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Application of Stem Cell Therapy in Rejuvenation and Treatment of Diseases

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Introduction

Regenerative Medicine

Through the stimulation of previously irreparable organs to heal themselves, regenerative medicine promises the potential of healing damaged tissues and organs within the body. The aim is to repair damaged tissues by using stem cells. It seeks to devise new therapies for patients with severe injuries and chronic diseases.

Cell Therapy

Cell therapy is a broad clinical procedure derived from biological products as a regenerative medicine to replace or regenerate damaged cells as a result of the natural aging process. The most common cellular procedures include the use of exosomes, amniotic fluid, platelet-rich plasma (PRP), and adult mesenchymal stem cells. These types of cells are found in almost all tissues of the human body, but they have a higher concentration in the vascular part of the fat tissue in the navel and in the bone marrow. The stem cell therapy is applied in many chronic autoimmune diseases and metabolic disorders. The further details about these cell types will be provided in the following article.

Definition of Stem Cells

What Are Stem Cells?

Unique human cells known as stem cells have the capacity to differentiate into a wide variety of cell types. They are undifferentiated cells, meaning they have not yet developed into specialized cells with specific functions. Stem cells can divide and self-renew indefinitely, providing a constant supply of new cells for the body. Stem cells are being examined for their potential utilize in regenerative medicine, which involves replacing damaged or diseased cells and tissues with healthy ones. Stem cells also have crucial roles in growth and development, tissue repair, and the maintenance of healthy tissues in the body of an organism.

The two main types of stem cells are adult stem cells and embryonic stem cells.

- Embryonic stem cells (ESCs) are inferred from the inward cell mass of a developing embryo, typically 4-5 days after fertilization. These cells have the ability to divide and differentiate into any type of cell in the body, including neurons, heart cells, liver cells, and many others.

There are two types of embryonic stem cells: pluripotent and totipotent.

- Pluripotent stem cells have the ability to differentiate into any type of cell in the body, except for the placenta and other extraembryonic tissues. These Cells are derived from the inner cell mass of the blastocyst, a structure that forms about 4-5 days after fertilization. Pluripotent stem cells can be cultured in the laboratory and induced to differentiate into specific cell types, such as neurons or heart cells.

- Totipotent stem cells are even more versatile than pluripotent stem cells, as they have the ability to differentiate into any type of cell in the body as well as the placenta and other extraembryonic tissues. Totipotent stem cells are only present for a short period of time during early embryonic development, and they give rise to all the cells in the developing embryo.

- Adult stem cells (also known as somatic stem cells) are found in various tissues and organs throughout the body, such as bone marrow, kidney, liver, umbilical cord, brain,skin, salivary gland and muscle. Unlike embryonic stem cells, adult stem cells are already partially differentiated and can only develop into certain types of cells that are specific to the tissue or organ in which they are found.

Adult stem cells are classified into various types:

- Only one kind of cell can differentiate from unipotent stem cells. An example of unipotent stem cells are muscle stem cells (also known as satellite cells), which can only differentiate into muscle cells.

- Oligopotent stem cells can differentiate into a few types of cells. An example of oligopotent stem cells are lymphoid stem cells, which can differentiate into different types of immune cells.

- There is a restricted number of cell types that multipotent stem cells can develop into.Examples of multipotent stem cells include hematopoietic stem cells, mesenchymal stem cells, and neural stem cells.

Mesenchymal Cells

Multipotent adult stem cells, sometimes referred to as mesenchymal stromal cells (MSCs), have the ability to differentiate into a range of cell types, such as osteoblasts (bone cells), chondrocytes (cartilage cells), and adipocytes (fat cells).

Here are some of the key characteristics of mesenchymal cells:

1. The ability to stick to plastic surfaces, which makes them easy to isolate and culture in the laboratory.

2. In vitro, they can transform into mesodermal cells such as mucus, cartilage, fat, muscle cells, and they can also transform into ectodermal neuron, and endodermal hepatocyte cells.

3. Expression of surface markers such as CD105+, CD73+,CD90+, CD45-, CD34-, CD14-, CD11b-, CD79-, HLA-DR-

- Strong immunosuppressive effect
- Antiapoptotic activity
- Neoangiogenesis
- Tissue regeneration
- Antimicrobial effect
- Immunomodulation
- Anti-inflammatory effect

Use in Diseases

Mesenchymal cells are mainly used for:
Rheumatoid arthritis; Joint replacement; Osteoarthritis; Soft tissue injury; Ligament injury; Migraine and tension headaches; Diabetes; Chronic ischemic cardiomyopathy; Hair loss; Erectile dysfunction; Pulmonary diseases; Autoimmune diseases (multiple sclerosis, lupus, Crohn's Disease, etc.).

