilitation include the use of drug therapy, rehabilitation measures and mechanisms of sanogenesis and self-healing, which can be influenced by the methods used in the course of restoring the health of neurological patients. The organizational model of modern neurorehabilitation is based on an interdisciplinary multistage approach. The analysis of the relationship between patho- and sanogenetic reactions is important for the development of this organizational model. Exogenous therapeutic and rehabilitation measures form a single complex with endogenous factors of sanogenesis. These measures achieve the maximum effect only with the conscious active participation of the patient in the recovery process. The theoretical basis of the research is the concept of the theory of functional systems by P. K. Anokhin and the axiomatic theory of human health. The integration of these approaches is considered as the most general self-acting self-healing mechanism, concretized in the form of the concept of sanogenesis. Mechanisms for maintaining homeostasis are activated at all levels when a damaging factor occurs. Pathogenesis develops, becoming an integral part of the processes of sanogenesis.

Keywords: rehabilitation, sanogenesis, pathogenesis, theory of functional systems, theory of human health, innovation, stroke.

Introduction

Acute cerebrovascular accidents (ACVI) remain one of the most pressing health problems in the world. Stroke ranks second in mortality in the Russian Federation (RF), yielding to cardiovascular diseases [1; 2]. Stroke is 123 cases per 100,000 population an-

nually [3]. 31 % of stroke patients require outside help. Only 10–12 % of patients return to their previous work after a stroke [4; 5]. More than 450 thousand new cases of stroke are registered annually in the Russian Federation, despite the measures taken to reduce mortality from diseases of the circulatory system. Stroke doubles the risk of dementia in older people. Unfortunately, the global prospects for stroke are disappointing due to the increasing morbidity and mortality of patients, especially in countries with low living standards [6].

Patients who have undergone stroke, as a rule, require long-term rehabilitation.

To date, the first version of the organizational model of medical rehabilitation in Russia has been developed, and its individual blocks are being implemented [7]. The developed concept and system of organizing neurorehabilitation involves 3 stages and 3 levels of care for patients with lesions of the nervous system. This approach takes into account the severity of the patient's condition and his rehabilitation potential.

The updated models of medical rehabilitation have been developed in Russia taking into account the regulatory framework for neurorehabilitation. Strengthening the active role of the patient himself in the rehabilitation process is clearly visible in the framework of the adopted approaches. In fact, this means the activation of the process of sanogenesis, or more broadly — the activation of the forces of self-healing in the course of restoring health. Therefore, the *multidisciplinary rehabilitation team* (MDRK) includes not only clinicians, but also psychologists, educators, social workers and other specialists. The means and methods of rehabilitation used are increasingly based on self-organized mechanisms of sanogenesis [8].

The article discusses some theoretical issues of the direction of innovation in neurorehabilitation. These innovations are aimed at the optimal combination of drug therapy, rehabilitation measures and mechanisms of sanogenesis and self-healing in the course of restoring the health of neurological patients.

Sanogenesis in the rehabilitation of patients with brain damage

The solution of theoretical issues of neurorehabilitation plays an important role in improving the methods of rehabilitation of patients, incl. stroke victims. Neurorehabilitation seeks to achieve an optimal ratio of medical (medicinal) methods with rehabilitation measures. The conscious activity of the patient himself also plays an extremely important role in the healing process, because along with drug therapy, it is important to maximally activate the forces of self-healing, evolutionarily embedded in the natural essence of man [9].

In this regard, an increasingly active use of the concept of sanogenesis is an important and relatively new theoretical approach in the development of rehabilitology. Sanogenesis is usually understood as a complex of protective and adaptive mechanisms aimed at restoring impaired self-regulation of the body. It is obvious that sanogenetic mechanisms are regulated, on the one hand, by the nervous system (mainly the central nervous system), and on the other, by genetic regulatory programs [10]. In this interpretation, sanogenesis is one of the most important, but not the only form of manifestation of the mechanisms of human self-healing action [11]. The simultaneous development and interaction of the mechanisms of pathogenesis and sanogenesis is considered by many authors as an integral process of human self-healing, aimed at restoring the full functioning of all organs, systems and homeostasis of the patient [12–14].

Rehabilitation care is based on the use of differentiated medical and neuropsychological methods. These methods are part of a unified rehabilitation program and are applied in accordance with the stage of the disease [7; 15]. At the same time, the processes of sanogenesis proceed in a self-acting self-organized mode. The patient can contribute to obtaining a beneficial effect of sanogenetic mechanisms of self-healing at the maximum accessible level by his correct actions during rehabilitation measures.

