

Exploration and Therapeutic Practices with Stem Cells: A Critical Perspective

Ali Hazazi^{1*}, Fawaz Albloui¹, Mohammed Albayadh¹,
Mohammed Ageeli Hakami², Sultan Arif³ and Omer Alsweed¹

¹Department of Pathology and Laboratory Medicine,
Security Forces Hospital Program, Riyadh, Saudi Arabia.

²Department of Clinical Laboratory Sciences, College of Applied Medical Sciences,
Shaqra University, Al-Quwayiyah, Riyadh, Saudi Arabia.

³Department of Plastic Surgery, Security Forces Hospital Program, Riyadh, Saudi Arabia.

<https://dx.doi.org/10.13005/bbra/3160>

(Received: 13 August 2023; accepted: 27 September 2023)

Stem cell studies have recently enabled a quantum leap in the field of regenerative medicine and the attempt to find cures for diseases of a complex nature. Clinical trials remain the only criterion for ensuring the safe application of stem cells; however, the rapid improvement in the quality of related research may have given the inaccurate perception that such cells offer a magic solution to complex diseases. It is crucial to recall that stem cell transplantation is a complex process, and each of the many steps it entails requires research before the procedure can be used. In the same way, it remains to seek ascites the correct information for the uses of reliable medical sources. At the clinical level, stem cells have been successfully used to treat certain diseases, especially a limited number of blood disorders, but factors related to the patient's condition and human leukocyte antigen matching are important for the application of this type of treatment.

Keywords: Immunology; Molecular Genetics; Regenerative Medicine; Stem Cells.

Perceptions of Stem Cells

Despite remarkable progress in using stem cell transplantation to treat complex diseases in which conventional drug therapy has failed, the development of this treatment has been unjustifiably exploited. The supposed ability of stem cells to fully cure diabetes, cirrhosis, kidney failure, and injuries is periodically published and circulated¹. However, such claims are not yet proven by clinical applications or experiments on people with such diseases. Furthermore, these claimed developments are publicized for purely financial gain and without reference to the ethics

of the medical profession, even if stem cells have indeed yielded some promising indicators for complex diseases in laboratory experiments². The failure of specialized centers to apply stem cells has also been given much consideration as, if such cells are handled by non-specialists or incorrectly, a humanitarian catastrophe will inevitably ensue with consequences that may be fatal or give rise to tumor disorders and other complications that become difficult to control³. The importance of stem cells lies in the facts that first, they are the cells responsible for compensating and regenerating damaged tissues or cells in the body; and second,

*Corresponding author E-mail: ahazazi@sfh.med.sa



they have the ability to develop and differentiate into other types of specialized cells, such as stem cells that form blood, skin tissues, and the nervous system^{4,5}. This differentiation occurs through the activity of specific genes that are responsible for determining the biological pattern or pathway for the formation of new cells, which is known as the process of cellular differentiation⁶.

Stem Cell differentiation

In terms of their importance, stem cells can be categorized into three main groups: human embryonic stem (HES) cells, induced pluripotent stem cells (iPSC), and adult stem cells⁷. Research experiences and clinical applications differ according to this typology. In a simplified summary of these types, HES cells form the embryo in its first primitive stages after the fertilization of the egg and have been subject to much medical research⁸. Although research has not yielded clear and safe evidence for therapeutic application, many researchers believe that HES cells will be used to treat several complex genetic diseases in the future because such cells have the highest ability in terms of development and division⁹. However, the uses of HES cells might be extremely limited due to both their high cost and opposition to their use on religious grounds, which generates problems, controversies, and a lack of conviction about the rightness of following this path¹⁰.

In the same way, the discovery of iPSC represents a revolution in the future of regenerative medicine¹¹. In the last ten years, scientists have been successful in converting (normal) somatic cells into cells bearing the characteristics of HES cells through bioengineering by adding a set of transcription factors and genes with special capabilities in which ordinary cells acquire the biological characteristics of stem cells¹². Some studies have highlighted the importance of applying such cells therapeutically. However, given the limited number of clinical trials using these types of cells, their future use is fraught with risks, and clarity is lacking from the therapeutic point of view since scientists in the field of stem cells have not discovered means to finally and completely control them. The path of differentiation and development of these cells remains a mystery that researchers continue to decipher¹³.

