Abstract

Mesenchymal stem cells (MSCs) naturally differentiate into cells of tissues of mesodermal lineage: cartilage, bone or adipose tissue. As a result of specific environmental stimuli, MSC are able to transdifferentiate into cells of endodermal or ectodermal lineage. Also, MSCs are able to regulate the inflammatory processes and to support healing and regeneration. These properties make MSCs suitable in cell-based therapy and tissue engineering. Characteristics of MSCs (for example differentiation and proliferative potential and cytokine secretion profile) can vary slightly depending on their origin. These differences can be further amplified by the effects of specific environments. Thus, to obtain maximal benefit, it is important to select MSCs optimal for a particular environment. The main goal of this thesis was to design *in vitro* protocol for transdifferentiation of MSCs into neuron-like cells. For this application, the adipose tissue-derived MSCs seemed to be optimal, due to their higher production of basic fibroblast growth factor, one of the important factors in neural development. The resulting cells acquired typical neuron-like morphology, expressed genes for neuron-specific markers and produced neuron-specific proteins. Further, the resulting cells showed immunomodulatory properties similar to non-differentiated MSCs; they suppressed the production of IFN-g and supported the production of IL-10 in activated splenocytes. Thus, these neuron-like cells could both be used for their anti-inflammatory effect, as well as for replacement of lost neuronal cells. By contrast, in a case of damaged rabbit cornea, bone marrow-derived MSCs showed better results in the healing of the injury, compared to adipose tissue-derived MSCs, and were able to substitute the role of absent limbal stem cells.