Regulatory legal documents indicate the need for the earliest possible start of rehabilitation measures. Early rehabilitation should begin as early as the first 12–48 hours of a patient's hospital stay in the acute and acute period of stroke.

The basic principles of rehabilitation of patients with lesions of the nervous system are:

— multidisciplinary approach;
— continuity and phasing;
— consistency and duration;
— complexity;
— individualization of rehabilitation programs and their social orientation;
— active participation in the rehabilitation of the patient himself, his family and friends;
— monitoring the adequacy of loads and the effectiveness of rehabilitation [16].

These principles clearly demonstrate the orientation towards the individualization of rehabilitation programs, their social orientation. The patient's relatives and friends take an active part in the rehabilitation process. As a result, rehabilitation measures are increasingly focused on activating the processes of sanogenesis in the patient's recovery.

Drug therapy inevitably dominates at the first stage of rehabilitation in the acute period of stroke. The patient's life at this stage often depends solely on timely medical intervention, up to and including surgery. Rehabilitation measures, as such, come to the fore at the second stage of rehabilitation. At the first stage they are also important and contribute to the prevention of contractures, pain syndromes, thrombosis, congestion in the lungs, etc.

At the second stage, the emphasis is on rehabilitation activities carried out in a medical institution with the participation of MDRK specialists. The main task of the MDRK is the most effective activation of the processes of sanogenesis, or the forces of self-healing of a person.

Sanogenesis develops independently in a self-organized self-acting mode immediately after exposure to damaging factors. This can be, for example, cerebral ischemia or traumatic brain injury. The processes of pathogenesis and sanogenesis always proceed simultaneously. This usually happens before the patient begins to receive medical attention. In other words, sanogenesis occurs before the treatment started and continues continuously at all stages of providing assistance to the patient. From this point of view, the rehabilitation process can be considered as the maximum activation of the compensatory-adaptive mechanisms of sanogenesis during the restoration of the patient's health. Therefore, neurorehabilitation today presupposes the fastest possible start of rehabilitation measures directly at the first stage of the acute period of the disease. This approach is fully consistent with the understanding that the processes of sanogenesis begin simultaneously with the processes of pathogenesis of the disease. Rehabilitation measures stimulate the

development of "self-healing" processes of sanogenesis most effectively if they are started as quickly and competently as possible.

The Regulation on MDRK (Appendix 2 of the Order of the Ministry of Health No. 788n dated July 31, 2020) provides for the establishment of a rehabilitation diagnosis. The diagnosis should take into account the patient's active participation, environmental factors, and the patient's personality factors, which are determined on the basis of the International Classification of Functioning (ICF). The modern structure of rehabilitation diagnosis gives a fairly accurate description of the patient's condition and life limitations. The diagnosis includes the influence of environmental factors, personal factors and their changes in the process of carrying out measures for medical rehabilitation. The accuracy of the diagnosis is important both when moving from one stage of treatment to another, and for ensuring the continuity of treatment in different medical institutions.

Structural and functional changes in brain damage

Restitution, regeneration, compensation and neuroplasticity are important mechanisms of sanogenesis. Restitution provides initial restoration (in fact, self-healing) of function, i. e. true resumption of the activity of partially damaged and functionally inhibited nerve structures. For example, the phenomenon of diachisis, discovered in 1897 by C. von Monakow.

Regeneration of nerve structures and organs functionally associated with them occurs later (for example, the regeneration of peripheral nerves after injury and the resumption of the work of the muscles they innervate). Regeneration is also a self-acting self-organized process of manifestation of the self-healing forces of the body. Compensation is the replacement of a lost function at the expense of functionally similar or other structures. Compensation mechanisms also operate in a self-organized manner.

Early recovery after brain damage is associated with regression of local cerebral edema, resorption of decay products and inflammatory mediators formed as a result of ischemia and necrosis, improved blood flow in the infarction zone, and restoration of the functioning of partially damaged neurons.

Compensatory changes associated with neuroplasticity occur in parallel with these processes or somewhat later. New synaptic connections are formed in the brain. The structures of the brain that were not previously involved in the implementation of the impaired function are involved in its implementation, there are changes associated with diachysis. The plasticity of the nervous system is understood as the ability of the nervous tissue to independently restore its function through qualitative and quantitative neuronal rearrangements, changes in neuronal connections and glial elements [17]. This process is one of the many mechanisms of sanogenesis. Nervous tissue is capable of independently changing the structural and functional organization. It has been established that self-acting sanogenetic processes of neuroplasticity in the central nervous system occur at the molecular, cellular, synaptic, anatomical levels, not only in the cortical regions, but also in the subcortical structures [18].

