Journal of Nanomedicine & Biotherapeutic Discovery

OPEN ACCESS Freely available online

Perspective

Harnessing Exosomes as Nanocarriers for Biologic Drug Delivery in Neurological Disorders

Li Wei*

Department of Clinical Neuroscience, Zhejiang University, Hangzhou, China

DESCRIPTION

Neurological disorders, ranging from neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease to acute brain injuries such as stroke, represent a major challenge for global health. These pathologies are often difficult to treat due to the complexity of the Blood-Brain Barrier (BBB), a selective permeability mechanism that limits the efficacy of many therapeutic agents. Exosomes are small bilayer lipid vesicles that range in size from 30 nm to 150 nm in diameter. They are naturally secreted by various cells, including neurons, glial cells, and endothelial cells, and play an important role in intercellular communication by transporting proteins, lipids, RNA (Ribonucleic Acid), and other bioactive molecules. Exosomes are involved in many physiological processes, including immune responses, tissue repair, and modulation of inflammation. This has led scientists to explore their potential in drug delivery systems, particularly in the context of neurological diseases. Exosomes are derived from natural cell membranes, making them highly biocompatible and less likely to elicit an immune response when used as delivery vehicles. This is particularly useful for the delivery of biologic drugs, which may include proteins, RNA-based therapies, or gene-editing tools such as CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats).

Exosomes can be engineered to carry specific surface markers that facilitate their targeting to the desired cells or tissues. This is particularly useful in the case of neurological disorders where precise delivery of therapeutic agents to specific brain regions is essential for efficacy. One of the main challenges in the treatment of neurological diseases is the difficulty in delivering drugs to the brain due to the restrictive nature of the BBB. Exosomes have demonstrated the ability to cross the BBB both paracellularly and intracellularly. Their small size and dual lipid composition allow them to interact with endothelial cells lining the blood vessels in the brain, allowing the cargo to be transported directly to neuronal tissue. Exosomes can carry a wide variety of therapeutic agents, including small molecules, nucleic acids (such as RNA or microRNA), and proteins. This versatility makes them suitable for a wide range of biologic drugs for the treatment of neurological disorders. Additionally, exosomes can be loaded with tools for gene modification, offering a promising approach for precision medicine in the treatment of genetic disorders such as Huntington's disease.

Exosomes have been used to deliver anti-inflammatory molecules, antibodies targeting tau, and even gene therapies aimed at correcting misfolded proteins. These therapeutic strategies are particularly important in Alzheimer's disease (AD), where protein aggregation and neuroinflammation contribute significantly to disease progression. In Parkinson's disease (PD), exosomes have been used to deliver dopamine-producing genes and other neuroprotective agents directly to the brain. Their ability to cross the BBB opens new avenues for gene therapy, offering hope to patients who do not respond well to traditional drug treatments. Exosomes have been studied as tools to deliver neuroprotective factors such as Brain Derived Neurotrophic Factor (BDNF) to improve neuronal survival and repair after ischemic stroke. Their potential to reduce neuroinflammation and promote tissue regeneration is a major focus of on-going research. Clinical application of exosomes in drug delivery is challenging due to the difficulty of producing exosomes in large quantities, the need for precise and efficient loading of therapeutic cargo, and the potential for off-target effects.

Furthermore, the safety and long-term efficacy of exosome-based therapies must be thoroughly studied before clinical translation. Continued advances in exosome engineering, including the development of synthetic exosome mimetics, surface modifications, and optimized cargo loading techniques, are expected to overcome these challenges. Furthermore, with the advent of personalized medicine, exosomes may play a major role in delivering tailored therapies based on individual patient needs. Exosomes represent a novel and highly promising approach for the delivery of biological drugs, particularly in the treatment of neurological disorders. Their biocompatibility, targeted delivery capabilities, and ability to cross the blood-brain

Correspondence to: Li Wei, Department of Clinical Neuroscience, Zhejiang University, Hangzhou, China, E-mail: li.wei@zju.edu.cn

Received: 25-Oct-2024, Manuscript No. JNBD-24-36219; **Editor assigned:** 28-Oct-2024, PreQC No. JNBD-24-36219 (PQ); **Reviewed:** 11-Nov-2024, QC No. JNBD-24-36219; **Revised:** 18-Nov-2024, Manuscript No. JNBD-24-36219 (R); **Published:** 25-Nov-2024, DOI: 10.35248/2155-983X.24.14.289

Citation: Wei L (2024). Harnessing Exosomes as Nanocarriers for Biologic Drug Delivery in Neurological Disorders. J Nanomedicine Biotherapeutic Discov. 14:289.

barrier make them an ideal candidate for advancing treatments for diseases such as Alzheimer's disease, Parkinson's disease, and stroke. Although research is still in its early stages, the future of exosome-based therapies has great potential to revolutionize the treatment of complex neurological diseases.