Osteoblasts Responses on Containing Strontium and Calcium Carbonate Hybrid Films Deposited on Ti

Cruz, M. A. E.[1]; de Faria, A. N[1,2]; Ciancaglini, P[1]; Ramos, A. P.[1]

[1]Dep de Química, FFCLRP, USP, SP, Brazil, [2]Dep de Bioquímica, FMRP, USP, SP, Brazil

INTRODUCTION. Modification of metallic surfaces is applied to improve the cell-implant interaction to achieve biomaterials with rapid osteointegration. Thus, many researches have been devoted to manipulate the composition and physical-chemical properties of materials to stimulate better osteoblast response. $CaCO_3$ and materials that promotes Sr^{2+} release are used once they display osteoinductive and osteocondutive properties.
OBJECTIVES. In this study, we evaluate the osteoblast response to Ti surfaces modified with $CaCO_3$ or $SrCO_3$ hybrid coatings.
MATERIALS AND METHODS. Ti surfaces were modified with 2-layers of octadecylphosphonic acid-Langmuir-Blodgett film containing Sr^{2+} or Ca^{2+} and exposed to CO_2(g) for mineral growth. The resulted hybrid coatings were characterized by Scanning Electron Microscopy, X-Ray diffraction and contact angle measurements. Osteoblast primary culture was proceeded to evaluate the cell behavior by cell viability, alkaline phosphatase (ALP) activity, mineralized nodules quantification by colorimetric methods. The cell morphology was investigated by confocal fluorescence microscopy using acridine orange as biomarker.
RESULTS AND DISCUSSION. Ti surface modification originated a continuous and homogeneous coating of $CaCO_3$ or $SrCO_3$.. The resulted coatings exhibited high roughness, wettability, and surface free energy (SFE) compared to the pure Ti (control). These parameters are especially important regarding bone-substituting implants. The osteoblast viability after 14 days diminished 4.8% (for $CaCO_3$) and 4.6% (for $SrCO_3$) compared to the control. The ALP activity was higher in 21 day compared to the 14 day in the modified surfaces, differing from the control. This result indicated a late cell growth induced by the hybrid coatings. It is known that Ca^{2+} and Sr^{2+} concentration affects the ALP activity and consequently the cell behavior. This result was corroborated by the quantification of mineralized nodules, which showed a reduced mineralization in the 14^{th} day compared to the control.
CONCLUSIONS. Ti surface modification increased its roughness, wettability, and SFE favoring the target application. The coatings were not toxic to osteoblasts, but the cell response was late compared to the pure Ti, regarding the ALP activity and mineralized nodules quantification.

Keywords: Titanium, Langmuir-Blodgett Films, Strontium Carbonate, Calcium Carbonate, Collagen, Osteoblasts
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