The use of stem cells in regenerative treatment of diseases: a bibliographic review

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Abstract. There is hope that regenerative medicine will provide an unprecedented avenue of medical care to restore form and function by (re)-generating human cells, tissues, or organs. This exciting field uses natural and built-in repair protocols within the body, or powerful techniques like stem cell therapy for replacing damaged cells with engineered tissues using gene editing. Those are profound implications and not just an answer for therapy but potentially curing diseases which were previously untreatable. In this article, we highlight the recent innovations, clinical uses, and directions in regenerative medicine that illustrate its potential to revolutionize science and made a review about the use of stem cells in the treatment of some diseases. By fostering the body's inherent regenerative capacities or employing advanced biotechnological interventions, this paradigm shift in medicine holds transformative promise. We delve into the mechanisms, clinical trial outcomes, and prospects that underline regenerative medicine as a pivotal force in modern healthcare.

Keywords. Regenerative therapy, stem cells, tissues regeneration and therapeutic medicine.

1. Introduction

Regenerative treatment, more known as regenarative medicine, including stem cells, presents a high potential to cooperate in the regeneration of a tissue that had been damaged. In spite of it needs some adjusts to be 100% effective in ocasions, the study has increased and received more investments since its bigger apparition in the beginning of XXI century as it is a promising field in medicine.

The stem cells have been a target of intense reaserch due to it's unique ability of differentiation in cells in the human organism. This capability of celular differentiation turns it to a crucial gear to regenarate tissues and damaged organs, as well as the treatment of chronic and degenerative diseases. This therapeutic form of medicine has a goal to estimulate and amplify the natural competence of reconstruct injured organs. Instead of replacing the wounded organ from a patience to another that came from a donator, what brings issues and complications, there's a possibility of repairing it through regenerative treatment – therapeutic medicine.

Important results from uncountable studies with experimental animals, boosted some groups from all over the world to initiate clinical studies of transplant with stem-cells for a lot of illness, particularly, cardiovascular and neurological diseases.

At that, this article has the objective to review the importance of the regenerative therapy to have the theme better studied, to eventually turn out the best alternative for treatment.

1.1 Methods

A bibliographic review was employed, using articles published between the years 2002 and 2023 from the PubMed (www.pubmed.com), Scielo (www.scielo.org), and Google Scholar (https://scholar.google.com) databases.

The searches were conducted using the following terms: cardiovascular diseases, regenerative therapy, stem cells, tissue regeneration, and gene therapy. For searches in English, the following terms were used: cardiovascular diseases, regenerative therapy, stem cells, tissue regeneration, and gene therapy.

Thus, the study analysis was conducted based on articles selected according to certain inclusion and exclusion criteria. Articles that showed progress in studies in the area of regenerative therapy on tissues and the role of stem cells in the process, along with bibliographic review papers and experimental studies, were included. Articles with little progress or proficiency on the subject were excluded.

2. Discussion

Stem cell therapy, also known by regenerative medicine, stands for a great potential for the treatment of plenty of diseases. The stem cells have a unique property, which is the skill to differentiate into varied cell types. This type of therapy assure the replacement or restore of injured organs and tissues.

One of the main benefits of the regenerative medicine with the use of stem cells is its capability to fulfill problems and conditions which were practically titled as untreatable. For instance, the upgrading of stem cells therapy has been an excellent treatment for neurodegenerative diseases, such as in Alzheimer's and also Parkinson's, showing incredible results and promise. The skill to regenerate neural cells and improve brain activity could create an amazing field in medicine for the treatmet of debilitating conditions.

In the dimention of cardiovascular diseases, stem cell therapy shows encouragement for regenerating heart tissue post-myocardial infarction. Researches have demonstrated that this type of cells have the ability to repair cardiac tissue as well.

The stem cells have this ability to differentiate due to their specifical markers and signs from the ambiance. These cells respond to physical and chemical elements that influence their goal. They're basically shaped by the signs they receive, the environment where the stem cells are placed helps to give their direction and in what they could transform. There are a lot of types of stem cells that are used in this kind of situation: The Hematopoietic Stem Cells (HSCs), Mesenchymal Stem Cells (MSCs), Induced Pluripotent Stem Cells (iPSCs) and Embryonic Stem Cells (ESCs).

