Experimental evaluation of PLA NanoMatrix 3D scaffold for tissue engineering

Liubchak Iryna, V. Deineka, M. Pogorielov, Y. Kozik

Sumy State University, Ukraine **|** Area **Biomaterials for Medical Application**

Introduction. Scaffold type and construction are crucial limitation for tissue engineering technology. Nanofibrous structures that mimic natural extracellular matrix are widely studied as the best solution with good regeneration potential.

Aim. The aim of our research was in vitro and in vivo assessment of new nanofibrous NanoMatrix3D (NM3D) electrospun scaffolds made of Poly(lactic acid) (PLA) as a candidate for tissue engineering scaffold.

Methods. Scaffolds were prepared from polylactide solution using NM3D®-electrospinning technology. In vitro experiment included SEM, mass density determination, static and dynamic degradation tests in SBF solution. Toxicity of material in cell culture was assessed with FDA/PI staining followed by fluorescent microscope visualization and Resazurin reduction assay. General toxicity and tissue reaction were evaluated in 4, 8 and 12 weeks after subcutaneous, intramuscular and intraperitoneal implantation of material to 60 laboratory rats. Cell-loaded scaffolds were applied to full-thickness skin wound of 24 rats (12 – for scaffolds with ADSCs, and 12 – for DFBs). Healing progress was evaluated on 7th and 14th postoperative days.

Results. PLA NM3D® electrospun scaffolds have porous structure (pore size 25-300 µm) made of chaotically orientated nanofibers, and relatively low mass density (150- 190g/m2). Scaffolds have satisfactory degradation rate as they lost from 42,7% to 56,2% initial weight after static and dynamic tests respectively, and they most completely degrade and are replaced by newly-formed connective tissue at the end of in vivo experiment (12 weeks). FDA/PI staining and Resazurin reduction assay proved cells viability and proliferation. Histological analysis of skin defect filled with cell-loaded PLA scaffold demonstrate collagen fibers formation and vessels ingrowth mainly in peripheral zones of the scaffold.

Conclusion. PLA NM3D® electrospun scaffolds have structure similar to extracellular matrix and provide conditions for cell migration, adhesion and proliferation. They are biodegradable, biocompatible, nontoxic materials and could be used as basis for tissue-engineering construction as they support connective tissue formation and vessels ingrowth in the injured site.