The third type of cell offers hope of providing safe treatment by transplanting adult

stem cells, which have the characteristic of development and differentiation into a specific path, led by hematopoietic stem cells¹⁴. This type of stem cell has proven its ability to treat some cases of bone marrow failure, blood cancer (leukemia), lymphoid and myeloid tumors, and blood breakdown (anemia) as well as some diseases resulting from the failure of the immune system. Transplanting adult stem cells offers hope when the attending physician considers it the last step after all attempts at conventional treatments have been exhausted, as stem cell transplantation requires many clinical and laboratory procedures and examinations¹⁵. In addition, Human leukocyte antigens (HLA) matches tests, particularly in allogeneic transplant. This type of transplant has been performed for patients suffering from bone marrow failure¹⁶.

Further, in other diseases, such as Hodgkin's lymphoma, donors are not required for transplant; in such cases, stem cells come from patients themselves in a process called autologous transplant¹⁷. The stem cells are extracted from the patient before the start of the chemotherapy or radiotherapy process and returned to them after the completion of the treatment process. They contribute to the creation of new stem cells to replace those destroyed during the treatment for lymphoma with high doses of anti-cancer¹⁸.

Stem Cell transplant considerations

During the transplantation pathway, the patient will be under chemotherapy for a period of time to prepare the body to receive this type of cell. The patient will also be kept in strict isolation. Following the transplant, it is important to follow up the treatment plan¹⁹. Molecular genetic tests also have an important role in showing successful engraftment. Despite the safe application of blood-forming stem cells, the HLA matching process is an ever-present concern in the absence of a donor. From this standpoint, stem cells taken from the umbilical cord blood of newborns widen the choice in terms of performing stem cell transplantations. Consequently, some medical facilities have established a special section for an umbilical cord blood bank: the blood is extracted immediately after birth, laboratory tests are conducted to ensure that it is free of infectious diseases and viruses, and HLA data are recorded²⁰. The researchers pointed out that, despite the scientific progress presented

by umbilical cord blood cells, some risks may be present, especially if these cells contain genetic or hereditary diseases that cannot be detected directly but appear late in the life of the donor or recipient of these cells²¹. Some treatment plans follow the condition of the child from whom the umbilical cord blood was taken after a year has passed to see whether they have any genetic or hereditary disorders before transplantation²².

Closing Remarks

Stem cells remain a promising treatment for various genetic, cancerous and immunological diseases, but on an insignificant scale due to the limited clinical dependence²³. Also, in diseases that have credits for stem cell therapy, the patient undergoes numerous clinical and laboratory tests, and also the suitability of this type of treatment before proceeding with the transplantation process²⁴.

ACKNOWLEDGMENT

It is essential to express appreciation to the researchers in various fields of stem cells, who play an influential role in enriching the therapeutic field, which will have an effective impact in serving patients who require this type of treatment.

Conflict of interest

Authors declare no conflict of interest.

