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Biophysics of migration of olfactory ensheathing cells (OEC), possible application in spinal cord injuries

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Abstract

Introduction: Olfactory ensheathing cells (OECs) are a unique type of glial cells with axonal growth-promoting properties. Unlike other glial cells, OECs can migrate and enhance axonal extension after spinal cord injury (SCI). Some of the most important regulatory mechanisms of OEC guidance and migration in regeneration involve Lamellipodial protrusions, lamellipodial waves, mechanical forces and brain-derived neurotrophic factor (BDNF). However, the presence of Neurite outgrowth inhibitor (NOGO) prevents axonal regrowth. These factors should be considered in the process of OECs transplantation for neural repair and therapeutic purposes.

Methods: The activities of cell and their interactions with each other and media was monitored and analyzed in real time through advanced time lapse technique. The "scratch" migration assay, inverted coverslip and Boyden chamber migration assays and traction force microscopy were implemented to monitor and study the cytoskeletal dynamics as well as the effect of BDNF on migration of OECs. Docking of dodecylphosphocholine (DPC) to Nogo-66 was modeled to reveal the mechanism at the molecular level.

Results and discussion: The cell–cell adhesion process does not occur and the migration rate is declined in the absence of highly dynamic lamellipodia waves. The transient receptor potential cation channels (TRPCs) that are responsible for BDNF-induced calcium signals, and required for BDNF-induced OEC migration were highly expressed in OECs. There was also a correlation between cytoskeletal dynamics and substrate stiffness in growth cones in different types of neurons that shows the importance of the mechanical properties of the environment in neuronal navigation during embryonic development and nerve regeneration.

Conclusion: The results reveal that transplantation and migration of OECs provide a promising means to be implemented for the treatment of nerve injuries, though and more experiments are needed to approve it for clinical purposes.

Keywords: Biophysics, OEC, migration, spinal cord injuries, growth factors, neuron, axon, regeneration

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