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Stem cells and biomaterials for the treatment of spinal cord injury, stroke and ALS

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Stem cells alone or in combination with biomaterials have been investigated for their therapeutic potential in animal models of spinal cord injury (SCI), stroke and ALS. We compared human mesenchymal stem cells (MSCs) from bone marrow, a conditionally immortalized human stem cell line from fetal spinal cord (SPC-01) and human induced pluripotent stem cell-derived neural precursors (iPS-NPs) for their capacity to migrate towards lesion sites, differentiate and induce regeneration. Transplanted cells were labeled with iron-oxide nanoparticles for MRI tracking. Animals were tested using motor and sensory tests. Animals with chronic SCI were implanted with HPMA-RGD hydrogels seeded with MSCs. In SCI, the best functional improvement was found after iPS-NP transplantation, followed by MSCs and SPC-01. MRI proved that the cells migrated into the lesion, survived for several months and differentiated into motoneurons and glia. Improved motor and sensory scores in chronic SCI were found after the implantation of biomaterials seeded with MSCs. Natural ECM hydrogels bridged the SCI lesion cavity, modulated the immune response and provided the substrate for *in vivo* neural tissue regeneration. Grafting of iPS-NPs reversed stroke-induced somatosensory and motor deficits and protected the host substantia nigra from atrophy. MSC were also intrathecally applied to rat ALS-model (SOD1). Overall survival in the cell-treated group compared with the sham-treated group was prolonged, the cell-treated rats showed better motility, grip strength and greater numbers of perineuronal nets in the spinal cord. Our results demonstrate that the intrathecal application of MSCs can slow down progression of the disease.

Biography

Eva Sykov is a Physician, Scientist, an internationally recognized expert in Neuroscience and Cell Therapy and was the Director of the Institute of Experimental Medicine from 2001-2016. Her research focuses on neurologic diseases and stem cells. She has worked at Charles University, Prague, Founding and Directing the Department of Neuroscience, 2nd Medical Faculty (1996-2012) and leading the Center for Cell Therapy and Tissue Repair (2000-2011). In 2008 she built the Innovative Biomedical Center, which houses a business incubator that assists in the transfer of results in regenerative medicine research into practice.

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