Due to their potent regenerative effects, new angiogenic capabilities, and immunosuppressive/regulatory effects, Wharton's jelly-derived MSCs are found in adipose (adipose) tissue, bone marrow, or umbilical cord and are cultured and made ready for administration in our GMP standard laboratories at our center. to the patient. Its applications are numerous and diverse [1-3].

Additionally, it helps with a few neurological diseases like Parkinson's disease, ALS, and neuropathy. Several clinical applications of adipose-derived stem cells are currently being researched.

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Stromal Vascular Fraction (SVF)

Made from the adipose (fat) tissue that patients have donated through liposuction, SVF is an autologous product. A diverse range of cells, including multipotent mesenchymal stem cells (MSCs), unipotent progenitor stem cells, fibroblasts, erythrocytes, macrophages, and other immune cells, are mixed together to form this heterogeneous mixture. Hence, SVF is a good source of multipotent and unipotent stem cells that could help to replenish the need of cells to regenerate the targeted tissues[4,5].

Treatment with the SVF cells is an advanced approach in the stem cell therapy used for:

- Anti-aging
- Hair loss
- Orthopedic diseases
- Diabetic foot ulcers
- Male and female infertility

Growth factors and other physiologically active substances are present in the SVF along with several types of stem cells. Isolation of the SVF cells from fat tissue is a rather simple process. The complete process, including pre-anesthesia, isolation and the injection of SVF cells only takes about 4 hours and is performed in a clinic. The procedure is usually well tolerated and has been clinically confirmed as safe. Hence, SVF is an attractive therapeutic approach, considering the safety of the harvesting procedure and the abundance of easily available cells.

Use of SVF in skin-related issues:

- Eliminating the wrinkles in the skin,
- Whitening of the stains and dark areas,
- In the treatment of festering chronic sores (diabetes,compression, venous ulcer, etc.)
- Face renewal can be done with mesotherapy (Facial Rejuvenation) applications,
- In filling the gaps which occur after disorders such as acne or chicken pox,
- In the treatment of burns, past surgery or trauma-related cavities
- In plumping the lips,
- In indirect baldness therapy
- In periodontal applications in dentistry

In orthopedics

- Arthritis and arthrosis
- Stretching and breaking of ligaments
- Meniscus damage
- Endless fractures
- Osteonecrosis of the femoral pelvis
- Bursitis

- Cartilage damage
- Osteoarthritis of the joints
- Tendinitis
- Muscle strain and strain
- After surgical intervention

Benefits

- High efficacy; often, it is the only method of treatment.
- A low invasive procedure.
- Outpatient therapy.
- A real opportunity to significantly delay/avoid surgery and disability.
- An excellent alternative in case of drug intolerance (e.g.,antirheumatic drugs, cortisone).
- Acceleration of self-healing processes in the body (e.g.,after fractures, osteonecrosis, soft tissue rupture).
- Universality: MSCs can be used as monotherapy/combined with plastic surgery/combined with laser technologies.
- A simple procedure.
- Clinically proven safety: no side-effects.

For back pain

Fibroblast

Fibroblasts are a type of connective tissue cell that play a crucial role in the maintenance and repair of tissues throughout the body. They are present in a wide variety of tissues, such as the skin, ligaments, tendons, and organs. Collagen, elastin, and hyaluronic acid are among the constituent proteins of skin that are purified and naturally produced by fibroblast cells. It can be applied to the management of long-term wounds and to eliminate deep wrinkles brought on by aging [6-8].

Exosome

Small extracellular vesicles known as exosomes are released by a variety of cell types, including stem cells, and contain a variety of bioactive molecules, such as proteins, lipids, and nucleic acids,including microRNAs. Exosomes are crucial intercellular communication mediators and can be taken up by recipient cells to modulate cellular signaling and gene expression. For this reason, they are called messenger cells.

They enter the cell and repair the defective or missing cell, making it function as it did in its younger years. Exosome treatment is a fast, long-acting skin treatment applied by the mesotherapy technique that rejuvenates the cells. Exosomes are reliably used in the treatment of many skin diseases in addition to skin rejuvenation. (e.g. acne, eczema, rose, skin blemishes). In my experience, I have mostly used it for rejuvenation, scar tissue removal, and auto-immune skin diseases. Autolog, allogenic

Conclusion

In conclusion, regenerative medicine has the potential to revolutionize healthcare by using stem cells to regenerate damaged tissues and organs. A promising method in this area is cell therapy, which uses

several cell types to repair or restore the body's damaged cells. Adult stem cells and embryonic stem cells are the two primary kinds of stem cells. Mesenchymal cells are a type of multipotent adult stem cell that have been found to have strong immunosuppressive effects, anti-inflammatory effects, neoangiogenesis, and tissue regeneration capabilities. They are currently being used to treat various diseases, including autoimmune diseases, soft tissue injuries, and diabetes. Stem cells hold the promise of revolutionizing regenerative medicine and enhancing the lives of millions of people globally with additional study and development.

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