MEDS Chinese Medicine (2021)
ISSN 2616-1753 Volume 3 Issue 2
DOI: 10.23977/medcm.2021.030225
Clausius Scientific Press, Canada

Application of Stem Cells in Modern Medicine and Aesthetics

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Keywords: Stem cells, Cosmetology, Anti aging

Abstract: This paper starts from the overview of the application of stem cells in beauty industry. This paper introduces the basic characteristics of stem cells and the biological characteristics, mechanism of action of different stem cells, as well as the application potential in the clinical beauty industry. The application status of stem cells in the fields of anti-aging, skin whitening, facial plastic surgery and hair loss treatment were described respectively. Finally, the application prospect of stem cells in the beauty industry was prospected.

1. Introduction

In 2014, Dr. Zhang Hongkai, President of INTERNATIONAL HEALTH CELLS REHABILITATION ASSOCIATION of the United States, believed that human beings have only one disease, namely “cell disease”. He put forward the rudiment of cell medicine. As the basic unit of the structure and function of life body, cell constitutes a very important link in the chain of life body from macro to micro. In micro, cell is composed of subcellular components and various molecules of different sizes; In macro, cell is composed of subcellular components, Stem cells, together with other extracellular matrix components, constitute various tissues and organs of life. Different from terminal differentiated cells, stem cells are a special group of cells that are not fully differentiated and immature. They have the potential of self-renewal, high proliferation and multi-directional differentiation, and are known as “universal cells”, Stem cells play a key role in the self repair of damaged tissues. In the process of continuous differentiation and development of stem cells into various tissues and organs, stem cells will lose their original totipotent type and become specialized stem cells with specific functions. And in some specific conditions, such as under the guidance of different transcription factors, stem cells will differentiate in different directions, which is its plasticity. Because of its plasticity, stem cells have important value, broad prospects and great potential in clinical medicine. Up to now, stem cell therapy for various genetic diseases, trauma and pathological injury, tissue defect and immune deficiency diseases have important research results, involving almost all medical fields. Induced differentiation of stem cells into different types of cells, tissues and even organs, making them become the source of donor transplantation; the specific cells obtained by cell engineering from stem cells, as the target cells of gene therapy, are the research hotspots of medicine and biology in recent years.

2. Classification of Stem Cells

2.1 Embryonic Stem Cells

Embryonic stem cells (ESCs) are the first stem cells used in the study of chronic wound healing. Their amazing proliferation ability indicates that the study of embryonic stem cells may help people to further understand the regeneration process and provide the best treatment. ESCs are derived from the cell mass during the development of fertilized egg to blastocyst or blastocyst, which can not be obtained from patients. Direct use of ESCs will involve all the shortcomings of allogeneic transplantation and ethical issues related to embryonic tissue. Although ESCs themselves are not suitable for tissue transplantation, they do provide the potential to enhance the physiological healing process through paracrine mechanism.

2.2 Bone Marrow Mesenchymal Stem Cells

Bone marrow mesenchymal stem cells,the earliest discovered mesenchymal stem cells, are another promising candidate for repairing or replacing damaged tissues. As we all know, they have the ability to differentiate into multiple lineages, such as endothelial cells, nerve cells, hepatocytes and so on. It has been confirmed that bone marrow mesenchymal stem cells can differentiate into keratinocytes, endothelial cells, pericytes and monocytes. In addition to self differentiation potential, bone marrow mesenchymal stem cells also promote wound healing through autocrine and paracrine pathways. The combination of growth factors and cytokines secreted by bone marrow mesenchymal stem cells can successfully induce angiogenesis, reduce inflammatory cell infiltration, promote fibroblast migration and collagen production, which provides a new window for the treatment of chronic wounds.

2.3 Adipose Derived Stem Cells

Adipose derived stem cells are also a kind of mesenchymal stem cells, which can differentiate into adipocytes, osteoblasts, chondrocytes and myogenic cells. It can be said that adipose derived stem cells have almost the same potential as adipose derived stem cells, but they are more popular because of their wide availability and relatively easy access to enough cells. As stem cells with differentiation potential, adipose derived stem cells have epithelial differentiation potential. Local injection of adipose derived stem cells can accelerate wound epithelization through differentiation into keratinocytes. In addition, adipose derived stem cells have been proved to enhance wound healing through differentiation and angiogenesis, which can provide a feasible treatment method for clinical chronic wound treatment.

Adipose derived stem cells also secrete a large number of growth factors and cytokines in the process of wound healing to increase the recruitment of macrophages, accelerate the proliferation of fibroblasts and keratinocytes in vitro, enhance the production of collagen, then form granulation tissue, improve angiogenesis, and ultimately improve the wound healing rate. Adipose derived stem cells have been shown to release many powerful angiogenic factors, and can also reconstruct blood vessels by differentiating into endothelial cells.

2.4 Induced Pluripotent Stem Cells

Since the advent of induced pluripotent stem cells, they have attracted more and more attention in the field of regenerative medicine because of their easy access, no immune rejection and pluripotent differentiation potential. Using induced pluripotent stem cell technology, we can produce autologous pluripotent stem cell populations derived from differentiated adult tissues without using embryonic cells or egg cells. In addition, induced pluripotent stem cells derived from

autologous somatic cells are non immunogenic. The potential of induced pluripotent stem cells also includes promoting vascularization during wound healing. Studies have shown that exocrine derived mesenchymal stem cells from human induced pluripotent stem cells can promote collagen synthesis and angiogenesis, thus promoting skin wound healing[1]. Induced pluripotent stem cells have been shown to differentiate into cardiomyocytes, vascular smooth muscle cells and pericytes. Therapeutic induced pluripotent stem cells can be isolated and differentiated from patients, reprogrammed to pluripotent state, and then differentiated into the desired cell type.

