SPINAL CORD INJURY TREATMENTS

ADULT STEM CELLS VS. EMBRYONIC STEM CELLS

Adult Stem Cells Treat Spinal Cord Injury in Humans and Animals:

2008 Researchers reported that bone marrow adult stem cells improved function in eight spinal cord injury **patients**. Geffner LF *et al.*, Administration of autologous bone marrow stem cells into spinal cord injury patients via multiple routes is safe and improves their quality of life: Comprehensive case studies, *Cell Transplantation* 17, 1277-1293, 2008.

2008 Australian scientists published results of a 3-year clinical trial, showing adult nasal cells were safe and produced some improvement for spinal cord injury **patients**. Mackay-Sim A *et al.*, Autologous olfactory ensheathing cell transplantation in human paraplegia: a 3-year clinical trial, *Brain* 131, 2376 - 2386, September 2008.

2006 Scientists in Italy & Israel demonstrated that stimulating immune cells enhanced abilities of adult neural stem cells to promote functional recovery of mice with spinal cord injury. Ziv Y *et al.*, Synergy between immune cells and adult neural stem/progenitor cells promotes functional recovery from spinal cord injury, *Proceedings of the National Academy of Sciences USA* 103, 13174-13179, August 29, 2006.

2006 Spanish researchers achieved almost complete functional recovery of rats with chronic spinal cord injury using bone marrow adult stem cells. Zurita M & Vaquero J, Bone marrow stromal cells can achieve cure of chronic paraplegic rats: functional and morphological outcome one year after transplantation, *Neuroscience Letters* 410, 51-56, July 10, 2006.

2006 Dr. Carlos Lima in Portugal reported on transplant of nasal stem cells into 7 **patients** with spinal cord injury. Patients regained some motor function and sensation, and 2 patients showed bladder control improvement. Lima C *et al.*, Olfactory mucosa autografts in human spinal cord injury: A pilot clinical study, *Journal of Spinal Cord Medicine* 29, 191-203, June 2006.

2006 Toronto researchers found that transplanting adult neural stem cells into rats up to 8 weeks after spinal cord injury resulted in significant improvement and recovery. Karimi-Abdolrazaee S *et al.*, Delayed transplantation of adult neural precursor cells promotes remyelination and functional neurological recovery after spinal cord injury, *J Neuroscience* 26, 3377-3389, 29 March 2006

2006 University of Louisville scientists turned nasal stem cells into specialized cells that could insulate neurons, and showed repair of spinal cord damage in rats. Zhang X, *et al.*, Role of transcription factors in motoneuron differentiation of adult human olfactory neuroepithelial-derived progenitors, *Stem Cells* 24, 434-442, March 2006

2005 Treating spinal cord injured rats with umbilical cord blood stem cells gave moderate recovery in mobility and function. Kuh S-U *et al.*, Functional recovery after human umbilical cord blood cells transplantation with brain-derived neurotrophic factor into the spinal cord injured rat, *Acta Neurochir (Wien)* 147, 985-992, 2005.

2005 Extending earlier results, Wisconsin and Swedish researchers injected neural stem cells into rats with spinal cord injury. The study shows reduction of pain, and increased recovery of function and feeling. Hofstetter CP *et al.*, Allodynia limits the usefulness of intraspinal neural stem cell grafts; directed differentitation improves outcome, *Nature Neuroscience* 8, 346-353, March 2005.

2004 Japanese scientists tested the effects of bone marrow stromal cells on repair of injured spinal cord. The study demonstrated that the adult stem cells promoted both tissue recovery and behavioral improvements in rats. Ohta M *et al.*, Bone marrow stromal cells infused into the cerebrospinal fluid promote functional recovery of the injured rat spinal cord with reduced cavity formation, *Experimental Neurology* 187, 266-278, 2004.

2003 University of South Florida and Korean researchers used human umbilical cord blood stem cells on rats with spinal cord injuries. Cells migrated to injured areas and rats showed significant behavioral improvements even treated days after the injury. Saporta S *et al.*, Human umbilical cord blood stem cells infusion in spinal cord injury: Engraftment and beneficial influence on behavior, *J Hematotherapy Stem Cell Research* 12, 271-278, 2003.

Touted ESCR Spinal Cord Injury Studies in Animals:

2006 Johns Hopkins researchers turned embryonic stem cells into motor neurons and showed some improvement in mobility of spinal cord injured rats; however, one of the factors needed for success was adult neural stem cells to provide a growth factor and migration path for the embryonic stem cells. Deshpande DM *et al.*, Recovery from paralysis in adult rats using embryonic stem cells, *Annals of Neurology* 60, 32-44, 2006.

2006 California researchers showed that human embryonic stem cells in spinal cord-injured rats did not cause a decline in locomotion in the injured rats. No evidence of improvement was reported. Cloutier F et al., "Transplantation of human embryonic stem cell-derived oligodendrocyte progenitors into rat spinal cord injuries does not cause harm," *Regenerative Medicine.* 1, 469-479, 2006.

2005 California researchers used human embryonic stem cells to treat rats with new but not long-term spinal cord injury. The stem cells were turned into the nerve cells that surround spinal cords, and the rats showed modest functional improvement. The experiment was not continued long enough to test for tumors. Keirstead H *et al.*, Human embryonic stem cell derived oligodendrocyte progenitor cell transplants remyelinate and restore locomotion after spinal cord injury, *J Neuroscience* 25, 4694-4705, May 11, 2005.

2005 Researchers at Washington University, St. Louis, found that transplanting embryonic stem cells into rat spinal cord gave no improvement, and caused tumors in a number of animals. Howard MJ *et al.*, Transplantation of apoptosis-resistant embryonic stem cells into the injured rat spinal cord, *Somatosensory and Motor Research* 22, 37-44, March/June 2005.

2005 Researchers used human embryonic stem cells to remyelinate the protective sheath around injured rat spinal cords. However, there was no test for any functional recovery. Nistor GI *et al.*, Human embryonic stem cells differentiate into oligodendrocytes in high purity and myelinate after spinal cord transplantation, *Glia* 49, 385-396, February 2005.

1999 Researchers used human embryonic stem cells in rats with spinal cord injury. The rats showed some functional improvement. McDonald JW *et al.*, Transplanted embryonic stem cells survive, differentiate and promote recovery in injured rat spinal cord, *Nature Medicine* 12, 1410-1412, December 1999.