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Application of bone-marrow mesenchymal stem cells and platelet-derived growth factors for human osteogenic graft engineering

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Tissue engineering is one of the perspective approaches for therapy of large bone defects resulted from trauma or tumor resection and non-healing fractures. Composition of biograft includes collagen-hydroxyapatite scaffold, human mesenchymal stem cells (hMSCs), preparations of platelet-derived growth factors (PDGFs) and fibrin glue. The purpose of the study was to assess the effect of soluble preparations of PDGFs on hMSCs proliferation then osteogenic differentiation *in vitro* and to support bone reconstruction *in vivo*. Preparations of PDGFs were platelet releasate (PR) and platelet lysate (PL). In our experiments, *in vitro* PR and PL were shown to increase cell proliferation by 16.6- and 14.4- fold respectively at the final concentration of 5% compared to a basal medium with 10% fetal bovine serum. Induction of osteogenic differentiation of MSCs *in vitro* by β-glycerophosphate, L-ascorbic acid and dexamethasone was up-regulated by PL (in 5% concentration), as it was demonstrated by augmentation of *osteopontin* (SSP1) gene expression for 4.7-fold and osteocalcin (*BGLAP*) gene expression for 18.9 fold. Experiments *in vivo* showed that rabbit radial bone defects of 1.5×0.7×0.3 cm in size were efficiently replaced by MSC-based osteogenic graft. X-ray densitometry showed the increase of bone density to 2200±100 Hounsfield units (HU) in site of biograft implantation in comparison with 1800±100 HU in non-treated control 3 months post operation. Immunohistochemical staining elicited osteogenesis activation with tubular bone formation in site of biograft replacement. Healing process was weaker when only pre-differentiated hMSCs and scaffold without PDGFs were used in biograft composition. To summarize, hMSCs, PL, collagen-hydroxyapatite scaffold and fibrin glue are the principal components in engineering of MSC-based human osteogenic graft for bone repair, healing and substitution.

Biography

Nataliya Danilkovich has graduated from the Belarusian State University, Biological Faculty, Department of Microbiology from Belarus. Currently, she is a PhD candidate at the Department of Cellular Biotechnologies, The Republic Research Center for Transfusiology and Medical Biotechnologies. She has published 1 international and 13 national paper.

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