The Impact of Mesenchymal and Muscle-Derived Stem Cells on Skeletal Muscle Function and Molecular Background in the mdx Mouse Model of Muscular Dystrophy

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Abstract

Introduction / Objectives: Duchenne muscular dystrophy (DMD) is a severe genetic disorder leading to progressive degeneration of skeletal muscles, including respiratory and cardiac muscles. Advances in medicine and physiotherapy have extended patients' lifespan; however, this improvement is often not accompanied by a corresponding enhancement in quality of life.

Modern therapeutic approaches focus on stem cell therapy due to its regenerative potential. Stem cells are capable of differentiating into skeletal muscle cells, potentially replacing damaged tissues. Studies investigating the use of stem cells, including mesenchymal stem cells (MSCs) and induced pluripotent stem cells (iPSCs), have shown promising results in improving physical performance, muscle strength, and overall health status.

Materials and Methods: Tissue-derived mesenchymal stem cells (MSCs), and Human iPSC-Derived Mesoangioblast-Like Cells (HIDEMs). The regenerative potential of the cells was first evaluated under in vitro conditions and subsequently administered to dystrophic mice via intramuscular injections into skeletal muscles (m. tibialis anterior and m. gluteus maximus). In the case of HIDEM cells, systemic administration via tail vein injection was also performed.

The functional effects of the therapy were assessed based on overall physiological condition, including blood parameter analysis and body temperature measurements, physical performance evaluated by treadmill running tests, muscle strength measured using forelimb and hindlimb grip strength tests, hemodynamic and cardiovascular parameters (systolic/diastolic blood pressure and heart rate), as well as molecular analysis of muscle samples collected after therapy.

Results: Improved physical performance, reflected by an increased running distance ($p<0.01$), as well as enhanced muscle strength ($p<0.05$), were observed in mice treated with SkMDSPCs and MSC stem cell therapy.

Conclusions: The obtained results indicate that stem cell-based therapies may represent a promising future adjunctive treatment for DMD, contributing not only to slowing muscle degeneration but also to improving functional capacity and quality of life.

Keywords

Duchenne muscular dystrophy, stem cell therapy, muscle regeneration.

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