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Nervous System is Fundamental Regulation of Physiological Activities in the Body

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Introduction

A Every other system in the body is regulated by the central nervous system (CNS), which is essential for this. Periphery-brain crosstalk has gradually become the focus of attention. Since the discovery of bidirectional communication cases between the peripheral and central immune systems as well as between the brain and the peripheral organs (such as the heart, lung, liver, pancreas, gut, and kidney) under physiological or pathological conditions. Pathophysiological disruptions in the brain can lead to dysfunctions in the peripheral organs, according to recent research. At the same time, research has shown that pathological processes in the peripheral brain also play a role in the onset and progression of CNS disorders, like Alzheimer's disease.

Extracellular vesicles (EVs) have been extensively studied and contributed to a new understanding of how the body communicates information. The International Society for Extracellular Vesicles (ISEV) published guidelines that defined EVs as a collection of nanoscale substances derived from the cell membrane structure. They are divided into subgroups based on their diameter, source, and biochemical markers, such as exosomes, microvesicles, microparticles, ectosomes, oncosomes, and apoptotic bodies. EVs are frequently regarded as a biological collection because, regrettably, no practical technical method can thoroughly purify each subtype of EV separately. Eukaryotic organs contain nearly all cells that can secrete EVs. MicroRNAs, proteins, nucleic acids, lipids, and other biological signals from the parent cell are carried by these nanoscale vesicles. Furthermore, these bioactive molecules can be taken up by receptor cells and delivered to them to alter their biological function.

Description

Endothelial cells form the blood-brain barrier (BBB), a highly selective semi-permeable barrier that can prevent non-selective blood-circulating solutes from reaching the CNS's extracellular fluid, where neurons are located. Neurons, astrocytes, pericytes, and the extracellular matrix (ECM) they contain are typically all admitted to the BBB. To prevent brain damage, the BBB cells actively transport metabolites with specific transporters and restrict the entry of peripheral immune factors (such as signal molecules, antibodies, and immune cells) into the CNS. As of not long ago, crossing the BBB have stayed a significant obstruction in relieving CNS problems. Scientists have discovered that EVs may be one of the most important communicators in periphery-brain crosstalk due to their ability to influence BBB phenotype and move between the two sides of the BBB, particularly in a pathological state. This discovery was made possible by the development of a variety of research methods, as well as the separation and purification of nanosized substances. By promoting Cadherin 5 expression, miR-132-enriched EVs, for instance, increased the BBB's selectivity. The cerebrovascular crisis got worse when miR-132-enriched EVs' synthesis and secretion were inhibited. Microvascular endothelial cells' uptake of amyloid beta (A) accelerated the transport of A by EVs from microvascular endothelial cells to the brain, thereby increasing the risk of Alzheimer's disease [1].

In light of such rich exploration discoveries, EVs have produced new knowledge into the pathogenesis and transmission pathways of CNS problems and have started motivation for novel restorative measures. There is a pressing need to investigate the role of EVs in crosstalk between the brain and the periphery, and there is already a growing body of research in this area. A review of the evidence that is currently available is necessary to promote a more comprehensive understanding of CNS disorders and more innovative therapies for them, despite the fact that the work that has been done up to this point is limited and our understanding of CNS disorders may be significantly expanded by conducting more in-depth research in the future. As a result, the current research on EVs-modulated periphery-brain crosstalk in CNS disorders is discussed in this summary, followed by outlooks and predictions for future research directions in light of current obstacles [2].

Four parts summarize the characteristics of extracellular vesicles, or EVs, so that EVs can communicate with the brain and the peripheral nervous system: To begin, EVs have the ability to cross the BBB, which has a significant filtering effect. Due to its high selectivity, the BBB shields the brain from harmful molecules and pathogens, making it difficult for the brain to communicate with the periphery. Interestingly, EVs can cross the BBB bilaterally by being taken in by vascular endothelial cells with endocytosis on one side and released on the other. Second, EVs are widely available and consistently in use. EVs are endogenous and only a nanometer in size, allowing for their steady presence in nearly all bodily fluids and organs. EVs can physically transport their cargoes in order to carry out long-distance information communication thanks to this feature. Thirdly, EVs' path of travel is in some way targeted. Tumor-derived EVs, which have integrin expressed in their membrane, exhibit this characteristic particularly well. In order to direct metastasis and facilitate communication between tumor cells in various organs, Integrin serves as a "navigator." This property can be used to "trick" tumor cells into ingesting chemotherapy drugs by directing their delivery. Engineering modification has the potential to significantly improve this ability, but EVs from the brain and other tissues are slightly less targeted. Last but not least, EVs are able to move a variety of cargoes, including proteins, lipids, and nucleic acids (microRNAs, lncRNAs, and circular RNAs, respectively). In addition, the quantity and type of EVs carried by some CNS disorders are disease-specific and vary depending on the stage of disease progression [3].

EVs have the potential to carry out the task of information communication between the brain and the periphery thanks to the aforementioned benefits. Brain-derived EVs may assist in the diagnosis of CNS disorders by transferring disease-specific molecules into the bloodstream, cerebrospinal fluid (CSF), and other body fluids. As these molecules spread with EVs, a number of pathological conditions in the peripheral organs appeared at the same time, making it difficult to slow the disease's somatic progression. Additionally, the transport of EVs allows toxic substances produced by the peripheral organs to cross the BBB and reach neural cells like neurons and glial cells, which in turn causes neuroinflammation and CNS disorders. Peripheral EVs, on the other hand, are beneficial for the remission of some CNS disorders, particularly those derived from bone marrow, fat, or umbilical cord mesenchymal stem cells, which have demonstrated promising therapeutic results. The biological functions of EVs in the bilateral communication of periphery-brain crosstalk in CNS disorders are the focus [4].

Crosstalk between the peripheral and central immune systems modulated by EVs in CNS disorders Numerous studies have demonstrated that the development of CNS disorders is accompanied by significant central immune system dysfunction. Recent research has revealed that the peripheral immune system has a pathophysiological impact on the neuroimmune system in CNS disorders despite the fact that the BBB prevents peripheral immune cells and molecules from entering the brain in the majority of cases. Additionally, the

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peripheral immune system is made up of the innate immune system and the adaptive immune system. Some of these EVs cross-contaminate the central and peripheral immune systems by transporting cytokines and other important molecules across the BBB. The central immune response and the peripheral immune system both see sharply increased EV secretion. Through the regulation of glial cells, which are essential components of the central immune system, it has been discovered that some innate immune cells, such as macrophages, monocytes, and neutrophils, affect the central immune system by EVs [5].

Conclusion

In addition, it was confirmed that EVs isolated from the plasma of rats with systemic inflammation induced the activation of microglia and increased the microglia-derived secretion. There is growing evidence to suggest that EVs could be important mediums in the crosstalk between the brain and the periphery. The majority of regulation of EVs targets the spread of inflammation between the brain and the periphery because CNS disorders are accompanied by inflammation from the beginning to the end. It has been demonstrated that EVs from the peripheral organs can, through systemic circulation, reach the central nervous system (CNS) and cause the CNS the corresponding pathological and functional damage, acting as important mediators of crosstalk. As a result, the majority of current research focuses on crosstalk between the brain and the periphery. Brain-derived EVs, on the other hand, can travel to the peripheral organs through CNS lesions by breaking through the BBB. Peripheral organ comorbidity may be brought on by the bioactive molecules they carry. There is still solid evidence to support the existence of bilateral communication, despite the fact that relevant research on communication between the brain and the periphery is still in its infancy.

Acknowledgement

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Conflict of Interest

None.

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