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Poly(L,L-lactide)/collagen/calcium glycerylphosphate composite scaffold seeded with mesenchymal bone marrow stromal cells for bone tissue regeneration

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Large bone defects caused by injuries, bone loss, infected nonunions are still a major challenge in orthopaedic and trauma patients. Human bone tissue has both organic and inorganic components. It should also be noted that 95% of bone organic components is collagen I type. A large variety of collagen scaffolds has been used as carriers in bone tissue engineering approaches. However, collagen scaffolds have weak mechanical properties for tissue replacement applications, especially for bone regeneration. Although several alternatives have been proposed, no composite polymer material is yet available to promote effective bone regeneration. The ideal polymer scaffolds must stimulate bone regeneration. Hence, the goal of this study was to generate novel composite scaffolds for tissue engineering aimed at skull bone regeneration. More specifically, we combined polylactide scaffold, collagen gel, GP and bone marrow stromal cells (BMSCs). The composite scaffold's efficacy was evaluated based on *in vitro* cell cultivation and the ability of BMSCs to extra cellular matrix protein and osteocalcin synthesize, whereas its *in vivo* performance was evaluated based on experimental regeneration of skull bone defects in rabbits. Polylactide scaffolds with a pore size of 50-250 μm were fabricated. The biocompatibility of polylactide scaffolds was improved by collagen gel filling. It is shown that collagen gel and calcium glycerylphosphate promotes the accumulation of alkaline phosphatase and osteocalcin by cells. Histological analysis after composite scaffolds with cells implantation in the bone defect of the rabbit clearly demonstrated the efficiency of bone regenerative processes.

Recent Publications

1. Yu A Nashchekina, P O Nikonov, V M Mikhailov and G P Pinaev (2014) Distribution of bone-marrow stromal cells in a 3D scaffold depending on the seeding method and the scaffold inside a surface modification. Cell and Tissue Biology 8(4):313–320.
2. Yudintceva N M, Nashchekina Y A, Blinova M I, Orlova N V, Muraviov A N, Vinogradova T I, Sheykhov M G, Shapkova E Y, Emeljannikov D V, Yablonskii P K, Samusenko I A, Mikhrina A L, Pakhomov A V and Shevtsov M A (2016) Experimental bladder regeneration using a poly-L-lactide/silk fibroin (PL-SF) scaffold seeded with nanoparticle-labeled allogenic bone marrow stromal cells. Int. J. of Nanomedicine 11:4521-4533.
3. Yu A Nashchekina, N M Yudintceva, P O Nikonov, E A Ivanova, L V Smagina and I V Voronkina (2017) Effect of concentration of collagen gel on functional activity of bone marrow mesenchymal stromal cell. Bulletin of Experimental Biology and Medicine 163(1):123–128.
4. Nashchekina Y and Raydan M (2017) Noninvasive penetration of 5 nm hyaluronic acid molecules across the epidermal barrier (in vitro) and its interaction with human skin cells. Skin Res Technol. 24(1):129–134.

Biography

Yudintceva Natalia works in the field of the regenerative medicine. She studies the possibilities of using tissue-engineering grafts based on polymeric scaffolds and stem cells to restore the structural integrity of the tissues of the genitourinary system (urine bladder, urethra) on experimental models, including on models of the tuberculous bladder. Another direction of her investigations is a development of the polymeric small diameter vessels for cardiac surgery.

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