Abstract

This study is focused on the interaction of cells with surface-modified existing or newly created materials designed for vascular and bone tissue engineering, and also for controlled drug delivery into implants.

In the first part of the study, the surface of polyethylene foils was irradiated with Ar plasma and then grafted with various bioactive molecules (glycine, polyethylene glycol, albumin) or with colloidal carbon or gold nanoparticles. These modifications adjusted the physical and chemical properties of the material for the adhesion, growth and also phenotypic maturation of vascular smooth muscle cells (VSMC) towards the contractile phenotype.

In the second part of the study, we developed a novel perivascular system for controlled drug delivery into autologous vein grafts, currently used for constructing aortocoronary bypasses. The system comprised a polyester mesh, which ensures the mechanical stability of the system and of the venous wall, and a copolymer of L-lactide and ε–caprolactone (Purasorb), which serves as a carrier of the antiproliferative drug Sirolimus. This system inhibited the proliferation of VSMC *in vitro* and also *in vivo* in a rabbit model.

Finally, we created composite nanofibrous membranes containing a copolymer of L-lactide and glycolide (PLGA) and diamond nanoparticles (ND) by an electrospinning technique. These membranes supported the attachment, spreading and subsequent proliferation of human osteoblast-like MG-63 cells *in vitro*. The PLGA-ND membranes showed higher mechanical resistance without considerable cytotoxic injury or inflammatory activation of the cells.

Key words: Synthetic polymers, surface modification, vascular smooth muscle cells, bone cells, controlled drug delivery, Sirolimus, nanofibers, nanodiamonds, electrospinning, tissue engineering