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Mesenchymal Stem Cell-Derived Exosomes in Clinical Trials

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Mesenchymal stem cells, also known as MSCs, are pluripotent stem cells originating from embryonic mesoderm that can develop into a range of cell types and self-renew. Because of this property, MSCs are an effective treatment for various types of diseases. MSCs are widely distributed in the body and can be obtained from bone marrow, umbilical cord, umbilical cord blood, embryo, adipose tissue, dental pulp, skeletal muscle, amniotic fluid, skin, and other tissues. Among these, human umbilical cord-based MSCs are easy to collect and isolate, have a more effective immunomodulatory function and proliferation potential than other MSCs, are natural, non-invasive, and do not raise ethical questions. They also exhibit minimal immunity and proliferate readily in vitro. These cells have attracted the attention of many researchers due to their powerful tools for treating various diseases.

Extensive research studies on the clinical applications of MSC-based therapies including cancer diseases, heart, neurological, and orthopedic disorders have been carried out in recent years. However, compared to intact MSCs, MSC-derived exosomes offer many potential advantages when used as therapeutic agents. First of all, their application prevents the transfer of cells that can have DNA damage or mutations. Second, the exosomes are small (30-100 nm in diameter) and move easily, while MSCs are too big to move through capillaries, and most of them don't make it past the first pass capillary bed. Third, unlike whole cells, exosomes can be transported and stored at low temperatures for lengthy periods of time without losing bioactivity. Furthermore, their lipid bilayer walls can protect content molecules' bioactivity in a complicated physiological environment. Fourth, exosomes can be quantitatively applied to patients in a clinic to improve clinical outcomes and can be engineered through exogenous exosome modification or endogenous cell bioengineering to acquire specific properties((Hu et al, 2022; Dilsiz, 2024).

Therapeutic deliverable exosomes are emerging as viable cargo delivery vehicles because to their natural intercellular communication, great biocompatibility, low immunogenicity, low toxicity, lengthy blood circulation ability, and aptitude to traverse a range of biological barriers. Since exosomes are membrane-bound nanoparticles, they usually create a lower immune system reaction than stem cells. This makes exosomes more biocompatible and enhances the possibility that a therapy will be successful. Exosomes are easily made from cultured stem cells and can be stored for a longer period of time in optimal conditions. This makes MSCs possible to produce exosomes in high quantities and use them to treat various types of diseases. Based on preclinical research, 39 clinical trials are now investigating the use of MSC-derived exosomes for a range of disorders(available online: http://www.clinicaltrials.gov/)some of which have published their results.

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