REFERENCES

1. HM, S.W. 'Therapeutic prospective of stem cells in veterinary practice', *Open Access Journal of Veterinary Science & Research*. 2019;4(2), pp. 1–5. doi:10.23880/oajvsr-16000179.
2. Gugjoo, M.B. 'Mesenchymal stem cells therapeutic applications in gastrointestinal disorders', *Therapeutic Applications of Mesenchymal Stem Cells in Veterinary Medicine*. 2022, pp. 247–278. doi:10.1007/978-981-19-3277-9_7.
3. Kaufman, D.S. and Thomson, J.A. 'Embryonic stem cells', *Stem Cell Therapy for Autoimmune Disease*. 2019, pp. 5–10. doi:10.1201/9780367813895-2.
4. de Carvalho Ribeiro, P. *et al.* 'Differentiating induced pluripotent stem cells into renal cells: A new approach to treat kidney diseases', *Stem Cells International*, 2020, pp. 1–9. doi:10.1155/2020/8894590.
5. Higuchi, A. *Biomaterial control of Therapeutic Stem Cells* [Preprint]. 2019, doi:10.1039/9781788012690.
6. Slack, J. '2. embryonic stem cells', *Stem Cells: A Very Short Introduction*. 2021, pp. 21–37. doi:10.1093/actrade/9780198869290.003.0002.
7. Gaston, G. and Gallicchio, V.S. 'Stem cell treatment of autism spectrum disorders', *Stem Cell and Regenerative Medicine*. 2022;6(2). doi:10.33425/2639-9512.1074.
8. Schiesser, W.E. 'Six PDE model for stem cell differentiation', *Spatiotemporal Modeling of Stem Cell Differentiation*. 2022, pp. 35–39. doi:10.1016/b978-0-323-90797-2.00006-2.
9. Turner, L. 'The American stem cell sell in 2021: U.S. businesses selling unlicensed and unproven stem cell interventions', *Cell Stem Cell*. 2021;28(11), pp. 1891–1895. doi:10.1016/j.stem.10.008.
10. Schiesser, W.E. 'One PDE stem cell model', *Spatiotemporal Modeling of Stem Cell Differentiation*. 2022a, pp. 1–4. doi:10.1016/b978-0-323-90797-2.00005-0.
11. Weiss, J.N. and Levy, S. 'Stem cell ophthalmology treatment study (SCOTS): Bone marrow derived stem cells in the treatment of Usher syndrome', *Stem Cell Investigation*. 2019;6(a), pp. 31–31. doi:10.21037/sci.2019.08.07.
12. Sharma, S.K. 'Basics of stem cell transplant', *Basics of Hematopoietic Stem Cell Transplant*. 2023a pp. 9–20. doi:10.1007/978-981-19-5802-1_2.
13. Jordan, E. and Gallicchio, V.S. 'Stem cell therapy as a treatment method for rheumatoid arthritis', *Stem Cell and Regenerative Medicine*, 2020;4(1). doi:10.33425/2639-9512.1043.
14. Saglio, F. 'Car T-cell', *Hematology, Transfusion and Cell Therapy*, 43. doi:10.1016/j.htct.2021.10.955.
15. Wang, Y. 'A special issue on "Stem cell immunology"', *Cellular Immunology*, 326, p. 1. doi:10.1016/j.cellimm.2018.02.014.
16. Weiss, J.N. and Levy, S. 'Stem cell ophthalmology treatment study (SCOTS): Bone marrow derived stem cells in the treatment of Usher syndrome', *Stem Cell Investigation*, 6. 2019, pp. 31–31. doi:10.21037/sci.2019.08.07.
17. Nair, D.S. and Thomas, B.B. 'Stem cell-based treatment strategies for degenerative diseases of the retina', *Current Stem Cell Research & Therapy*. 2022;17(3), pp. 214–225. doi:10.2174/1574888x16666210804112104.
18. Meriç, N., Parmaksız, A. and Gülbağ, Z. 'Determination of the relationship between CD34+ stem cell amount and DMSO in hematopoietic stem cell transplantation', *Transplant Immunology*. 2023;78, p. 101831.

- doi:10.1016/j.trim.2023.101831.
19. Kumaria, A. 'Stem cell-based therapies and Glioblastoma: A seminal matter', *Hematology/Oncology and Stem Cell Therapy* [Preprint]. doi:10.1016/j.hemonc.2021.01.008.
 20. Elfeky, R. *et al.* 'Immune reconstitution following hematopoietic stem cell transplantation using different stem cell sources', *Expert Review of Clinical Immunology*. 2019;15(7), pp. 735–751. doi:10.1080/1744666x.2019.1612746.
 21. Khurana, P. *et al.* 'Stem Cell Research Lab Resource: Stem cell line induced pluripotent stem cell (ipsc) line MLI-003A derived from an individual with the maximum number of filaggrin (FLG) tandem repeats', *Stem Cell Research*. 2020;45, p. 101827. doi:10.1016/j.scr.101827.
 22. Sharma, S.K. 'Stem cell transplant for autoimmune diseases', *Basics of Hematopoietic Stem Cell Transplant*, 2023b, pp. 247–258. doi:10.1007/978-981-19-5802-1_21.
 23. Xiang, E., Huang, R. and Yang, S. 'Change in micromechanical behavior of surface densified wood cell walls in response to superheated steam treatment', *Forests*. 2021;12(6), p. 693. doi:10.3390/f12060693.
 24. Krentz, N.A.J. 'Improvements in stem cell to beta-cell differentiation for the treatment of diabetes', *Journal of Immunology and Regenerative Medicine*. 2021;12, p. 100043. doi:10.1016/j.regen.100043.