The control of gene delivery through a tunable electrospun scaffold system

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Abstract

To regulate in situ gene delivery from biomaterial scaffolds, electrospun alginate nanofibers were applied to adsorb DNA/polyethylene (PEI) complex. The transfection efficiency increased with increasing deposited nanofibers. However, alginate was not favor for cell adhesion. Therefore, biocompatible poly (ε-poly olactone) (PCL) nanofibers was coelectrospun with alginate to increase biocompatibility. The scanning electron microscopy and fluorescent dye staining results suggested that the definite fiber ratios could be controlled. In addition, contact angle and FT-IR results also indicated that the properties of composite fibers can be regulated by the fiber ratios. The in situ transfection results demonstrated that the incorporated PCL fibers improved biocompatibility; however, the transfection efficiency was reduced. To preserve both gene transfer ability and biocompatibility, EDTA was applied to remove calcium ions for loosening alginate fiber structure. This treatment may initially maintain alginate fibers for nanoparticle adsorption, but these alginate fibers were gradually degraded in days to create a more appropriate environment for cell survival. For clinical application, we tried to regulate calcium concentration during fiber crosslinking to control the stability of alginate fibers. Though decreasing the levels of crosslinking, alginate fibers were degraded with time, which promoted both transfection efficiency and biocompatibility. These results supported biodegradable composite scaffolds should be potential for drug delivery with excellent bioactivity, which should be beneficial for tissue engineering applications.