EuroSciCon

October 04-06, 2018
Moscow, Russia

17th Edition of International Conference and Exhibition on

Pharmaceutics and Novel Drug Delivery Systems

Int J Drug Dev & Res 2018, Volume 10
DOI: 10.21767/0975-9344-C1-003

Engineered spatiotemporal delivery of morphogens for concurrent vascularization and osteogenesis

Esmaiel Jabbari
Florida University of South Carolina, USA

Osteogenesis and vascularization during development are coupled by spatiotemporal regulation of paracrine signaling in which the invading vascular endothelial progenitor cells (EPCs) secrete osteogenic morphogens to stimulate cell differentiation and bone formation. Conversely, the differentiating mesenchymal stem cells (MSCs) in the vicinity of the vascular endothelial cells release vasculogenic morphogens to further stimulate vasculogenesis for the metabolically highly active osteoblasts. The objective of this work was to investigate the effect of timed and localized release of an osteogenic morphogen, bone morphogenetic protein-2 (BMP2) and a vasculogenic morphogen, vascular endothelial growth factor-165 (VEGF), in a micro-patterned co-culture system on synergistic expression of paracrine signaling factors and coupling of osteogenesis and vasculogenesis. Polyethylene glycol based nano gels (NGs) were used for grafting and timed-release of BMP2 for 21 days and timed-release of VEGF for 10 days. Human MSCs and NG-BMP2 were encapsulated in a high-stiffness slow-resorbing hydrogel matrix whereas the combination of human MSCs+EPCs and NG-VEGF were encapsulated in a compliant fast-resorbing gelatin-based matrix. The effect of spatiotemporal release of VEGF and BMP2 on vascularized osteogenesis and paracrine signaling was assessed by biochemical, mRNA, protein analysis, and immunofluorescent staining. Timed release of VEGF and BMP2 from the NGs resulted in the highest extent of vascularized osteogenesis by the encapsulated human MSCs and EPCs in the micro-patterned matrix. Further, localized and timed-release of VEGF and BMP2 in the patterned matrix sharp increased the expression of paracrine signaling factors basic fibroblast growth factor (bFGF, vasculogenic and osteogenic), platelet-derived growth factor (PDGF, vasculogenic), and transforming growth factor-beta (TGF-β, osteogenic) by the encapsulated human MSCs and EPCs. These results suggest that mineralization and vascularization are coupled by localized secretion of paracrine signaling factors by the differentiating MSCs and EPCs.

jabbari@cec.sc.edu