3. Application of Stem Cells in Cosmetic Surgery

3.1 Application in Anti-Aging

With the passage of time, the internal growth and metabolism of organisms, aging also occurs. Genetic factors, environmental factors and behavioral factors all affect the aging of the body. Aging is not only a spontaneous and inevitable process, but also a natural law. However, we can take measures to effectively delay aging. In today's highly developed science and technology, the use of stem cell anti-aging therapy can not only make the skin full of elasticity and luster, but also repair the damaged tissue and delay aging from the inside out. Different from traditional conservative methods, stem cell therapy can significantly delay aging[2]. The reason why stem cell anti-aging therapy is effective is that stem cells have the ability of rapid proliferation and continuous differentiation, as well as the ability to secrete growth factors. Stem cells can enhance the ability of self regeneration and self repair of aging body, thus can delay aging to a certain extent. After stem cells enter the human body, they can continue to proliferate. With the continuous growth of the number of cells and the continuous progress of cell differentiation, the new cells replace the damaged cells, activate the dormant cells in vivo, and gradually restore their corresponding functions. At the same time, stem cells can secrete some bioactive substances and special protein components, such as VEGF, IGF and other growth factors, which can promote the recovery of damaged cells and prevent further cell aging.

3.2 Application in Wrinkle Removal

Healthy skin is smooth and elastic, metabolism function is exuberant, this also is the dream of many women. However, due to the gradual increase of age, under the effect of natural aging and photoaging, the synthesis ability of fibroblasts in the skin gradually decreased, and the content of collagen decreased, causing skin aging. When the content of collagen decreases, it will cause crosslinking and solidification of collagen fibers, loss of elasticity, wrinkles, skin relaxation and other aging phenomena[3]. Therefore, in the process of wrinkle removal, improving the synthesis speed and number of fibroblasts is the key to the treatment of skin wrinkles.

3.3 Application in Skin Wound Healing

Skin is the largest organ of human body, covering the surface of human body, belonging to the first line of defense of body immunity. Accidents lead to a large area of skin defects, can cause serious diseases, and even life-threatening. In clinical treatment, it is necessary to rapidly proliferate new cells to make skin wound heal as soon as possible.Stem cells are undifferentiated cells with strong ability of self-renewal and proliferation in vitro[4]. In vivo experiments on related animals have confirmed that stem cells can secrete a large number of growth factors. On the one hand, these growth factors can promote a variety of important cells to migrate to the damaged area and accelerate the repair of the damaged area; on the other hand, growth factors can promote the

regeneration of key tissue cells , which can significantly reduce the wound area, accelerate the regeneration of epidermis, and also improve the wound healing caused by radiation injury The skin atrophy of the patients . In addition, stem cells have great potential in postoperative wound healing.

3.4 Application in Burn Wound Repair

At present, there are three main methods of burn treatment: autotransplantation, allogeneic transplantation and xenotransplantation, but these three methods have defects. Autotransplantation is the best method in burn treatment, but it is not widely used in clinic. Allografts and xenografts not only have low ability to integrate into tissues, but also have the risk of disease transmission. However, mesenchymal stem cells have low immunogenicity, multi differentiation potential and wide sources, so they are widely used and studied in clinic[5].The main functions of stem cells in burn wounds are as follows. Firstly, stem cells differentiate into fibroblasts, keratinocytes and other cells by virtue of their multi-directional differentiation potential; secondly, growth factors secreted by stem cells can promote the repair of damaged epidermis, promote the formation of damaged tissues and new blood vessels; finally, stem cells can improve the local microenvironment of burn wound, and then promote wound healing.

3.5 In the Treatment of Alopecia

There are many reasons for hair loss, such as aging, endocrine disorders, mental stress and so on, which can lead to a large number of abnormal hair follicles and hair loss. Studies have shown that PDGF, KGF, VEGF and other growth factors secreted by stem cells can promote hair growth. Animal experiments have confirmed that intracutaneous injection of stem cells or smearing stem cell culture medium outside the skin can stimulate hair follicle growth[6]. Stem cell growth factors play a role in regulating the hair growth cycle, which can make more hair follicles enter the growth period, thus promoting hair regeneration and growth.

3.6 Application in Skin Whitening

The distribution and content of skin pigment determine the skin color, and melanin is the most important determinant. The main factors affecting skin whitening are tyrosinase activity, oxygen free radical, pigment deposition and cell regeneration.Melanin in the skin is produced by melanocytes in the basal layer of the epidermis. When melanocytes are stimulated by external conditions, tyrosine secreted by melanocytes undergoes a series of complex physiological and biochemical processes under the action of tyrosinase and oxidation, and finally forms indole polymer. Under the action of cell metabolism, melanin particles are transported to the surface of skin to deepen the skin color.Tyrosine is the main raw material for melanocytes to produce melanin, and tyrosinase is the main rate limiting enzyme in the process of transforming tyrosine into melanin[7]. Relevant studies have shown that growth factors secreted by stem cells can inhibit the growth activity of tyrosinase, thereby reducing the expression of tyrosinase related proteins, and ultimately inhibit the synthesis of melanin, which plays a role in skin whitening .

4. Conclusion

Stem cells have many advantages, such as easy to obtain, less damage to tissue, large reserves in vivo, and stable proliferation in vitro. Stem cells have strong repair ability and proliferation and differentiation ability, and will be fully utilized in anti-aging and skin repair. However, the mechanism of improving repair has not been verified, and the paracrine growth factors have not

been clearly identified. Therefore, it is necessary to explore the reaction mechanism and identify the ways to improve the repair without changing the characteristics of stem cells. More importantly, we need to achieve rapid and large-scale expansion of stem cells to provide sufficient cell sources for basic and clinical research.

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