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Stem cell recruitment and angiogenesis of neuropeptide substance P coupled with self-assembling peptide nanofiber on tissue regeneration

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Abstract

Here we developed bioactive self-assembling peptide nanofiber hydrogel (RADA-SP and KLD-SP) which could recruit mesenchymal stem cells. The self-assembling peptide forms fibers (5 to 10nm) and assembles into a 3D scaffold at physiological solution. Substance P(SP) is an injury-inducible factor that acts early in the wound healing process to induce CD29+ stromal-like cell mobilization.

To investigate the inducible ability of them, we implanted KLD-SP into subcutaneous of nude mice. And then, we injected NIR-labeled hMSCs into tail vein. The migration of injected cells was tracked using multi spectrum imaging system in real time.

By applying these bioactive peptides on ischemic hind limb models and osteoarthritis models, the abilities of stem cell recruitment and angiogenesis were evaluated.

Limb ischemia was produced in athymic mice and peptides were injected into ischemic sites. In RADA-SP group, it was shown that many mesenchymal stem cells were recruited into injected sites compared to other groups. Moreover, TUNEL+ cell density was 7 times lower than ischemia group. In Masson's trichrome staining, injection of RADA-SP could prevent fibrosis.

Osteoarthritis was produced in rats and 0.5% (wt/vol) peptides were injected into osteoarthritis sites 3weeks after surgery. And the tissues were harvested 6weeks after injection for analysis. In micro CT datas, it was shown that articular cartilage of KLD-SP group has smooth surface. In histological staining, injection of KLD-SP could regenerate cartilage tissue.

In conclusion, SP coupled with self-assembling peptide nanofiber is effective to recruit mesenchymal stem cells and that leads to protect limb ischemia and regenerate articular cartilage.

Biography

Soo Hyun Kim has completed his Ph.D. from Seoul National University and postdoctoral studies from University of Connecticut. He is tenure Research Scientist in Korea Inst. of Sci. & Tech. and Professor of Korea Univ. He is the Vice President of Korean Tissue Engineering and Regenerative Medicine Society. He has published more than 145 papers in reputed journals and has more than 45 patents. He is serving as an Editorial Board Member of reputed journals. Research interests include Tissue Engineering, Biomedical Polymer and Biodegradable Polymer.