POLYMERIC SCAFFOLDS FOR TISSUE REGENERATION

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ABSTRACT

Polymeric scaffolds and matrices are used in many tissue engineering applications to provide the structural, biochemical and mechanical signals required for tissue regeneration and function. We have shown in subcutaneous implants that scaffolds with large interconnected pores (150µm) support rapid ingrowth and vascularization, which was improved by surface heparinization and the delivery of heparin-binding growth factors [1,2]. Spontaneous transmural endothelialization of small diameter vascular grafts made from these scaffolds could be achieved in vivo [3]. The acceleration of vascularization and endothelialization by growth factor delivery is shown to translate to the circulatory animal model, and the improvement of vascularization by growth-factor delivery via heparinized degradable hydrogels (used as ingrowth matrices) are shown [4].

Electrospun materials are often lauded as ideal scaffolds due to their similarity in structure to the fibrous extracellular matrix (ECM). These structures also readily lend themselves to the incorporation of ligands for integrin binding, glycosminoglycans that represent ECM proteoglycans, growth factors that stimulate cellular growth, healing and differentiation, and drugs that can be used to suppress adverse responses. Standard electrospinning techniques, however, often result in porous scaffolds of insufficient porosity to allow for tissue ingrowth [5].

The effects of various methods of increasing the fibrous scaffold porosity (sacrificial fiber, sacrificial bead, and low temperature techniques), as well as the effect of incorporation of adhesive peptide sequences, heparin and dexamethasone on the in vivo healing responses, are presented and discussed.

These results are useful for, and currently being used in, the development of vascular grafts and heart valves using tissue engineering and regenerative medicine approaches.

Acknowledgement: Students, colleagues and collaborators who contributed to this work.

References:

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