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Nanostructured Lipid Carriers Loaded with PDE4 Inhibitors to Attenuate Neuroinflammation in Parkinson's Disease: A Review

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Abstract

Parkinson's disease (PD) is a progressive neurodegenerative condition marked by movement impairments and the degeneration of dopaminergic neurons, often associated with chronic neuroinflammation. Recent data shows that neuroinflammation plays a key role in the development of Parkinson's disease, mainly due to the activation of microglia, release of pro-inflammatory cytokines, and oxidative stress. Phosphodiesterase 4 (PDE4), which hydrolyzes cyclic adenosine monophosphate (cAMP), is essential for the regulation of inflammatory responses in the central nervous system. Inhibiting PDE4 has become a hopeful approach to raise cAMP levels inside cells and block inflammatory signals, especially by reducing the levels of NF-κB and TNF-α. However, the use of PDE4 inhibitors in medicine has been slowed down because they do not easily pass through the blood–brain barrier (BBB) and can cause side effects throughout the body. Nanostructured lipid carriers (NLCs) are gaining more attention as an alternative method to deliver drugs that can overcome the limitations of conventional PDE4 inhibitor formulations. The synergistic effects of PDE4 inhibitors that reduce inflammation and NLCs that target the brain offer an alternative approach to treat neuroinflammation and the loss of dopaminergic neurons in PD. This review provides a detailed look at the latest advancements in creating and developing nanostructured lipid carriers that are loaded with PDE4 inhibitors for treating Parkinson's disease.

Keywords: Parkinson's disease, Neuroinflammation, cAMP, PDE4 inhibitors, Nanostructured lipid carriers

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