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Transplantation of stem cell-derived neural network scaffold to repair transected spinal cord

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Functional deficits following spinal cord injury primarily attribute to neural cell death and loss of connectivity. Therefore, we designed tissue engineered neural network acting as bridge to rebuilt signal connection between the cut ends of the ruptured spinal cord. Adult stem cells with genetically enhanced expression of tropomyosin receptor kinase C (TrkC) were induced into neuron-like cells after co-cultured with Schwann cells over-expressing neurotrophin-3 in a gelatin sponge scaffold for 14 days. The formation of stem cell-derived neural network was confirmed by electron microscope and recording of spontaneous postsynaptic currents by whole-cell patch clamp. Then, this neural network scaffold was grafted acutely into rats with removal of 2 mm spinal cord tissue. Eight weeks later, stem cell-derived neuron-like cells of the grafts maintained their synaptic connection or formed new connection with regenerative axons. Although biotinylated dextran amine labeled fibers of corticospinal tract only formed a few connections with stem cell-derived neuron-like cells in the grafts, 5-HT labeled fibers formed much more connections. Furthermore, part of these connections was confirmed to be synaptic connections by double-labeled immunoelectron microscope. Animals with neural network scaffold transplantation resulted in higher BBB score and were improved cortical motor evoked potential. These findings indicate that stem cell-derived neuron-like cells resulting from NT-3/TrkC-induced differentiation can partially integrate into host neural network in rat spinal cord transected. The stem cell-derived neural network in the transection site of spinal cord may accept ascending or descending neural information, meanwhile, transduct it to the host neurons located at both sides of end of the transection site.

Biography

Yuan-shan Zeng is a Professor of Histology and Embryology. He has completed his PhD in Histology and Embryology from West China University of Medical Sciences in 1991. In 1998, he took Post-doctoral fellow training at Department of Anatomy, Indiana University. He has worked as a Visiting Professor at Department of Anatomy, the Hong Kong University in 2003. He is currently appointed as Head of Department of Histology and Embryology and Vice Director at Institute of Spinal Cord Injury in Sun Yat-sen University. His research program is mainly focused on "The stem cell transplantation and mechanism of repairing of spinal cord injury". So far, he has published more than 50 papers on international academic journals.

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