Hyaluronan Metabolism at the Interface of Immune Dysregulation and Neurodegeneration

Prerna Joshi
Department of Biotechnology, Delhi Technological University, New Delhi, India

Asmita Das*
Department of Biotechnology, Delhi Technological University, New Delhi, India

Abstract

Neurodegenerative illnesses are becoming more widely acknowledged as complex conditions impacted by immune-mediated processes in addition to neuronal dysfunction. One of the main glycosaminoglycans in the extracellular matrix, Hyaluronan (HA), has emerged a key regulator of tissue homeostasis, inflammation, and immune signaling. Based on the evidence of molecular connections between neurodegenerative and immune-deficient illnesses, this review explores the role of hyaluronan absorption and degradation in the immunological pathway of neurodegenerative disease development. Fragmented HA can function as an endogenous immunomodulatory signal, whereas dysregulated HA metabolism modifies inflammatory signaling, immune cell trafficking, and antigen processing. Neurodegenerative microenvironments are increasingly being shaped by such immune-associated mechanisms. A thorough review of the literature supports this connection by showing that hyaluronan uptake and degradation is a common pathway that is enriched in both immunodeficient disorders and neurodegenerative conditions. This suggests that there is a shared molecular axis that underlies immune dysregulation and neuronal vulnerability. The co-occurrence of immunological dysfunction and neurodegeneration implies, rather than directly addressing neuronal loss, HA-associated pathways may have an indirect impact on disease development via modifying immune responses. This review emphasises hyaluronan metabolism as lucrative and biologically relevant target for immunologically directed intervention from a therapeutic standpoint. Immune-driven neurodegenerative development may be attenuated by altering HA absorption, degradation, or downstream immune signaling. Collectively, this review highlights hyaluronan as a crucial biochemical link between immunodeficiency and neurodegeneration and underscores its potential use in creating immune-based treatment approaches meant to enhance the prognosis of neurodegenerative diseases.

Index Terms

Hyaluronan Metabolism, Neurodegeneration, Immune Dysregulation