Different parts of the central nervous system have different neuroplastic potential for self-healing. The cerebral cortex is considered the most plastic part of the central nervous system, which is due to the variety of its constituent cellular elements and their connections. Macro-level neuroplasticity in the process of sanogenesis is associated with a

change in the network structure of the brain, which provides communication between the hemispheres and different areas within each hemisphere. At the micro level, changes occur in the neurons and synapses themselves. Plasticity can manifest itself both quickly and slowly at all levels. In this case, it is important to emphasize that neuroplasticity proceeds as a self-organized sanogenetic process. Thus, "fast neuroplasticity" activates previously unused horizontal connections in the cerebral cortex, as well as modulation of synaptic transmission [19; 20].

Plastic processes are accompanied not only by structural changes in synapses, dendrites, astroglia, neurons and capillaries. In parallel, molecular-genetic and biochemical mechanisms of influence on plasticity are activated through the production of biologically active substances of stimulating, inhibitory or modulating action [21]. These mechanisms underlie memory, learning, and recovery of the nervous system after injury.

Another type of neuroplasticity is sensitization, which manifests itself in an automatically arising amplification of the response to potentially dangerous damaging stimuli. This type of neuroplasticity can occur in the same synapses where habituation or addiction occurs (one of the simplest forms of neuroplasticity). It can be short-term and long-term. The reversible mechanisms of plasticity (habituation and sensitization) differ from long-term potentiation. This kind of plasticity results in permanent, long-term changes in the strength of synaptic connections. This mechanism underlies the self-restoration of the patient's cognitive capabilities: learning, acquisition of knowledge, skills, self-restoration of memory.

It has been proven that neurogenesis is possible in some parts of the brain. In an adult, such structures include the hippocampus and the subventricular zone [22; 23]. In the hippocampus, progenitor cells are located in the vascular-rich periventricular zone. In these zones, sanogenetic reactions in the form of neurogenesis are ongoing.

Neurogenesis is an important self-acting process of restoring brain tissue and the nervous system as a whole. It manifests itself in the form of cell proliferation, migration and cell differentiation. Outside the neurogenic zones of the brain, two forms of neurogenesis have been identified. The first is local neurogenesis associated with the activation of progenitor cells in response to pathological stimuli. The second is the migration of progenitor cells from neurogenic areas of the brain to damaged areas. When the central nervous system is damaged, the mechanisms of sanogenesis are manifested in the fact that the direction of cell migration changes independently: they leave the rostral migration flow and move to distant areas where neuronal death is detected [24; 25]. Progenitor cells replacing damaged neurons are located throughout the periventricular region of the forebrain [24; 26].

There is evidence of perivascular mesenchymal stem cells found in neurogenic and non-neurogenic areas of the brain in the perivascular spaces of adult animals and humans [24].

Perivascular mesenchymal stem cells have specific features. These include differentiation along the ectodermal or mesodermal pathway, immunomodulatory pro-regenerative ability (secretion of growth factors, angiogenesis factors, mitogens and cytokines), maintenance of tissue homeostasis, including the microenvironment of stem cells, etc.

The body's self-healing mechanisms are multifaceted. In addition to structural changes in the nervous tissue, dynamic shifts also occur. They are of a functional nature, spreading both directly in the lesion focus and at a distance from it [18].

It must be borne in mind that during rehabilitation, plasticity can manifest itself as a two-faced Janus. Plasticity is involved in the emergence and consolidation of both positive and negative (pathological) changes in the central nervous system. When mobilizing genetically programmed mechanisms of sanogenesis, damaging factors can form pathological systems. Such systems are possible as a result of inadequate rehabilitation measures. The properties and features of the formation of pathological systems have been studied in detail by G. N. Kryzhanovsky, his colleagues and students [14; 27; 28].

In relation to pathological systems in the body, there is a restructuring of the normal self-regulation of functional systems. Self-regulation can be aimed at eliminating a pathological system or establishing a new compensatory level of intrasystemic relations. Spasticity and other clinical symptoms may form by 3–4 weeks after stroke. Clinical neurology provides for the early use of methods that prevent the development of muscle hypertension and pathological attitudes. It is these factors that determine in the future the formation of contractures, pain syndrome and a decrease in the patient's functional capabilities [29].