HSCs are used in gene therapies to take care of blood disorders like anemia and leukemia. They camo from the bone marrow and have the capability to differentiate into most cells from the blood. MSCs are the ones explored by immunomodulatory properties. The iPSCs are adult cells reprogrammed to an embryonic-like state, offer a nice solution by avoiding the ethical issues with the embryonic cells. And finally, ESCs, they have a significant potential of differentiation and are employed to understand diseases.

Stem cell regenerative therapy is also an area of research that shows significant promise in the advancement towards curing such conditions, for example musculoskeletal diseases. Temporomandibular joint syndrome, osteoarthritis, and spinal cord injuries have limited treatment options in the past seen progressive new methods by use of stem cells. For example, stem cell injections have been proposed to regrow cartilage in arthritic joints with the hopes of reducing pain and improving range-of-motion.

In addition, it is also advancing in the dermatologist area. The ability of stem cells to regenerate skin tissue for burn victims or potential therapies against chronic wounds are just a few examples, showing how these amazing human resources can and finally will be used. Research has also found that new methods for developing less rejection-susceptible and more efficient skin grafts hold promise.

Another part of medicine that had been contemplated by the regenerative therapy is the oncology field, regenerating bone marrow and imune cells damaged by chemotherapy. This path aims to restore the patient's immune system and recover the consequences.

In the field of organ transplantation, analysis on stem cells is creating a path towards potential movement in generating bioartificial organs. This may in turn, help to address the chronic shortage of donor organs and reduce problems related to combating organ rejection. Lab-grown organs made from the recipient's own cells could turn out the future of organ transplantation.

Further, the gene therapy, another type of regenerative medicine that is now introduced in the world, can be classified into two categories: somatic gene therapy and germline gene therapy. In somatic gene therapy, the genetic material is inserted into selected target cells, but the genetic information is not passed on to the next generation, unlike in germline gene therapy. This area between gene editing technologies such as CRISPR and stem cell therapy promises to be an exciting domain. It has the power to correct those genetic errors where they reside and cure diseases like: cystic fibrosis, sickle cell anemia and muscular dystrophy. If DNA is edited in stem cells before they are directed down a developmental pathway and transplanted, then the resulting tissues will be free of genetic errors.

Nevertheless, these projects are accompanied by quite a number of challenges. The ethical implications of using embryonic stem cells have continued to be raised. Moreover, there is still the danger of tumorigenesis and, consequently, the serious practical problems associated with potential rejection by the host immune system. The research is focused on the improvement of safety and to increase the efficacy of stem cell therapy, and the iPSCs development is another pathway in an alternate. IPSCs are adult cells reprogrammed to an embryonic-like state, offer a nice solution by avoiding the ethical issues with the embryonic cells.

Another ethical issue is the inequality when it comes to stem cell treatments. Because they are expensive and involve complex technologies, only the wealthy can afford these treatments, deepening health disparities. Ensuring equal access to these new treatments is essential to avoid inequalities among different social groups.

Additionally, the use of prescribed fertility drugs raises concerns about the regulation and oversight of these treatments. Pharmacies offer stem cell treatments without proof or critical information

about their effectiveness. This highlights the importance of applying appropriate standards to ensure patient safety and treatment efficacy.

Moreover, from an ethical standpoint, it is important to obtain complete information and consent for stem cell research and treatment. Both the patient and the donor must be fully aware of the risks, benefits, and outcomes of the procedures. This includes a general discussion on the experimental nature of many stem cell treatments and the resulting uncertainties.

3. Conclusion

Regenerative medicine, specifically with stem cells is a really important part in the world of medical care. It has the ability to do what was once considered impossible treat and cure a variety of conditions. In limitless ways, the ability of regenerating injured tissues and organs is positioned to redefine patient care by reducing pain for patients throughout their lives.

The process to incorporating stem cell therapies into routine medical practice is linked with ethical, regulatory and scientific hurdles. Overcoming these barriers will require an effort involving scientists, clinicians, policymakers and ethicists. However, success from them will be achieved only if their safety and efficacy are assured and they become widely available at affordable prices.

As research continues to advance using these treatment strategies, such as the use of gene editing alongside stem cell therapy for further therapeutic potential, the future of regenerative medicine looks quite promising where disease is not just treated through managing symptoms but a healthier scenery can also be engineered as true healing and regeneration.

In the modern age of rapid scientific progress, regenerative therapy is seen as a light at the end of the tunnel that could change tomorrow where treatment becomes synonymous with repair and regeneration for all mankind.

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