Stem Cell Therapy in Spinal Cord Injury

An assay submitted for partial fulfillment of the requirements for the degree "Master of Science" in Orthopedic surgery

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SUMMARY

Spinal cord injury (SCI) primarily affects young adults, lead to severe and permanent neurological deficits and consequent disabilities usually persist throughout the rest of their lives. . The costs for long- term nursing and rehabilitative care pose huge economic burdens on patients and their families and even society.

Although no effective therapeutic option is currently available, recent progresses in stem cell biology have opened an avenue to therapeutic strategies to replace neural cells by transplantation of stem/progenitor cells for various disorders in the CNS, recent animal studies have shown that cellular transplantation strategies hold promise to enhance functional recovery after spinal cord injury (SCI).

At least a part of functional deficits after SCI is attributable to chronic progressive demyelination. Therefore, several studies transplanted glial-restricted progenitors or oligodendrocyte precursors to target the demyelination process.

Directed differentiation of stem/progenitor cells to oligodendrocyte lineage prior to transplantation or modulation of microenvironment in the injured spinal cord to promote oligodendroglial differentiation seems to be an effective strategy to increase the extent of remyelination.

Transplanted stem/progenitor cells can also contribute to promoting axonal regeneration by functioning as cellular scaffolds for growing axons. Scaffolds used to fill the lesion cavity or introducing regeneration-promoting genes will greatly increase the efficacy of cellular transplantation strategies for SCI.

A large number of studies have focused on stem cell therapy for SCI, most of which showed good effects. The common stem cell types for SCI treatment include mesenchymal stem cells (MSCs), hematopoietic stem cells (HSCs), neural stem cells (NSCs), induced pluripotent stem cells (iPSCs), and embryonic stem cells (ESCs). The modes of treatment include in vivo and in vitro induction.

T he pathways of transplantation consist of intravenous, transarterial, nasal, intraperitoneal, intrathecal, and intramedullary injections. Most of the SC treatments for SCI use a number of cells ranging from tens of thousands to millions. Early or late stem cell administration, application of immunosuppressant or not are still controversies.

Potential mechanisms of SC therapy include tissue repair and replacement, neurotrophy, and regeneration and promotion of angiogenesis, antiapoptosis, and anti-inflammatory. Common safety issues include thrombosis and embolism, tumorigenicity and instability, infection, high fever, and even death.

Recently, some new approaches, such as the pharmacological activation of endogenous SCs, biomaterials, 3D print, and optogenetics, have been also developed, which greatly improved the application of stem cell therapy for SCI.

Most studies support the effects of stem cell therapy on SCI, while a few studies do not. The cell types, mechanisms, and strategies of are very different among studies. In addition, the safety cannot be ignored, and more clinical trials are required. The application of new technology will promote stem cell therapy of SCI.