Characterization of three-dimensional bone constructs derived from unloaded human fetal osteoblasts exposed to the random positioning machine.

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Abstract

Human cells exposed to microgravity form large 3D tissue constructs mirroring the in vivo architecture (e.g. cartilage, intima constructs, cancer spheroids and others). In this study, we exposed human fetal osteoblasts (hFOB 1.19) cells to the Random Positioning Machine (RPM) for 7 and 14 days with the purpose to engineer 3D bone constructs. RPM-exposure of hFOB 1.19 cells induces alterations in the cytoskeleton, cell adhesion, ECM and 3D multicellular spheroid (MCS) formation. In addition, it also influences the morphologic appearance of these cells after 7 days as it forces adherent cells to detach from the surface and assemble in 3D structures. The RPM-exposed hFOB 1.19 cells exhibited a differential gene expression of the following genes: transforming growth factor beta 1 (TGFB1), bone morphogenetic protein 2 (BMP2), SRY-Box 9 (SOX9), actin beta (ACTB), beta tubulin (TUBB), vimentin (VIM), laminin subunit alpha 1 (LAMA1), collagen type 1 alpha 1 (COL1A1), phosphoprotein 1 (SPP1) and fibronectin 1(FN1). RPM-exposure also induced significantly altered release of the cytokines and bone biomarkers sclerostin (SOST), osteocalcin (OC), osteoprotegerin (OPG), osteopontin (OPN), interleukin 1 beta (IL-1□) and tumor necrosis factor 1 alpha (TNF-1□). After two weeks of incubation, the spheroids presented a bone-specific morphology. Of late unloading conditions and use of prebiotics are known to augment 3D tissue engineering of immune cells and bone. Preliminary results from the use of a prebiotic AHCC on lymphocytes and hFOB cells in unloaded conditions will also be presented.

Biography

Dr.Sundaresan is a Professor of Biology at Texas Southern University and the director of the Osteoimmunology and Integrative Physiology Laboratory. Her laboratory focusses on research in Immune suppression, mathematical modeling, bone biology, tissue engineering, cardiovascular biomarkers and nutritional immunomodulation.The specific areas we investigate are upstream targets in lymphocyte signaling in microgravity, adaptive genetic response gene suites, hyper gravity and high altitude stress, lymphocyte locomotion and signal transduction in microgravity,bone tissue engineering and resorption models and human radiation/cancer / toxicity models. We also have ongoing projects in nanoformulation, nanotechnology and mathematical tissue modeling of heavy ion effects..

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