NASCIC
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ADVOCACY COURSE

Module 8 – Cell Replacement

How Stem Cells Work for Therapeutic Effects

Cell transplantations can exert beneficial effects in several ways which depend on the cell type used.

For neuronal cells derived from NSCs, new neurons can integrate into the spinal cord to communicate with other neurons. The goal is for transplanted neurons to form relays to communicate information across the lesion.

NSCs can also turn into new oligodendrocytes and form new myelin on axons that have lost their myelin insulation.

Even new astrocytes derived from NSCs could help facilitate axon regeneration and support existing neurons.

NSCs, similar to other cell types, also produce growth supporting proteins that can induce regeneration of damaged axons, plasticity, and support survival from secondary injury.

Mesenchymal stem cells (MSCs) and bone marrow stromal cells (BMSCs) are non neural cells and stem cells commonly used for transplantation. MSCs and BMSCs are not used for their abilities to turn into neurons, but instead, are used for their ability to produce high amounts of anti-inflammatory molecules, and growth-promoting molecules that can induce plasticity and regeneration.

Because MSCs and BMSCs don't function by replacing lost neural architecture they have been experimentally applied by delivering both into the spinal cord, as well as outside of the spinal cord, to reduce inflammation and encourage survival of spinal cord tissue and plasticity.

MSCs are a purified source of stem cells derived from the bone or fat and typically require expanding in culture. BMSCs are a mixture of unpurified cells derived from the bone marrow, consist of both MSCs and hematopoietic cells amongst other cell types, but can be directly relocated from the bone marrow to the spinal cord with minimal processing.

Schwann Cells are a form of myelinating cell that exists in the peripheral nervous system and are essential to the ability of the peripheral nervous system to regenerate. Schwann Cells also function by producing growth factors and trophic factors to encourage axon growth and plasticity. Schwann Cells may also be capable of remyelinating axons that have lost their insulation similar to oligodendrocytes that have been derived from NSCs.

Schwann Cells can be obtained from an individual's own body and either expanded in culture, or the peripheral nerve can be cut out and re-implanted directly into the spinal cord lesion.

Finally, the ability for cell transplants to produce and secrete proteins that encourage regeneration has been attributed to much of the therapeutic properties of stem cells. Researchers have made use of genetic engineering approaches to force stem cells to produce high abundances of key proteins such as growth factors and trophic factors. Forcing the expression of more regenerative proteins has been explored as a means of augmenting the therapeutic effects of stem cell transplants.

As we've discussed, many factors will affect the survival and success of these new cells in the injured region. Cell transplantation, although very popular in clinical trials, still have a long way to go to ensure appropriate therapeutic effects can occur.