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Impact of 3D cell culture on bone regeneration potential of mesenchymal stromal cells

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Free article

Abstract

As populations age across the world, osteoporosis and osteoporosis-related fractures are becoming the most prevalent degenerative bone diseases. More than 75 million patients suffer from osteoporosis in the USA, the EU and Japan. Furthermore, it is anticipated that the number of patients affected by osteoporosis will increase by a third by 2050. Although conventional therapies including bisphosphonates, calcitonin and oestrogen-like drugs can be used to treat degenerative diseases of the bone, they are often associated with serious side effects including the development of oesophageal cancer, ocular inflammation, severe musculoskeletal pain and osteonecrosis of the jaw.The use of autologous mesenchymal stromal cells/mesenchymal stem cells (MSCs) is a possible alternative therapeutic approach to tackle osteoporosis while overcoming the limitations of traditional treatment options. However, osteoporosis can cause a decrease in the numbers of MSCs, induce their senescence and lower their osteogenic differentiation potential.Three-dimensional (3D) cell culture is an emerging technology that allows a more physiological expansion and differentiation of stem cells compared to cultivation on conventional flat systems.This review will discuss current understanding of the effects of different 3D cell culture systems on proliferation, viability and osteogenic differentiation, as well as on the immunomodulatory and anti-inflammatory potential of MSCs.

Biomolecules

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Efficacy and Safety of Mesenchymal Stem/Stromal Cell Therapy for Inflammatory Bowel Diseases: An Up-to-Date Systematic Review

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Free article

Abstract

Inflammatory bowel disease (IBD) is a chronic inflammatory disorder of the gut that can lead to severe gastrointestinal symptoms, malnutrition, and complications such as fistulas and cancer. Mesenchymal stem/stromal cells (MSCs) are being investigated as a novel therapy for IBD and have been demonstrated to be safe and effective for perianal fistulizing Crohn's disease (PFCD). This systematic review aims to present the most recent studies on the safety and efficacy of MSC therapy in IBD. A detailed search strategy of clinical trials on MSCs and IBD was performed on PubMed, with 32 studies selected for inclusion in this review. The newest studies on local MSC injection for PFCD continue to support long-term efficacy while maintaining a favorable safety profile. The evidence for systemic MSC infusion in luminal IBD remains mixed due to marked methodological heterogeneity and unclear safety profiles. Although further studies are needed to better establish the role of this novel treatment modality, MSCs are proving to be a very exciting addition to the limited therapies available for IBD.

J Adv Pharm Technol Res

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The enhancement apoptosis of osteosarcoma mesenchymal stem cells co-cultivation with peripheral blood mononuclear cells sensitized by secretome and granulocyte macrophage colony-stimulating factor

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Abstract

The advanced, metastasis, and reccurent of osteosarcoma (OS) patients have a poor prognosis postaggresive surgery and chemotherapy. Peripheral blood mononuclear cells (PBMCs) as cell-based immunotherapy may successful in the OS treatment. To investigate the enhancement apoptosis of OS-mesenchymal stem cells (OS-MSCs) co-cultivated with PBMCs sensitized using the secretome and granulocyte macrophage colony-stimulating factor (GMCSF). This true experimental study with posttest only control group design and *in vitro* study. The sample was cultured OS-MSCs which confirmed by Cluster of Differentiation-133 using immunocytochemistry (ICC) and histopathology analysis. The sample divided into six groups accordingly: OS-MSC, OS-MSC + PMBC, OS-MSC + PMBC + Secretome, OS-MSC + PMBC + GMCSF, OS-MSC + PBMC + Secretome + GMCSF (*n* = 5/N = 30). The enhancement of OS-MSCs apoptosis was analyzed through Interleukin-2 (IL-2) level through the Enyzme-Linked Immunosorbent Assay examination, expression of

Signal Transducers and Activators of Transcription (STAT)-3 and caspase-3 by ICC. One-way analysis of variance test and Tukey Honestly Significant Difference to analyze the difference between the groups ($P < 0.05$). The highest of IL-2 level was found in the PBMC + Secretome + GMCSF group. The highest expression of caspase-3 was found in OS-MSC + PBMC + Secretome + GMCSF group with significant different between groups ($P < 0.05$). There was insignificant difference of STAT-3 epxression and IL-2 level between groups ($P > 0.05$). The co-cultivation of OS-MSCs and PBMSCs activated using secretome and GMCSF has a great ability to enhance OS-MSCs apoptosis.

Injury

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Early injection of autologous bone marrow concentrates decreases infection risk and improves healing of acute severe open tibial fractures

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Abstract

Introduction: Open fractures are at risk of nonunion; surgeons are reluctant to propose early standard bone grafting after open fractures, preferring to wait in order to adequately assess the facture status of infection. Bone marrow contains mesenchymal stem cells (MSCs) and granulocyte and macrophage precursors identified in vitro as colony forming units-granulocyte macrophage (CFU-GM), both of which have a prophylactic action against infection. We therefore tested the hypothesis that early injection of bone marrow concentrate would be useful in these fractures.

Methods: We evaluated a series of 231 patients who had received early percutaneous implantation of bone marrow concentrate (BMC) to treat open fractures (with gap less than

10 mm) that were Gustilo-Anderson Type II or III. The results were compared with those of 67 control (no early graft) patients and with those of 76 patients treated with an early, standard of care, iliac bone graft. All patients were treated with external fixation and were considered to have an aseptic fracture at the time of early grafting, but the actual status of infection was re-assessed at the time of grafting by histology and/or analysis of the aspirate. The bone marrow graft contained after concentration 49,758 ± 21,642 CFU-GM-derived colonies/cc and 9400 ± 1435 MSCs/cc which represents an important increase compared to the level of CFU-GM cells and MSCs present in a standard auto-graft. Healing was evaluated at 9 months.

Results: The rate of unsuspected infections was higher than 15% in the 3 groups. Bone union and removal of external fixation was achieved at 9 months by 50.7% of patients in the Control Group, by 86.8% of patients in the group with a standard bone graft, and by 87.4% of patients in the bone marrow group. A 90% risk reduction ($p = 0.005$) in the need for an invasive standard bone graft to treat a nonunion and in the risk of infection was observed when bone marrow was proposed as early injection to the treatment of type II or type-III tibial fractures.

Conclusion: Bone marrow concentrate for early grafting in open fractures with limited gap was efficient for healing while decreasing infection.