Exogenous factors affect the mechanisms of sanogenesis, including the use of specific techniques by the participants of the MDC. This makes it necessary to constantly improve the skills of the members of the MDRK. Patients recover to varying degrees of impaired functions, including motor functions [30]. The first level is true "self-healing" with the return of impaired motor functions. It is possible in the absence of neuronal death, when the pathological focus consists mainly of inactivated cells. The second level is compensation with the main mechanism of functional restructuring and the involvement of new, previously unused brain structures. The third level is readaptation, or adaptation to an existing defect. At this level, patients use special means of technical rehabilitation (support canes, crutches, walkers, wheelchairs).

The strategy of rehabilitation therapy for patients who have suffered a stroke or TBI involves, first of all, the elimination or reduction of the influence of pathological systems that form persistent neurological syndromes. Such an impact is possible as a result of suppression of pathological determinants, destabilization of the pathological system and activation of antisystems. The optimal result is achieved by a combination of the mechanisms of sanogenesis and pharmacological and non-drug therapeutic effects [14; 30].

In this regard, at the stage of early rehabilitation, it is important to prevent the formation of stable pathological systems: contractures, pathological motor stereotypes and postures, arthralgias. A significant decrease in their severity is possible due to the activation of sanogenetic mechanisms and the destruction of pathological systems [31]. The role of a conscious purposeful activity of the patient himself in the prevention of the formation of stable pathological systems can hardly be overestimated.

The nature and degree of reorganization of neuronal connections is determined by the load exerted on them. The volume, intensity and time costs for each type of treatment and rehabilitation are determined by the specifics of the disease, the characteristics of its course, the severity of the consequences, the personal qualities of the patient, the degree of his psychological traumatization and social maladjustment. It has been shown experimentally that training in motor skills, depending on the intensity of the load, can contribute to the expansion of the area of cortical representation of the muscles involved [32–34]. But too active rehabilitation in the early period of stroke can have an unfavorable effect [35; 36]. Thus, forced loading on the paretic limb during the first 7–14 days from the onset of

stroke development led to a delay in the recovery of motor functions and an increase in the lesion focus [36]. This was explained by the additional release of glutamate and catecholamines, hyperexcitability of neurons in the perifocal zone, and imbalance between the processes of excitation and inhibition. In this case, excessive loads had a negative impact on sanogenetic mechanisms. The qualified work of the MDRK members plays a key role in avoiding this mistake.

The severity of compensatory-adaptive reactions may differ in patients of different ages. Thus, our studies [37; 38] showed that in patients of different age groups with ischemic stroke (IS) of moderate and mild severity, psychopathological disorders (anxiety, depression) had varying degrees of severity. In patients of young and middle age in the acute period of stroke, there were no significant differences in the dynamics of indicators of psychopathological status. On the contrary, in elderly and senile patients, there was a positive dynamics of these indicators. In elderly patients, a significant predominance of sympathetic tone in the cardiovascular system was revealed, which was not observed in middle-aged and elderly patients with a predominance of the tone of the parasympathetic nervous system.

So, in elderly patients, Kerdo's vegetative index was 19.3, while in old and middle age it corresponded to 1.3 and 9.3 ($p = 0.023$). The absence of this effect was especially clear in patients with IS and metabolic syndrome [39]. The use of a "questionnaire for identifying signs of vegetative changes" and a "study design for identifying signs of vegetative disorders" (A. M. Wein, 1991) showed that vegetative disorders had different dynamics in individuals of different age groups. In the middle-aged group, during the first week, the indicator changed from 21.5 ± 06 points to 19.0 ± 0.42 points ($p = 0.004$). The same indicators in the elderly group were equal to 26.8 ± 12.1 and 25.0 ± 14 points, respectively ($p = 0.2$). Significant gender differences were found in the depression scale scores. In men, the indicator corresponded to 46.0 ± 0.5 points, decreasing by the end of the week to 40.0 ± 0.61 ($p < 0.02$), and in women it changed from 45.1 ± 0.7 points to 42, 5 ± 0.5 ($p > 0.05$).

Emotional background and autonomic imbalance with impaired autonomic support for organs and autonomic reactivity can have a significant impact on the course of compensatory-adaptive reactions. This effect is poorly understood. In such patients (especially in young and middle-aged people), their psychoemotional status is of particular importance — the empathy of relatives and friends, surrounding staff is important.

