Poster Session 1 – Tissue Engineering

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Effect of PDLLA/Bioglass composite films on expression at the mRNA level of collagen type I and bone sialoprotein in fetal osteoblasts

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In this study, we investigated a composite material with orthopaedic applications consisting of poly-d,l-lactide (PDLLA) and bioactive glass (Bioglass) ceramic particles. We evaluated its effect on the expression of bone specific markers at the mRNA level in fetal osteoblasts. We hypothesized that resorbable bioactive scaffolds generate, at the molecular level, an extracellular environment that induces a suitable array of signals to provoke the process of bone tissue morphogenesis. Composite films of poly-d,l-lactide (PDLLA) containing different amounts (0, 5 and 40 w/w) of bioactive glass (45S5 Bioglass) were prepared and used to test this in vitro. For many years, bioactive glasses, such as 45S5 Bioglass, have successfully been used in clinical applications, earning them an important place amongst clinical materials. Polymers based on lactic acid, such as PDLLA, have also been reported in terms of safety and biodegradation in man for two decades. We investigated how, in-vitro, the new composites developed here affect the expression of a number of genes associated with the differentiation and extracellular matrix deposition processes of fetal osteoblasts. Primary human fetal osteoblasts isolated from long bones of materials obtained from elective termination of pregnancy were seeded and cultured on the films and on culture-treated plastic (control) for a period of 4 days in basic culture medium (D-MEM/F-12 Nut Mix HAM, supplemented with 10% (v/v) FBS, 50 U mL^{-1} penicillin and 50 $\mu g\,mL^{-1}$ streptomycin). Real time RT-PCR was performed to check for the expression of osteoblastic markers at the mRNA level. Within four days, the cells demonstrated cytoskeletal organization by stress fiber formation and focal contact formation on the composite films. Real time RT-PCR analysis revealed that in the cells seeded on the 5% PDLLA/Bioglass films the expression of bone sialoprotein was significantly upregulated ($P > 0.1$) and collagen I expression was upregulated only for the Bioglass containing films (vs PDLLA alone) compared with control. In contrast, alkaline phosphatase expression was downregulated for all composites and PDLLA alone. The above study investigated the potential of PDLLA/Bioglass composites to induce cell differentiation. Our results indicate that incorporation of 45S5 Bioglass within the composites affects both collagen type I and bone sialoprotein mRNA levels in a concentration-dependent manner. These findings begin to provide a molecular basis for the understanding of the mechanisms of in-vitro osteogenesis that is promoted by bioactive glass. The results will provide new insights to the design and development of composites containing Bioglass as scaffolds for guided bone regeneration and production of a new generation of implants for orthopaedic surgery. Ethical approval for the collection and use of human fetal tissues, as described in this abstract, was given by the Riverside Research Ethics Committee (reference number RREC 2721).