

Immobilization of bioactive factor-loaded liposomes at the surface of electrospun nanofibers targeting tissue engineering strategies

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Abstract

The ability to manipulate and control the surface properties is of crucial importance in the designing of scaffolds for Tissue Engineering (TE) and Regenerative Medicine. Electrospun nanofibers (NFM), due to their morphology and fibrous structure have received much attention as potential biomedical devices, TE scaffolds and drug delivery carriers. Liposomes, a nanoparticle release system made by physiological material (phospholipids), hold tremendous promise as release systems. Liposomes may be combined with scaffolds to maintain a sustained and local delivery of the loaded drugs. The main objective of the present study is to evaluate the efficacy of dexamethasone (Dex) loaded liposomes immobilized on the surface of polycaprolactone (PCL) electrospun nanofiber meshes (NFM) as release system, for the induction of the osteogenic differentiation of human bone marrow-derived mesenchymal stem cells (hBMSCs). The PCL NFM surfaces were activated using the UV-Ozone irradiation technique. Aminolysis was performed to insert amine groups onto the NFM surfaces. Afterwards, SH groups were inserted at the surface of the NFMs through the reaction of the aminated surfaces with 2-iminothiolane. Ellman's reagent method was used to quantify the SH groups onto the NFM surfaces. Dex-loaded liposomes were covalently immobilized at the surface of chemically functionalized electrospun PCL NFMs. The *in vitro* release profile demonstrated a sustained release of Dex during 21 days, after an initial burst release of 12 h. Biological assays showed that Dex-loaded liposomes immobilized at the surface of electrospun PCL NFMs did not exhibit any cytotoxic

effect, promoting the osteogenic differentiation of hBMSCs. We herein validate the concept of using liposomes immobilized at the surface of a nanostructured fibrous system to be used as an advanced cell carrier device with autonomous release of growth/differentiation factors relevant for tissue engineering and regenerative medicine strategies.

Keywords: Liposomes, Electrospun Nanofibers, Drug Delivery System, Dexamethasone, Stem Cells Differentiation.