Traditionally, the main attention in the preparation of rehabilitation programs is given to the morphological and functional characteristics of patients. Our research shows that personality traits and psycho-emotional status have an important influence on the patient's motivation for recovery. In turn, positive motivation activates the compensatory-protective mechanisms of sanogenesis [9].

On the other hand, it is necessary to take into account the factors that can delay the restoration of impaired functions. These are such personal factors of the patient as lack of motivation for rehabilitation measures; inadequate assessment by patients of the presence of a deficit of function; pain reactions; trophic disorders; depressive mood background; low tolerance to physical activity and the social level of the patient's family. There are also external factors that limit the patient's mobility, the degree of self-service, the fulfillment of the patient's natural functions; overprotection; lack of means of technical rehabilitation. Consideration and elimination (if possible) of these factors are also necessary for effective rehabilitation [16].

As we can see, modern neurorehabilitation is constantly looking for ways to optimally combine the methods of therapeutic rehabilitation and self-acting mechanisms of self-healing of the patient. A new direction on this path is the harmonious relationship of medical and non-medical health factors in the development of a full-fledged integral theory of human health. Integration of the methodology of health theory [9; 11; 40] and the theory of functional systems proposed by P. K. Anokhin looks very promising [41]. This allows us to consider in a new way the interaction of self-acting mechanisms of sanogenesis, on the one hand, and the system of therapeutic and rehabilitation measures, on the other.

The theory of functional systems in rehabilitation

The idea of the structural and functional organization of the brain underlies the theory of functional systems. The processes of self-organization and reorganization constantly occur in the human brain, the purpose of which is to achieve a useful result. According to P. K. Anokhin a useful result is the main system-forming factor of the functional system of the body (FSO). The author formulated the main features of the PSO as an integrative education:

— FSO is a central-peripheral formation, becoming a specific apparatus of self-regulation. PSO maintains its unity on the basis of cyclical circulation from the periphery to the centers and from the centers to the periphery;
— the existence of any FSO is certainly associated with obtaining a specific adaptive effect;
— the final effect determines one or another distribution of excitations and activities in the PSO as a whole.

An absolute sign of PSO is the presence of receptor apparatus. Receptor devices can be extensive afferent formations of the central nervous system, which perceive afferent signaling from the periphery about the results of an action. The theory of functional systems states that an integral organism unites a large number of interacting PSOs. The integration of the PSO takes place on the basis of nervous, humoral and informational mechanisms. The result is a stable constancy of the mechanisms of homeostasis, adaptation and adaptation to the environment. In fact, all of these mechanisms are included in the concept of sanogenesis in accordance with its definition. Note that P. K. Anokhin did not use the terms sanogenesis and self-healing, using the term "self-regulation".

P. K. Anokhin formulated a new approach to understanding the functions of the whole organism. Classical organ physiology has traditionally followed anatomical principles. The theory of functional systems assumes the priority of the systemic self-organization of human functions. These self-acting self-sufficient mechanisms function steadily from the molecular to the social level [9].

A person has several levels of organization of the FSO. Some PSOs act as self-organized mechanisms of sanogenesis (metabolic, genetic, homeostatic, etc.). Other PSOs function in the form of conscious life activity at the behavioral, mental and social levels [42]. All FSOs have fundamentally the same architectonics, including the result, the reverse afferentation from the result, the center and the executive elements. The central architectonics of the PSO includes the stages of afferent synthesis, decision-making, an acceptor

of the result of an action, an efferent synthesis, an action and a constant assessment of the results achieved using reverse afferentation. Each result of the PSO action automatically generates a flow of reverse afferentations, which represent the most important signs of the results obtained.

The described understanding of the universal self-organization of PSO mechanisms is used when carrying out treatment methods based on biofeedback mechanisms. The dynamic self-regulating process of the formation of the FSO is subordinated to obtaining a useful result. Insufficiency of the result can completely reorganize the existing FSO and form a new one. FSO according to P. K. Anokhin is a complex of selective involvement of the components of the system elements to obtain a focused useful result. Self-regulation of this process is an integral part of the body's self-healing process. Self-healing occurs by automatically switching on and activating the mechanisms of sanogenesis in the course of healing.

From the standpoint of the theory of functional systems, rehabilitation measures act as an effective external link that activates the functions of self-organized PSO. In this respect, the published first version of the axiomatic theory of human health (THH) [9; 11] is of interest. The THH methodology relies heavily on the FSO theory and expands it. The key concept of THH is the category "health".

