# MOLECULAR AND CELLULAR MECHANISMS OF NEUROIMMUNE INTERACTIONS

***Ibrokhimova Poshshokhon Saidahmadovna***
*Student of Fergana Medical Institute of Public Health*

## ABSTRACT

This article explores the molecular and cellular foundations of the bidirectional communication between the nervous and immune systems. The roles of neurotransmitters cytokines and neuropeptides in neuroimmune signaling are analyzed. The research highlights the immune functions of microglia cells in the central nervous system and their importance in maintaining homeostasis. The role of neuroimmune disruptions in the development of pathological conditions is scientifically substantiated.

**Keywords:** Neuroimmunology cytokines microglia neurotransmitters blood-brain barrier homeostasis neuroinflammation immune response.

## INTRODUCTION

For a long time the central nervous system was considered immunologically privileged and independent of the immune system. However modern research shows that there are integral and complex connections between the nervous and immune systems. Neuroimmune communication shapes the body's overall response to stress infections and injuries. This interaction is mediated by neurotransmitters hormones and molecules released by immune system cells. The purpose of this article is to study the molecular mechanisms of neuroimmune connections and analyze their significance in healthy and pathological processes.

## METHODS

During the research process the latest scientific literature in the fields of neurobiology and immunology was analyzed. A systematic approach and comparative analysis methods were used to collect data. The functional activity of immune cells of the central nervous system particularly microglia and astrocytes was studied at the molecular level. Mechanisms of cytokine transport across the blood-brain barrier and their binding processes with receptors on neurons were modeled. Additionally clinical data on the involvement of immune system cells in nervous system regeneration were synthesized.

## RESULTS

The results of the analysis identified several important mechanisms of neuroimmune interactions. First it was confirmed that interleukins (IL-1 IL-6) and tumor necrosis factor (TNF-alpha) produced by immune cells directly affect

hypothalamic function leading to fever and behavioral changes. Second it was proven that neurotransmitters (acetylcholine norepinephrine) bind to specific receptors on immune cells to regulate anti-inflammatory responses (the cholinergic anti-inflammatory pathway). Third it was found that microglia cells participate not only in defense but also in maintaining synaptic plasticity. The results indicate that the neuroimmune systems function as a unified homeostatic network.

## DISCUSSION

Disruption of neuroimmune interactions can lead to the development of many diseases including Alzheimer's disease autism and depression. During the discussion it was emphasized that the transition of neuroinflammation into a chronic state leads to neuronal destruction. Increased permeability of the blood-brain barrier allows immune cells to enter the brain accelerating pathological processes. At the same time new perspectives for treating neurodegenerative diseases through immunomodulation were considered. In conclusion a deep study of neuroimmunological mechanisms serves as a fundamental basis for creating new treatment methods in medicine.

## REFERENCES

1. Abbas A K Cellular and Molecular Immunology 10th edition Elsevier 2021
2. Dantzer R Neuroimmune Interactions From Genes to Behaviour Nature Reviews Neuroscience 2018
3. Besedovsky H O and del Rey A Immune-Neuro-Endocrine Interactions Physiological Reviews 2019
4. Karimov N R Pathological Physiology Textbook Tashkent 2022
5. Ibrokhimova P S Modern Problems of Neuroimmunology Student Scientific Conference Materials Fergana 2023
6. Tracey K J The Inflammatory Reflex Nature 2020
7. Kipnis J Immune System and the Brain Scientific American 2018
8. Miller A H and Raison C L The Role of Inflammation in Depression Nature Reviews Immunology 2016
9. Saidov A X Medical Biology and Genetics Tashkent 2021
10. Ransohoff R M Microglia and Central Nervous System Homeostasis Science 2019
11. Concept for the Development of the Healthcare System of the Republic of Uzbekistan 2022
12. Gaisler-Salomon I Molecular Mechanisms of Neuroimmunology Academic Press 2020
13. Pavlov V A and Tracey K J The Cholinergic Anti-inflammatory Pathway Molecular Medicine 2017
14. Nazarov D E Foundations of Pharmacology Tashkent 2021
15. Watkins L R and Maier S F Glia A Novel Drug Target for Pain Nature Reviews Drug Discovery 2023