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ORIGINAL RESEARCH

Electrospun PGA/gelatin nanofibrous scaffolds and their potential application in vascular tissue engineering

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Background and methods: In this study, gelatin was blended with polyglycolic acid (PGA) at different ratios (0, 10, 30, and 50 wt%) and electrospun. The morphology and structure of the scaffolds were characterized by scanning electron microscopy, Fourier transform infrared spectroscopy, and differential scanning calorimetry. The mechanical properties were also measured by the tensile test. Furthermore, for biocompatibility assessment, human umbilical vein endothelial cells and human umbilical artery smooth muscle cells were cultured on these scaffolds, and cell attachment and viability were evaluated.

Results: PGA with 10 wt% gelatin enhanced the endothelial cells whilst PGA with 30 wt% gelatin increased smooth muscle cell adhesion, penetration, and viability compared with the other scaffold blends. Additionally, with the increase in gelatin content, the mechanical properties of the scaffolds were improved due to interaction between PGA and gelatin, as revealed by Fourier transform infrared spectroscopy and differential scanning calorimetry.

Conclusion: Incorporation of gelatin improves the biological and mechanical properties of PGA, making promising scaffolds for vascular tissue engineering.

Keywords: polyglycolic acid, gelatin, nanofiber, vascular tissue engineering, biocompatible scaffold

Introduction

The extracellular matrix complex, composed of proteoglycans, collagens, elastin, and various glycoproteins, is central to the maintenance of vessel wall cell integrity and appropriate signal transduction during important biological functions such as adhesion, differentiation, migration, induction of inflammatory responses, and wound healing through the integrin superfamily of receptors.[1] Methods influencing cellular functions using electrospun scaffolds remain a challenge because the scaffolds need to mimic some of the components of the natural extracellular matrix, whilst providing appropriate biochemical and mechanical inputs for the cellular environment.[2] Previous studies have attempted to develop thromboresistant and long-lasting synthetic fibrous scaffolds for tissue engineering in the field of vascular grafts. Subsequently, due to poor antithrombogenicity and inconsistent material properties,[3] clinical outcomes of synthetic vascular grafts have not always proven satisfactory.[4] In addition, the biocompatibility of tissue-engineered scaffolds is of primary concern because this affects cell attachment, proliferation, differentiation, and growth.[5]

Electrospinning has been used effectively to generate biomimetic nonwoven scaffolds for tissue engineering purposes.[6–8] Various synthetic biodegradable polymers have been electrospun into thin fibers for generating fibrous scaffolds,

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