FABRICATION OF 3D TUBULAR SCAFFOLD FROM PDLLA NANOFIBERS FOR BONE TISSUE ENGINEERING

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ABSTRACT

Bio absorbable poly-DL-lactic acid (PDLLA) nanofibers prepared by electrospinning were fabricated in the form of nanofibers mat and 3D tubular structures. These two forms of the nanofibers structures can be used later for local delivery of vascular endothelial growth factor (VEGF) to bone tissue. The thickness of the nanofibers mat and the 3D tubular scaffold can be controlled by varying the electrospinning time. VEGF is of particular interest because of its ability to stimulate angiogenesis during healing processes. Angiogenesis and osteogenesis are pivotal processes in bone tissue engineering. To this end ^{125}I-labeled VEGF was adsorbed to ~1cm^2 pieces of the nanofibers mat for 20 hours (for methods see [1]). Subsequently, desorption kinetics of ^{125}I-VEGF from PDLLA nanofibers were determined using a gamma counter. Morphology of the PDLLA nanofibers and PDLLA/VEGF nanofibers nanocomposite was characterized by using SEM and TEM. The morphological results showed that the individual nanofibers have an average diameter of ~ 200 nm with the majority of diameters in the range of 130 nm - 290 nm. The 3D tubular scaffold had a diameter of ~ 3 mm and length of ~ 75 mm. The distribution of the VEGF protein on the individual PDLLA/VEGF nanofiber was investigated by tilt the fiber during TEM imaging with different tilt degrees. A series of TEM images with different tilt degrees exhibit that the majority of the VEGF molecules were distributed on the fiber surface. The release of VEGF from PDLLA nanofibers demonstrates two phases: In the first phase VEGF is rapidly released (~ 54.1% in the first day) and in the second phase release is slow (~ 18.8% in the 2-7 days). About 73 % VEGF was released from the PDLLA nanofibers in the first week which is sufficient to promote the early stages of angiogenesis. The advantages of VEGF release in the early stage is not only to promoted angiogenesis, but also to enhance osteogenesis.These results suggest that the fabricated 3D tubular scaffolds of PDLLA nanofibers can be used to deliver VEGF locally in cylindrical cavities drilled in the bone of sheep in order to promote angiogenesis in bone tissue engineering.

References:

[1] Zurlinden, K., Laub, M., Dohle, D. S., & Jennissen, H. P. (2012) Immobilization and Controlled Release of Vascular (VEGF) and Bone Growth Factors (BMP-2) on Bone Replacement Materials. *Biomed. Tech. (Berl)*, **57,** 989-991.