Stem cells in spinal cord injury repair

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Spinal cord injury (SCI) often results in irreversible and permanent neurological deficits below the injury site and is considered a pathological state of functional damage to local neurons and axons fibres. There are several experimental treatments to minimize tissue damage: in the last years, cell transplantation emerged as a promising approach in spinal cord repair.

In our laboratory we use several experimental models of SCI in rodents, such as hemisection or compression, and study the effects of stem cell transplantation at different time interval from injury, to mimic therapy administered in humans in the acute and chronic phases. Moreover, we tested and compared the effects of the administration of different stem cell types, i.e. mesenchymal stem cells (MSCs) and embryonic neural precursors (NPs). We have studied the effects of stem cell transplantation on the formation of the glial cyst, on microglial activation and astrogliosis, and axonal growth. We have also considered functional recovery with a battery of behavioural motor tests for rodents.

First of all, in all cases the percentage of transplanted stem cells surviving in the host was very low (below 2%). Whereas we never observed a neural differentiation of MSCs, when we transplanted NPs we found groups of neurons extending their axons for several neuromers and making synapses, thus suggesting integration into the neural circuits of the host. Both types of cells reduced the glial cyst, microglial activation and astrocytosis, and, in the hemisection model, promoted sprouting of serotonergic raphespinal projections from the uninjured side. We have finally shown that stem cell transplantation promotes functional recovery after SCI.

Therefore, stem cell transplantation offers a promising approach for inducing regeneration through the damaged area. Stem cells, more than replacing damaged cells, can promote self repair of the injured spinal cord through the release of neurotrofic factors and immunomodulatory molecules. Our results support the therapeutic potential of these cells, since they can survive for a long time, differentiate, integrate in the host injured spinal cord and promote functional recovery after SCI.