INTERACTION OF ECOLOGICAL FACTORS AND GENETIC PREDISPOSITION IN CHILDREN'S EPILEPSIA

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Annotation: *The development of epilepsy in children is a multifactorial pathogenetic process, in which genetic predisposition and the interaction of external environmental factors play an important role. In recent years, it has become increasingly clear that it is not enough to attribute epilepsy only to hereditary or only to structural causes, but that gene-environmental interaction is crucial in determining the onset, clinical course, and prognosis of the disease. In this literature review, genetic predisposition, epigenetic mechanisms, environmental stressors, and their contribution to the process of epileptogenesis in childhood epilepsy are systematically analyzed. The results of the analysis show that environmental factors can act as a trigger that activates or exacerbates epileptic processes in children with a genetic predisposition.*

Keywords: *pediatric epilepsy, genetic predisposition, environmental factors, epigenetics, epileptogenesis, gene-environment interaction.*

Epilepsy is one of the most complex and socially significant pathologies in pediatric neurology, the etiology and pathogenesis of which have been the subject of scientific debate for many years. If in traditional approaches epilepsy was often explained by genetic or symptomatic causes, then modern studies show a complex interaction of genetic predisposition with environmental factors in the formation of the disease [18,21]. Especially in childhood, the development of the central nervous system further increases the clinical significance of this interaction.

Childhood is considered a period of high brain plasticity. Therefore, in genetically vulnerable or predisposed children, environmental factors can trigger the onset or aggravation of the epileptic process. This article analyzes these complex gene-environmental relationships from the perspective of epilepsy development [2,6,9].

Concept of genetic predisposition in childhood epilepsy

Advances in molecular genetics and neurogenetics in recent decades have allowed for a deeper understanding of the genetic basis of epilepsy. To date, it has been proven that a significant part of childhood epilepsy is associated with genetic factors. In this case, not only monogenic epilepsy, but also polygenic and complex hereditary mechanisms play an important role [1,19].

Genetic predisposition is not necessarily a direct cause of epilepsy, but it forms a favorable neurobiological background for epileptic activity. Changes in the activity of ion channels, disruption of synaptic transmission, and improper formation of neural networks

increase the predisposition to epileptic seizures. Especially epileptic encephalopathies associated with "de novo" mutations manifest with a severe clinical course in childhood.

At the same time, the concept of genetic predisposition is not a complete synonym for heredity. In many cases, epilepsy may not be present in the family history, but the child develops an epileptic process under the influence of external factors. This situation indicates the presence of hidden forms of genetic predisposition [2,3,22].

Epigenetic mechanisms and their role

Epigenetic mechanisms are considered as a link between genetic predisposition and environmental factors. Epigenetics involves processes that modulate gene expression without altering the DNA sequence. Methylation, histone modifications, and changes in gene activity through microRNAs play an important role in the process of epileptogenesis [4,15,17].

In childhood, epigenetic mechanisms are especially sensitive, and environmental influences in the prenatal and perinatal periods can lead to long-term changes in gene expression. As a result, favorable conditions for epileptic activity are formed, which clinically manifests as seizures [11,14].

Ecological factors and epileptogenesis

The concept of environmental factors is broad and includes physical, chemical, biological, and social stressors. In childhood epilepsy, these factors often play a triggering or modifying role.

Harmful factors affecting the mother's body in the prenatal period, including infections, toxic substances, environmental pollution, nutritional deficiencies, and stressful situations, negatively affect the development of the fetal brain. As a result, structural and functional immaturity of the central nervous system occurs [22].

In the perinatal and postnatal periods, hypoxic-ischemic lesions, infectious diseases, and severe metabolic disorders are considered the main environmental factors that activate the epileptic process. These factors can lead to the early onset of epilepsy in children with a genetic predisposition [7,8,10].

Pathogenetic basis of gene-medium interaction

In modern epileptology, the development of epilepsy is considered a result of the combined influence of genetic predisposition and environmental factors.

Genetically vulnerable neural networks undergo pathological reorganization under the influence of environmental stressors.

This process leads to an acceleration of epileptogenesis and the formation of epileptic neural networks [12,21].

This interaction is especially important in childhood, as sensitivity to external influences increases during brain development. As a result, the same environmental factor may not cause epilepsy in a healthy child, but causes the onset of the disease in a genetically predisposed child [16,20].

Clinical and prognostic significance

Understanding the interaction between genetic and environmental factors is important in the clinical assessment of childhood epilepsy.

This approach allows for a preliminary assessment of the age of onset, clinical form, risk of pharmacoresistance, and cognitive consequences of epilepsy [4,13].

In addition, minimizing environmental factors and implementing early preventive measures can serve to prevent the development of epilepsy or reduce its severity. This issue is especially relevant for children living in ecologically unfavorable areas [5].

Final considerations

The literature review shows that the interaction of genetic predisposition and environmental factors is crucial in the development of childhood epilepsy.

Epilepsy is often formed not by a single cause, but under the influence of environmental factors against the background of genetic predisposition. Epigenetic mechanisms are the central link in this process, leading to long-term changes in gene expression.

This approach has important scientific and practical significance in understanding, early diagnosis, and development of individual prevention and treatment strategies for childhood epilepsy.

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