Abstract

Biomaterials are considered as very promising tools for regenerative medicine. They have compensatory or supporting function in organism and they are often developed to support specific conventional medical procedures. So-called biomimetic materials are developed to imitate natural environment of organism and to induce positive innate responses of organism. An essential part of biomaterial development is *in vitro* biological evaluation, which characterizes (often for the first time) the potential of developed material for its clinical application. This Ph.D. thesis deals with *in vitro* biological evaluation of three different biomimetic materials. In all three cases, the comprehensive evaluation was an integral part of the material development and optimization processes. Each material was *in vitro* characterised at the level of cell-material interactions with respect to its intended specific application.. In the first part, cell response to potential drug delivery system based on colloidal complexes of cationic surfactants with hyaluronic acid (HyA) was characterized. HyA protection ability and its limits were described; also the role of fetal bovine serum (FBS) in cell response to the stress stimuli was confirmed. Results considered surfactant-HyA complexes as promising system for drug delivery. In the second part, cell carriers (scaffolds) based on collagen with application potential for bone surgery were evaluated. We proved the impact of crosslinking process of scaffold on adhesion of human cells and benefits and potential of dynamic cultivation for cell culturing on biodegradable scaffolds. Moreover, we selected the optimal biodegradable scaffold suitable for cell cultivation In the third part, local drug delivery system based on collagen/hydroxyapatite nano-/micro-structured resorbable layers with controlled elution of antibiotics was evaluated *in vitro*. The positive effect of hydroxyapatite content on cells and its limits in relation to the tested antibiotic type were emphasized. Layers were recommended for clinical application as bioactive interfaces that can not only support new formation of bone but also can serve as local drug delivery system. The last part of this thesis focuses on general description of cell adhesion process as a fundamental point of cell-surface interaction. For the first time, the difference in the early cell adhesion in the presence and absence of serum proteins was described in detail. Expression and localization of various proteins involved in cell adhesion and signaling were evaluated as being dependent on the presence or absence of serum proteins. Taken together, results of this thesis helped to evaluate the developed biomaterials under *in vitro* conditions. It was shown that every tested material has potential to support established medical procedures or to become the new alternative of treatment in the regenerative medicine. Our results also demonstrated the importance of *in vitro* biological evaluation in biomaterial development.