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ИССЛЕДОВАНИЯ СТВОЛОВЫХ КЛЕТОК И ТКАНЕВАЯ ИНЖЕНЕРИЯ ДЛЯ ЗАЖИВЛЕНИЯ И РЕПАРАЦИИ

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Статья посвящена перспективе использования стволовых клеток в регенеративной медицине и тканевой инженерии. В этой работе предпринята попытка изучить основные источники данных популяций клеток, их особенности и свойства. Дать краткую характеристику каждому типу. Полученные результаты анализа информации дают краткий обзор данной темы.

Ключевые слова: стволовые клетки, пролиферация, регенерация.

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STEM CELL RESEARCH AND TISSUE ENGINEERING FOR HEALING AND REPAIR

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The article is devoted to the perspective of using stem cells in regenerative medicine and tissue engineering. In this work, an attempt is made to study the main data sources of cell populations, their features and properties. Give a brief description of each type. The obtained results of the information analysis provide a brief overview of this toFig.

Key words: stem cells, proliferation, regeneration.

The human body does not have such good regenerative ability. Undoubtedly, there are cells in each of us, in particular in the skin, intestines, and bone marrow, that are capable of proliferating and replacing worn out or damaged tissue. However, in other organs, such as the heart and brain, they divide only under certain conditions and at a slower rate [8].

Stem cell-based therapies are the future of regenerative medicine and tissue engineering. This method of treatment could solve the problems of restoring the body after illnesses and injuries [5,8].

The aim

We set ourselves the goal of studying and briefly characterizing the main sources of cells that can be used for the process of artificial regeneration. Also highlight for each type of population the potential advantages and disadvantages of their method of production, differential efficiency, proliferation rate in vitro, methods of processing and administration of biomaterial, etc.

Results and discussions:

Stem cells are immature cells capable of self-renewal and differentiation into functional cell types [6].

To date, several stem scaffolds have been identified, namely embryonic stem cells (ESCs), induced pluripotent stem cells (IPSc), mesenchymal stem cells (MSCs) and adipose-derived stromal cells (ADSCs).

ES-cells are pluripotent stem cells derived from the inner cell mass of preimplantation blastocysts [2]. They can differentiate into almost all derivatives of all three germ layers and are capable of self-renewal, which provides some advantage over other sources [3]. In several experiments, ES-cells have been used to restore the epidermis and heal wounds. The results of all experiments were positive [4]. However, embryonic cells have several disadvantages. First, they are hypersensitive to stressful situations, which can cause DNA damage. To preserve the intact genome, they destroy foreign cells, thereby protecting and at the same time exposing their own population to death [1]. This can lead to developmental abnormalities and cancer. Secondly, their limited availability due to legal and ethical issues [8].

IPS-cells are a new class of pluripotent stem cells that were obtained by reprogramming human somatic cells through exposure to Yamanaka factors and subsequently additional factors [6]. In terms of morphology, proliferation potential and other characteristics, they are no different from embryonic stem populations. They can also differentiate into all derivatives of the three germ layers. Based on the experimental data obtained to date, three-dimensional skin equivalents consisting of fibroblasts and keratinocytes have been created using IPS cells in vitro [4]. The main advantage of these cells is the availability of unlimited quantities, but despite all the positive aspects, induced pluripotent stem cells have significant disadvantages, namely carcinogenic potential when delivered directly to the body, genetic instability, epigenetic memory, affecting further forced differentiation under the influence of certain factors , inefficient reprogramming resulting in low numbers of cells obtained with high processing costs, as well as potential immunogenicity to adjacent tissues (teratoma formation) [4,6,8].

MS-cells are multipotent precursors that can be obtained from various parts of the body (bone marrow, adipose tissue, hair follicles, dental pulp) [8]. They are able to differentiate into any cells of the mesodermal line. In addition to high regenerative capacity, mesenchymal stem populations exhibit low immunogenicity and negative induction of teratoma formation. This type of cells enhances the proliferative ability of neighboring tissues due to paracrine activity, migrating to certain areas of the body [4].

Bone marrow-derived stem cells (BM-MSCs) are one source of MSCs. They have shown a high therapeutic effect in the treatment of chronic non-healing ulcers in preclinical trials [4]. However, serious problems, such as the invasiveness of obtaining cells (an induced bone defect is obligatory), low isolation yield due to limited availability, low proliferation rate in vitro, to increase which special biomaterials for reproduction are required, requiring additional costs, aging during long-term cultivation, prevent the use of them at the clinic [6,8].

Currently, the main source of stem cells is adipose tissue. ADS cells have advantages over BM-MSCs, including high availability with minimal invasiveness and no ethical restrictions [6].

Possessing multipotency, these cells are able to differentiate into osteoblasts, chondrocytes and myocytes [7]. Their level of paracrine activity is much higher, since at the site of introduction into the body they bind to specific tissue cell receptors and release certain growth factors (for example, keratinocyte growth factor), thereby proving their regenerative potential [4,7]. In addition, ADS have a great effect on fibroblasts, increasing their proliferation and collagen synthesis, increasing the level of wound healing [7].

Conclusion:

Thus, stem cells play a key role in tissue engineering and regenerative medicine, allowing the restoration of damaged tissues and organs. Their ability to differentiate into various types of cells opens up prospects for creating artificial tissues and organs. Further research on stem cells may lead to the development of innovative treatments for various diseases and improve the quality of life of patients.

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