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Netcells Stem Cell Banking

Mesenchymal Stem Cells: The Uses of Cord Tissue

Mesenchymal Stem Cells (MSCs) are a multipotent and heterogeneous subset of stromal stem cells that can differentiate into a variety of cell types including osteoblasts, chondrocytes and adipocytes. MSCs can be isolated from bone marrow, mobilised peripheral blood, cord blood, placental tissue, adipose tissue, dental pulp, and even the fetal liver and lungs, however the youngest most primitive MSCs are obtained from the umbilical cord tissue (UCT).

Uses of Umbilical Cord Tissue

In order for umbilical cord cells to be considered MSCs, they have to comply with the criteria of the International Society for Cellular Therapy (ISCT): adherence to cell culture plastic; expression of CD73, CD90, and CD105; lack of expression of hematopoietic and endothelial markers such as human leukocyte differentiation antigen class II (HLA-DR), CD11b, CD14, CD31, CD34, and CD45; and an in vitro differentiation potential into three lineages such as bone, cartilage and fat.

The most popular property of UC-MSCs for clinical use is their immunosuppressive ability. Firstly, MSCs are weakly immunogenic due to their lack of HLA-DR and low expression of MHC class I molecules. MSCs also lack CD80 & CD86 proteins which are costimulatory molecules that induce T-cell activation and survival. The lack of these molecules suggests that MSCs would not elicit acute rejection and are therefore suitable for allogeneic cell-based therapy.

Secondly UC-MSCs have immunosuppressive properties in vitro and in vivo. The immunosuppressive effect of UC-MSCs is mediated by secreted factors as well as cell-to-cell contact.

The most appreciable advantage of using UC-MSCs is that the collection procedure is non-invasive and ethically accepted for autologous or allogenic use. UC-MSCs could be used autologously following gene therapy for inherited diseases, and also allogeneically as regenerative mediators or to deliver anti-inflammatory therapy for neonatal injuries, such as cerebral palsy or hypoxic brain damage.

UC-MSCs are of therapeutic interest because they represent a population of cells with the potential to treat a wide range of acute and degenerative diseases.

MSCs in Chronic Discogenic Low Back Pain

MSCs can be used in the treatment of chronic discogenic lower back pain. Discogenic lower back pain, originating from intervertebral disc degeneration as a result of traumatic events or ageing, is considered one of the major causes of chronic lower back pain.

One type of discogenic disorder is called an Internal Disc Disruption (IDD). This occurs when the disc tears or cracks (fissure) allowing the nucleus pulposus to meet the annulus fibrosus. When this happens, a chemical called proteoglycan may be released from the nucleus pulposus, which may irritate the annular nerves causing an inflammatory response and pain.

Current treatment options are limited to symptomatic treatment, including analgesics, physiotherapy and minimally invasive or surgical treatment. Disc degeneration commonly involves changes in disc morphology and composition of the extracellular matrix as well as loss of disc cells. Therefore, a potential therapeutic strategy would be the augmentation of the disc cell population to restore normal biologic function and matrix insufficiencies.

A study performed by Pang *et al* involved Human Umbilical Cord-MSC (HUC-MSC) transplantation in two patients with chronic discogenic lower back pain to test its feasibility and safety, and obtain the early indications of its therapeutic value. In both patients, the HUC-MSC transplantation significantly alleviated pain and improved physical lumbar function. The underlying mechanisms remain unclear, however data from animal studies have shown changes in cytokine expression after transplantation, indicating a possible mechanism for pain relief.

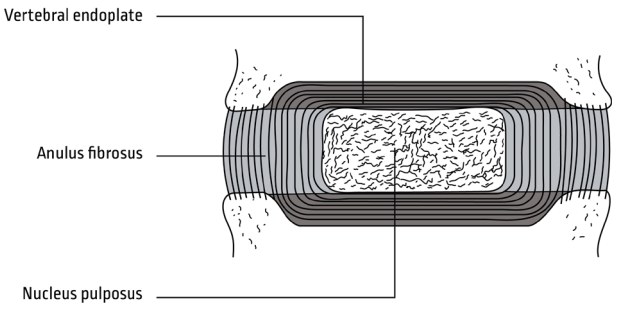

Figure 1:
Image showing the structure of the intervertebral disc. (Bogduk, 2005)

MSCs in COVID-19

COVID-19 is a pneumonia-like disease caused by the SARS-CoV-2 virus which results in a severe immune response causing COVID-19.

Recent studies indicate that the development of Acute Respiratory Distress Syndrome (ARDS) in severe cases is accompanied by a massive release of proinflammatory cytokines such as interferons and interleukins as well as other chemokines. This triggers a substantial immune response to the affected organs leading to vascular leakage and edema, tissue inflammation or damage, multiorgan failure, and severe morbidity.

There is an urgent need for novel therapies that can attenuate the excessive inflammatory response associated with the immunopathological cytokine storm and immunothrombosis, that can accelerate the recovery of functional lung tissue.

A study by Lanzoni *et al* made use of UC-MSCs, administered intravenously, as MSCs have been reported to limit inflammation and fibrosis in the lungs of patients with ARDS.

The objective was to establish safety and explore efficacy of allogenic UC-MSC infusions in patients with ARDS secondary to COVID-19.

The researchers looked at three aspects after UC-MSCs were transplanted:

a. survival after transplantation,
b. severe adverse effect (SAE)-free survival and
c. time to recovery.

This study showed that, after transplantation, both survival and SAE-free survival were significantly improved, while time to recovery was significantly shorter in patients treated with UC-MSCs compared to the control group.

MSCs from umbilical cord tissue can therefore have a therapeutic effect in a range of diseases, spanning from back pain to ARDS; this may be ascribed to their multipotency, ability to reduce inflammation and their immunosuppressive nature.

Many studies have shown that UC-MSC transplantation is safe and effective, paving the way for more studies to be performed on the use of UC-MSCs for the treatment of many different diseases.

Questions for CPD points

Scan the QR code to complete the questionnaire on Survey Monkey

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