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Short Communication

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Exosomes Applications in Parkinson's Disease

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Abstract

Exosomes are a kind of small membrane vesicles with the diameter of 30 nm to 150 nm containing complex RNAs or proteins, which could be secreted by cells under normal and pathological conditions. It has been reported that exosomes could play an important role in cell-cell communication, signaling pathway regulation, disease diagnosis and disease treatment; exosomes have been applied in many fields including clinical diagnosis, immunotherapy and tissue repair. Parkinson's disease as a kind of neurogenerative diseases, it has a high incidence rate in the elderly people, and there is no ideal treatment. The main pathological change of Parkinson's disease is the degeneration and death of dopaminergic neurons in the substantia nigra of the midbrain, which leads to the significant reduction of dopamine in the striatum. Here, we will introduce exosomes applications in Parkinson's disease, which may provide some new idea for Parkinson's disease treatment.

Keywords: Exosomes • Parkinson's disease • Dopamine • Neurogenerative disease

Description

With the depth of research, many articles reported that miRNAs or proteins which encapsulated in exosomes play an important role in Parkinson's disease, and the exosomes could be derived from neurons, astrocytes, oligodendrocytes [1] or neural stem cells [2] no matter normal people or Parkinson's disease patients. Those miRNAs or proteins which encapsulated in exosomes not only could regulate the pathology of Parkinson's disease but also could be the potential diagnosis markers for Parkinson's disease [3-5].

Exosomes-derived miRNAs and Parkinson's disease

Due to the special formation mechanism of exosomes, exosomes contain abundant miRNAs; those miRNAs could take part in the regulation of signal pathway, become the targets of disease treatment, and also could be used as a molecular pathological diagnosis marker of diseases. For example, Yan Jiang, et al. investigated the role of exosomes-derived microRNA-137 (miR-137) in Parkinson's disease, found that down-regulation the expression of exosomal miR-137 could alleviate the oxidative stress injury of Parkinson's disease *in vitro* [6]; Xiang Yang Cao, et al. collected serum samples of normal people and patients with Parkinson's disease, isolated the exosomes from the serum samples and analyzed the miRNAs by qRT-PCR, found that expression of miR-19b was decreased and the expression of miR-195 and miR-24 were increased in patients with Parkinson's disease compared with the normal people [3], and Manna I, et al. analyzed the serum miRNAs in 40 patients with Parkinson's disease and 20 patients with Progressive Supranuclear Paralysis, found that exosomes-derived miR-21-3p, miR-22-3p and miR-223-5p, miR-425-5p, miR-21-3p, and miR-199a-5p could be as the differential diagnostic methods for Parkinson's disease and Progressive Supranuclear Paralysis with high diagnostic sensitivity and specificity [7]. Those data demonstrated that exosomes-derived miRNAs could be used for diagnosis markers for Parkinson's disease or Parkinson's disease treatment.

Exosomes-derived protein and Parkinson's disease

Exosomes-derived protein also could affect the progression of Parkinson's disease. Especially, α-synuclein as a key regulation protein in pathogenesis of Parkinson's disease has been detected in exosomes from Parkinson's disease patients, and α-synuclein could regulate or affect the pathology of Parkinson's disease *via* exosomes-mediated signaling pathway. For example, Min Guo, et al. reported that exosomes-derived from microglia could induce α-synuclein aggregation in neurons, which help us understand the pathology of Parkinson's disease and to provide a potential treatment strategy for Parkinson's disease [8]; and Yun Xia, et al. stereotaxically injected plasma exosomes from patients with Parkinson's disease, found that injected plasma exosomes targeted and activated microglia to accumulate α-synuclein *in vivo* and *in vitro* [9].

Engneered-exosomes and Parkinson's disease

Because of the nano-scaled structure and low immunogenicity, exosomes could permeate the blood brain barrier easily, suggested that exosomes may be the ideal and effective neural drugs delivery vehicles [10,11]. For example, Mengke Qu, et al. injected the dopamine-loaded exosomes into Parkinson's disease mouse model, the results of studies demonstrated that dopamine-loaded exosomes could be delivered to the striatum and substantia nigra by permeating the blood brain barrier with the good therapeutic efficacy and low toxicity. Not only drugs, engneered-exosomes also could deliver RNA to treat the Parkinson's disease [12]. María Izco, et al. delivered a special shRNA mini circle (a kind of siRNAs target to alpha-synuclein) into Parkinson's disease model by RVG-exosomes, found that the specific RVG-exosomes could down-regulate the aggregation of alpha-synuclein, alleviate the loss of dopaminergic neurons, and the clinical symptoms of Parkinson's disease model [13].

Conclusion

Exosomes are nano-scaled small membranous vesicle which released through endocytosis, usually contain all kinds of non-coding small RNAs, lipids and proteins, could play an important role in cell-cell communications, functional regulation and disease treatment. Exosomes could participate in understanding and treatment of Parkinson's disease because of the miRNAs or proteins encapsulated in exosomes related to the Parkinson's disease. With the breakthrough of exosome research technology, we think exosomes applications in Parkinson's disease will be very promising.

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Competing Interests

The authors declare that they have no competing interests.

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