

Basic Science Abstracts

Development of a Novel Heart Valve Tissue Engineering Scaffold with Incorporated Cytokine Delivery

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Background

Through the use of nano- and microfiber constructs created by electrostatic processing, heart valve tissue engineering scaffolding with higher degrees of functionality can be achieved. Described herein is the development of a novel heart valve tissue engineering construct capable of serving as a delivery vehicle for cytokines, to aid in the direction of cell behavior and differentiation. The purpose of this study was to investigate the incorporation and release of various proteins, including immunoglobulin G (IGG), serving as a model protein system, and vascular endothelial growth factor (VEGF), from biodegradable polymer scaffolds, to assess delivery kinetics, mechanical properties and the impact on the activity of bioactive compounds.

Methods and Results

Scaffold production was carried out by electrospinning a suspension of aqueous solution of IGG or VEGF in a solution of poly(epsilon-caprolactone) (PCL) dissolved in chloroform to obtain nonwoven fibrous polymer mats. Fluorescent labeling of the proteins and microscopy was used to locate the proteins within the fibers, and it was found that the proteins were fully isolated within the core

of the polymer fiber. Mats were characterized via scanning electron microscopy for fiber diameters and porosity, with fiber diameters ranging from 4um to less than 1 um, and pore throat diameters in the range of 0.5 to 2 um. Using dynamic mechanical analysis, the elastic modulus and tensile strength of the scaffolds were found to be comparable to those of a decellularized porcine leaflet stabilized with a diepoxide, tested under identical conditions. ELISA demonstrated that protein release occurred over several weeks time, with limited burst release, and that activity of the protein was maintained.

Conclusions

It was found that scaffolds with either an IGG model protein system or VEGF could be readily produced via electrospinning. Initial mechanical evaluation indicates similar properties to biological leaflets. Delivery of the encapsulated protein in an active state was also achieved, demonstrating that these tissue engineering constructs may be employed to create scaffolds serving both for mechanical cellular supports and to selectively control the cells biochemical environment.