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Treatment of Neuronal Defects by Bone Marrow Stem Cells Differentiation to Neuronal Cells Cultured on Gelatin-PLGA Scaffolds Coated with Nano-Particles

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Abstract : Introduction: Although the application of a new strategy remains a remarkable challenge for treatment of disabilities due to neuronal defects, progress in Nanomedicine and tissue engineering, suggesting the new medical methods. One of the promising strategies for reconstruction and regeneration of nervous tissue is replacing of lost or damaged cells by specific scaffolds after Compressive, ischemic and traumatic injuries of central nervous system. Furthermore, ultrastructure, composition, and arrangement of tissue scaffolds are effective on cell grafts. We followed implantation and differentiation of mesenchyme stem cells to neural cells on Gelatin Polylactic-co-glycolic acid (PLGA) scaffolds coated with iron nanoparticles. The aim of this study was to evaluate the capability of stem cells to differentiate into motor neuron-like cells under topographical cues and morphogenic factors. Methods and Materials: Bone marrow mesenchymal stem cells (BMMSCs) was obtained by primary cell culturing of adult rat bone marrow got from femur bone by flushing method. BMMSCs were incubated with DMEM/F12 (Gibco), 15% FBS and 100 U/ml pen/strep as media. Then, BMMSCs seeded on Gel/PLGA scaffolds and tissue culture (TCP) polystyrene embedded and incorporated by Fe Nano particles (FeNPs) (Fe3o4 oxide (M w= 270.30 gr/mol.). For neuronal differentiation, 2×10 5 BMMSCs were seeded on Gel/PLGA/FeNPs scaffolds was cultured for 7 days and 0.5 µ mol. Retinoic acid, 100 µ mol. Ascorbic acid,10 ng/ml. Basic fibroblast growth factor (Sigma, USA), 250 µM Iso butyl methyl xanthine, 100 µM 2-mercaptoethanol, and 0.2 % B27 (Invitrogen, USA) added to media. Proliferation of BMMSCs was assessed by using MTT assay for cell survival. The morphology of BMMSCs and scaffolds was investigated by scanning electron microscopy analysis. Expression of neuron-specific markers was studied by immunohistochemistry method. Data were analyzed by analysis of variance, and statistical significance was determined by Turkey's test. Results: Our results revealed that differentiation and survival of BMMSCs into motor neuron-like cells on Gel/PLGA/FeNPs as a biocompatible and biodegradable scaffolds were better than those cultured in Gel/PLGA in absence of FeNPs and TCP scaffolds. FeNPs had raised physical power but decreased capacity absorption of scaffolds. Well defined oriented pores in scaffolds due to FeNPs may activate differentiation and synchronized cells as a mechanoreceptor. Induction effects of magnetic FeNPs by One way flow of channels in scaffolds help to lead the cells and can facilitate direction of their growth processes. Discussion: Progression of biological properties of BMMSCs and the effects of FeNPs spreading under magnetic field was evaluated in this investigation. In vitro study showed that the Gel/PLGA/FeNPs scaffold provided a suitable structure for motor neuron-like cells differentiation. This could be a promising candidate for enhancing repair and regeneration in neural defects. Dynamic and static magnetic field for inducing and construction of cells can provide better results for further experimental studies.

Keywords : differentiation, mesenchymal stem cells, nano particles, neuronal defects, Scaffolds
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