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Pathophysiological Features Resulting From Disruption of Synapse Function

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Annotation: This article analyzes the pathophysiological characteristics resulting from synaptic dysfunction. Changes in synaptic transmission affect inter-neuronal communication, leading to the development of various pathological conditions in the central and peripheral nervous systems. The study highlights the role of synapses in neurodegenerative diseases such as Alzheimer's, Parkinson's, and Huntington's diseases, as well as in conditions like epilepsy, schizophrenia, and depression. Additionally, the article provides insights into molecular and cellular-level dysfunctions, neurotransmitter imbalances, and modern therapeutic approaches aimed at treating these pathologies.

Keywords: Synapses, neurotransmitter, nervous system, pathophysiology, excitotoxicity, dopamine, serotonin, Alzheimer's disease, Parkinson's disease, Huntington's disease, neurodegeneration, Beta-amyloid, neuroprotective drugs, gene therapy, SSRI (selective serotonin reuptake inhibitors).

Introduction. One of the main functions of the central and peripheral nervous systems is to ensure the processes of interneuronal information transmission. This process is carried out through synapses and is of great importance in the transmission of nerve impulses. [1,2]. Disturbances in synaptic activity can lead to disruption of the communication system between neurons and cause the development of various neurological and psychiatric diseases. As a result of synapse dysfunction, changes in the metabolism of neurotransmitters are observed, the activity of neurons

is disrupted, which is an impetus for the formation of pathological processes [2,4.5].

Research goal. Study of pathophysiological features caused by dysfunction of synapses

Research methodology: Electrophysiological methods, neurochemical and molecular biological methods, Neuroautographic and visualization methods, clinical and psychological assessment methods, Use of animal models.

Main part. Synapses are the main structures that provide information exchange between neurons in the central and peripheral nervous systems. Disturbances in synaptic activity cause various pathophysiological processes, which, in turn, can lead to the development of neurodegenerative and psychiatric diseases [1,5,6]. As a result of a decrease or increase in the release of neurotransmitters at synapses, signals between neurons are incorrectly transmitted. For example, an excess of glutamate leads to excitotoxicity, which causes neuronal degeneration. Conversely, a deficiency of dopamine or serotonin can trigger the development of depression and Parkinson's disease [2,3].

- Alzheimer's disease: In this disease, beta-amyloid plaques and tau proteins damage synapses, disrupting neuronal connections and impairing memory functions.
- Parkinson's disease: As a result of the degeneration of dopaminergic neurons, the process of dopamine delivery through synapses is disrupted, which leads to movement disorders.
- Huntington's disease: Due to glutamatergic overstimulation, synapses are damaged and neurons gradually degenerate.

Currently, various therapeutic strategies are being developed to restore synapse function. Approaches such as neuroprotective drugs, neurotransmitter balance drugs, and gene therapy aim to reduce synaptic dysfunction. For example:

- ✓ Acetylcholinesterase inhibitors are used in Alzheimer's disease.
- ✓ Levodopa and dopamine agonists are used in Parkinson's disease.
- ✓ SSRIs (selective serotonin reuptake inhibitors) and antipsychotics are used in depression and schizophrenia [4,5,8].

Otto Levi is one of the scientists who proved the existence of neurotransmitters. He revealed the process of chemical transmission in the nervous system through his "heart experiments". In his experiment, he used two frog hearts and observed that when one of them was stimulated through a nerve fiber, it also affected the other heart. Through this, he proved that the substance "Vagusstoff" (later called acetylcholine) is involved in the transmission of impulses at synapses. This discovery brought him the Nobel Prize in 1936, together with Henry Dale. Henry Dale worked on neurotransmitters, especially acetylcholine, and its role in synaptic transmission. He determined that different neurotransmitters act on different types of neurons. Dale's role in revealing the mechanism of chemical transmission in the nervous system was significant, and he was awarded the Nobel Prize together with Levi[6,8].

Conclusion: Synapses are the main structures that provide signal transmission between neurons in the central and peripheral nervous systems. Disruption of their function can lead to various pathophysiological processes and contribute to the development of neurodegenerative and mental diseases. Scientific studies conducted by scientists have made a significant contribution to understanding the function of synapses.

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