IMMUNE AND INFLAMMATORY MECHANISMS IN PARKINSON'S DISEASE

Fayzullakhujayev Khasankhon Jaloliddin ogli,
Matmurodov Rustam Jumanazarovich
Tashkent State Medical University
Rakhimova Shakhnozakhon Mukhiddin qizi
Kimyo International University in Tashkent

Abstract. *To investigate the relationship between autoimmune and neuroinflammatory markers in patients with Parkinson's disease (PD) and to evaluate their possible contribution to disease severity.*

Keywords: *Parkinson's disease, autoimmunity, neuroinflammation, cytokines, α-synuclein, biomarkers.*

Introduction

Parkinson's disease (PD) is one of the most common neurodegenerative disorders, characterized by the progressive loss of dopaminergic neurons in the substantia nigra and the presence of Lewy bodies. Although its exact etiology remains uncertain, mounting evidence indicates that immune mechanisms play a pivotal role in PD pathogenesis. Chronic activation of microglia and the sustained release of proinflammatory cytokines such as TNF-α, IL-1β, and IL-6 have been shown to contribute to neuronal injury and disease progression (Tansey & Romero-Ramos, 2019; Hirsch & Standaert, 2021). Furthermore, both innate and adaptive immune responses appear to be involved, as infiltration of peripheral CD4+ T cells into the brain has been demonstrated in experimental models of PD (Brochard et al., 2009). Another important finding is the detection of autoantibodies and autoreactive T cells targeting α-synuclein in patients with PD, suggesting a possible autoimmune component of the disease (Sulzer et al., 2017; Kannarkat et al., 2013). Together, these findings highlight a complex interplay between neuroinflammation and autoimmunity that may accelerate dopaminergic neurodegeneration. Therefore, understanding immune-mediated processes in PD could help identify new biomarkers and develop targeted immunomodulatory therapies aimed at slowing disease progression.

Methods: The study included 45 patients diagnosed with Parkinson's disease (mean age 63 ± 8 years) and 20 healthy controls matched by age and sex. Serum levels of proinflammatory cytokines (TNF-α, IL-1β, IL-6) and autoantibodies against α-synuclein were measured using ELISA. MRI scans were performed to assess neuroinflammatory changes in the basal ganglia. Clinical evaluation was carried out using the Unified

Parkinson's Disease Rating Scale (UPDRS) and Hoehn and Yahr staging. Statistical analysis was performed using SPSS 26.0; $p < 0.05$ was considered significant.

Results: Compared to controls, PD patients showed significantly elevated serum levels of TNF-α, IL-1β, and IL-6 ($p < 0.01$). Autoantibodies against α-synuclein were detected in 62% of PD patients and were positively correlated with disease duration ($r = 0.48$, $p < 0.05$). MRI analysis revealed microglial activation patterns consistent with neuroinflammation. Patients with higher cytokine levels demonstrated more severe motor symptoms and higher UPDRS scores.

Conclusion: The findings support the hypothesis that autoimmune mechanisms and chronic neuroinflammation play a crucial role in Parkinson's disease progression. Measuring inflammatory and autoimmune biomarkers may help in early diagnosis and in monitoring treatment response. Future therapies aimed at immune modulation could potentially slow disease progression and protect dopaminergic neurons.

References

1. Hirsch, E. C., & Standaert, D. G. (2021). Ten Unsolved Questions About Neuroinflammation in Parkinson's Disease. Movement Disorders, 36(1), 16–24. https://doi.org/10.1002/mds.28367
2. Sulzer, D., Alcalay, R. N., Garretti, F., Cote, L., Kanter, E., & Gregersen, P. K. (2017). T cells from patients with Parkinson's disease recognize α-synuclein peptides. Nature, 546(7660), 656–661. https://doi.org/10.1038/nature22815
3. Tansey, M. G., & Romero-Ramos, M. (2019). Immune system responses in Parkinson's disease: Early and dynamic. European Journal of Neuroscience, 49(3), 364–383. https://doi.org/10.1111/ejn.14290
4. Kannarkat, G. T., Boss, J. M., & Tansey, M. G. (2013). The role of innate and adaptive immunity in Parkinson's disease. Journal of Parkinson's Disease, 3(4), 493–514. https://doi.org/10.3233/JPD-130250
5. Brochard, V., Combadière, B., Prigent, A., et al. (2009). Infiltration of CD4+ lymphocytes into the brain contributes to neurodegeneration in a mouse model of Parkinson disease. Journal of Clinical Investigation, 119(1), 182–192. https://doi.org/10.1172/JCI36470