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Biological significance and pathophysiological role of Matrix Metalloproteinases in the Central Nervous System

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Abstract

Matrix Metalloproteinases (MMPs), which are endopeptidase reliant on zinc, are low in embryonic tissues but increases in response to a variety of physiological stimulus and pathological stresses. Neuro-glial cells, endothelial cells, fibroblasts, and leucocytes secrete MMPs, which cleave extracellular matrix proteins in a time-dependent manner. MMPs affect synaptic plasticity and the development of short-term memory by controlling the size, shape, and excitatory synapses' function through the lateral diffusion of receptors. In addition, MMPs influence the Extracellular Matrix proteins in the Peri-Neuronal Net at the Neuro-glial interface, which aids in the establishment of long-term memory. Through modulating neuronal, and glial cells migration, differentiation, Neurogenesis, and survival, MMPs impact brain development in mammals. In adult brains, MMPs play a beneficial role in physiological plasticity, which includes learning, memory consolidation, social interaction, and complex behaviors, by proteolytically altering a wide variety of factors, including growth factors, cytokines, receptors, DNA repair enzymes, and matrix proteins. Additionally, stress, depression, addiction, hepatic encephalopathy, and stroke may all have negative effects on MMPs. In addition to their role in glioblastoma development, MMPs influence neurological diseases such as epilepsy, schizophrenia, autism spectrum disorder, brain damage, pain, neurodegeneration, and Alzheimer's and Parkinson's. To help shed light on the potential of MMPs as a therapeutic target for neurodegenerative diseases, this review summarizes their regulation, mode of action, and participation in brain physiological plasticity and pathological damage. Finally, by employing different MMP-based nanotools and inhibitors, MMPs may also be utilized to map the anatomical and functional connectome of the brain, analyze its secretome, and treat neurodegenerative illnesses.

Keywords: Addiction; Depression; Extracellular matrix; Matrix Metalloproteinase; Stress; Synaptic Plasticity.