DESCRIPTION FOR THE GENERAL PUBLIC

The main aim of this project is to create and develop new series of biomaterials based on nanoapatites functionalized with bioactive polymers. We plan to obtain biomaterials that could be used efficient as delivery system for multipotent stromal cells (MSCs), facilitating their differentiation toward functional tissue. The nanoapaties used in the model will be doped with lanthanides, therefore invented system will provide another possibility of bio-imaging. Our purpose is to obtain enhanced technology that encompasses approaches from nanotechnology and tissue engineering, i.e. coupling highly bioactive nanomatrices and cellular plasticity of multipotent stromal cells derived from human adipose tissue (hASC).

The osteochondral defects – clinical condition, which due to high morbidity, difficult diagnostic and substantial cost to healthcare systems, for years remains significant problem in orthopedic and sport medicine. Effective clinical management of osteochondral defects is major challenge, mainly because of poor self-healing capacity of articular cartilage, resulting form avascular character of tissue. The novel tissue engineering approaches of cartilage and bone tissues are focused onto preparation sophisticated systems composed of cells and matrices designed to grow tissue in vitro, prior to implantation within the subject. Such approach is aimed both on repair and regeneration of impaired tissues, therefore it provides perfect and desired therapeutic tool. The development of osteochondral tissue should be guided by the scaffold features. Ideal matrices will support cell colonization, migration, growth as well as differentiation toward specific, functional tissue.

Currently, nano-scaled apatites combined with biodegradable and biocompatible polymers are of great interest in tissue engineering and regenerative medicine, especially for reconstruction of osteochondral tissue. Special biological features of such scaffolds makes them a kind of interim, synthetic extracellular matrix (ECM), that promote cells interaction prior to forming new tissue. The most commonly used polymers for cartilage engineering includes biodegradable poly(lactic-co-glycolic acid) (PLGA), poly(L-lactic acid) (PLLA) and poly(caprolactone) (PCL), characterized with good biocompatibility and enhancing potential of MSC for creation of tissue that histologically resembles hyaline cartilage. Porosity of polymer scaffolds may be controlled, therefore we will be able to determine optimal path for nutrient transmission both at the site of damaged cartilage and bone. Due to the fact that apatite is a main component of bone mineral fractions, its usage in regenerative medicine was examined primarily regarding to bone tissue healing. Moreover, the importance of apaties has emerged not only in the context of bone regeneration but also as a factor facilitating and promoting cartilage regeneration, stabilizing chondrogenic phenotype of progenitor cells (multipotent stromal cells). In our model we decided to utilize adipose-derived cells for biocompatibility testing. Nowadays, ASCs are recognized as good candidates for cell-based therapies of osteochondral defects, mainly because of high proliferative ability and unique cellular plasticity expressed by ability for differentiation toward chondroblast and osteoblasts (i.e. cells forming cartilage and bone tissue, respectively). Additionally, features in favor of ASCs is easy access to fat biopsies, and limitations in sourcing of chondrocytes or bone-marrow derived multipotent stromal cells, also willingly proposed for regenerative therapies of osteochondral defects. Given the fact that obesity is one of the reasons for osteochondral defects development, the availability of ASCs for autologous therapies is one of the purposes of personalized therapy. Therefore, one of the aspects of the project will be determination of regenerative potential of hASC originated from orthopeadic patients in cultures with obtained biomaterials. In our opinion the scaffolds designed in the course of project, may be new alternative for currently used apatite carriers for cell therapies. Due to its physicochemical and biological properties, obtained biomaterials should provide suitable environment for adipose-derived multipotent stromal cells promoting them for synthesis of neo-extracellular matrix. The novelty of designed system will be ability for controlling the process of scaffold integration with tissue and monitoring of regeneration process, what may contribute to the development of a new field of science – theranostics.