A person is essentially self-sufficient in nature and contains everything in order to independently and fully exercise all his functions, to live and develop normally in society. This self-sufficiency is genetically fixed by evolution. Analyzing life through the prism of health, we see the integral property of self-healing inherent in a person.

The human sciences have not yet come to a single generalizing concept that encompasses all the mechanisms of self-healing and self-healing of a person. The THH development methodology considers a person in a holistic manner. The principle of integrity requires the presence of a generalizing concept in the conceptual apparatus of the THH, which includes in its content the systemic essence of all mechanisms of self-healing and self-healing of a person. It seems logical to consider health as such a generalizing integral concept in framework within the THH. In accordance with this, the following definition of the concept of health has been proposed. Health is a self-acting self-sufficient integral ability inherent in a person to fully function and self-reproduce at the cellular, tissue, organ, organismic, mental, social and spiritual levels. Health, as an integral ability for self-healing, is based on the self-organized action of the mechanisms of self-regulation, self-government, self-defense, sanogenesis and homeostasis. Health provides a person with self- restoration and self-healing after stress, injury and illness.

Health is an integral ability of an integral living organism, and not its specialized subsystem, function or group of functions. Healthy life can be viewed as the "ontogeny of health" from conception to death. Ontogeny of health is the ontogeny of functioning, restoration and reproduction of all self-healing mechanisms based on self-organization. The ontogeny of human health is based on self-organization. It is impossible to understand health and its evolution without understanding what self-organization is and how it works.

An axiomatic approach is at the heart of the creation of the THH. The specificity of the axiomatic approach made it possible to generalize and systematize the latest data in genetics, physiology, neurology, sociology of health, biophysics, quantum information theory and other sciences. This made it possible to introduce a number of new concepts

and develop a theoretical criterion for choosing factors that completely determine human health [11; 40]. The essence of the criterion is that this is the minimum set of irreplaceable factors that completely determine human health. The authors of the THH substantiated in the first approximation the hypothesis about the presence of 12 basic factors that completely determine human health.

The use of basic factors gives a powerful synergistic effect that some of the health factors cannot provide. This also applies to the factors of a healthy lifestyle, which are focused on the primary and secondary prevention of diseases of the cardiovascular system. Therefore, a promising area of neurorehabilitation is the patient's motivation to master self-healing techniques based on all basic health factors.

Thus, the integration of the theory of functional systems and the theory of human health seems to be a promising approach in the development of neurorehabilitology.

The disease usually affects many interrelated PSOs. In this regard, the assessment of various indicators of the body's activity in pathological conditions should take into account the systemic integration of physiological functions. When the structures of the brain are damaged, it is important to determine which stage of the systemic organization is impaired: afferent synthesis, decision-making, foresight or assessment of the results achieved. Disorders of afferent synthesis prevents the creation of a program of activity and a model of the required result. In case of violation of the reverse afferentation from the achieved result, there is no possibility of its adequate correction. This is often observed in patients with a pathological process in the frontal lobe. Excessive pathologically enhanced motivation and activation of the system make it uncontrollable, and the result of its activity has a pathological significance.

Rough disintegration in the activity of the FSO occurs when the suprasegmental structures of the autonomic nervous system are involved in the pathological process. These structures ensure the maintenance of homeostasis, the vegetative support of the activity of organs and systems, the adaptation of the organism to changing environmental conditions. The central vegetative apparatus is represented at the hemispheric, mesencephalic, bulbar and spinal levels and has a hierarchical organization [43].

CNS structures are not the only pathological determinant. It has been established that a pathological system, like pathodynamic integration, can cover different PSOs [14]. The same role is played by the enzymes of the intracellular signaling system, pathologically altered proteins, and dysregulatory or mutationally altered genes.

Conclusion

Analysis of the structural and functional changes occurring in the body with brain damage allows improving the methods of rehabilitation of patients with central nervous system damage. Self-organized mechanisms of sanogenesis are constantly functioning in the body (along with emerging pathogenetic processes). Their effectiveness increases significantly with conscious participation in the rehabilitation process of the patient himself. The mechanisms of sanogenesis are self-sufficient and immediately "turn on" automatically after the appearance of the lesion focus. The optimal combination of self-healing mechanisms with therapeutic and rehabilitation measures with the active participation of the patient himself ensures the healing process most effectively.

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