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Review

Somatic Stem Cell Therapies

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ABSTRACT

Resident stem cells or somatic stem cells (SSCs), are a population of undifferentiated cells within a differentiated organ and in a specialized cell. These cells participate in the regulation of homeostasis and tissue repair. Somatic stem cells are self-renewing and can be activated to multiply and differentiate as needed. They are identified in many tissues, including the heart, blood, muscle, skin, and brain. Extensive preclinical and clinical studies have demonstrated the functional and structural regeneration capabilities of these SSCs, such as mesenchymal stromal stem cells, hematopoietic stem cells, bone marrow-derived mononuclear cells, and resident. Somatic stem cells are used to treat disorders of the brain, pancreas, eyes, and heart. Organoids are *in vitro* cultured 3D structures that outline important aspects of organs *in vivo*. They derived from SSCs benefit from the cell-driven process of tissue regeneration and can be created directly from the diseased or healthy epithelium of many organs. Among the various SSCs, mesenchymal stem cells, especially those derived from bone marrow and adipose tissue, may be a treatment for diabetic retinopathy. These cells exert their therapeutic effects through paracrine mechanisms. In addition to secretory proteins, SSCs release extracellular vesicles that send their contents to target cells. One of the most promising applications of these vesicles with SSCs is cancer therapy. Furthermore, SSC-extracellular vesicles can be modified to improve targeted drug delivery. The ease of use and therapeutic effects of SSCs have made them candidates for cellular therapeutics. In this chapter, the concept of SSCs and SSC therapy, the use of SSCs, their applications, and their relationship with diseases will be discussed.

Keywords: Cellular therapy, mesenchymal stem cells, stem cells, somatic cells, therapeutics .

Due to their ability to produce more specialized cell populations in accordance with the body's requirements, somatic endogenous stem cells are essential for maintaining organ homeostasis.[1] These stem cells can be located, extracted from various tissues, and categorized based on how neuronally differentiated and developed they are. The first category consists of somatic stem cells (SSCs), which are mainly in a temporary developmental stage and finally settle in a particular area during the transition from perinatal to young somatic tissue. The second set of cells called perinatal stem cells, which are derived from amniotic tissue and fluid, placental tissue and blood, and umbilical cord tissue and blood, represent postnatal somatic tissues.[2]

Regulation of SSC division and proliferation is important for maintaining organ and tissue function in the body. Somatic cells have the same genetic code as zygotes, and the activating sites are sufficient to reprogram the cell into an early stage of development, according to the finding of adult cell nuclear transfer.[3]

The initial generation of induced pluripotent stem cells (iPSCs) was accomplished by ectopic expression of four specific genes [SRY-box transcription factor 2 (SOX2), octamer binding transcription factor 4 (Oct-4), kruppel-like factor 4 (KLF4) and c-Myc). Various cell types can be used to create iPSCs, which are thought to share a common molecular process. The increasing use of iPSCs to model the development of organs, tissues, and other systems of the body is due to the abundant supply of these cells compared to other pluripotent stem cells.[4]

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Somatic stem cells can only differentiate into a few mature cells and are self-renewing. Their primary function is to maintain tissue homeostasis. Normally kept dormant, these stem cells can only be triggered to differentiate and multiply into the needed type. Somatic stem cells have been identified in the heart, muscle, blood, brain, skin and intestine, and many other tissues. Clinical trials have been conducted to study the feasibility, functional role, and safety of cell therapies in sick humans.[5]

Organoid cultures have emerged as powerful *in vitro* models for many different organs. Organoids are 3D multicellular cultures that resemble the physiology, diseases, and structure of organs. Organoids are made from SSC, precursor cells, or pluripotent stem cells in two complementary ways with their own characteristics and specific applications. Organoids are made up of organs within the central nervous system, the digestive tract, the urogenital system, the airways, and the reproductive system. Both kinds of organoids have been used to research organ physiology and disease and to test new treatments including gene therapy and medications. Organoids have great potential to advance the understanding of kidney disease and facilitate the discovery of treatment options. Renal tubuloids and organoids are composed of pluripotent stem cells and SSCs, respectively. These species better reflect human disease and physiology than animal models, allowing for individualized medicine and high-throughput drug screening.[5]

Depending on the tissue from which they originate, SSCs have a high capacity for proliferation and can develop into a variety of cell types. Somatic stem cells in the body are in charge of producing new tissue in response to damage, illness, or routine maintenance. As a result, adult stem cell-based therapies have drawn a lot of interest in treating numerous degenerative disorders and rejuvenating aging tissue. However, since they spread quickly, they are also dangerous. Cancer can result from dysregulation in the systems that maintain stem cells dormant and incapable of proliferating. This raises questions about the safety of stem cell-based medicines, but it also opens the door to novel cancer treatment strategies. Understanding the abnormal molecular processes in stem cells during cancerogenesis may help prevent the development of future cancers.[6]

Even though there have been numerous clinical trials looking into using adult stem cells to treat disease, very few have led to therapies that have been authorized. Several types of hematologic cancers and other conditions[7] are treated with bone marrow transplants, which use hematopoietic stem cells (HSCs) to regenerate blood cells[8].

Skin stem cell therapy has been effective in healing burn victims' skin. Hematopoietic progenitor cells isolated from cord blood are the only stem cell-based goods authorized by the Food and Drug Administration for use in the country. In 2015, Holoclar®, a corneal injury treatment based on eye stem cells, received approval in Europe[]. Stem cell-based therapies still have unproven applications in other fields.[9]

Adult somatic stem cells are self-renewing cell populations that can create particular lineages of precursor cells that give rise to differentiated cell offspring in tissues and organs. For cell maintenance, repair, and regeneration throughout life, they are retained from organogenesis.[10]

In certain cell/extracellular matrix niches, SSCs are created during differentiation. *In vivo* tissue-specific locations known as niches contain differentiated cells that regulate stem cells. Although the niche's histological makeup varies greatly between different tissues, it frequently consists of stromal cells, extracellular matrix, blood vessels, neurons, and precursor differentiated cells that are related to the tissue.[11]

Quiescent stem cells (or active stem cells) and progenitor cells at different stages of development frequently coexist in the stem cell population. In addition to acting as a distinct topographical and functional site, the surrounding niche cells control stem and progenitor cells.[12-14]

Somatic stem cells are frequently multipotent, and their lineage produces terminal differentiated cells' unipotent progenitors. For self-renewal, activated stem cells divide symmetrically to make identical cells. An asymmetric cell division, on the other hand, results in the production of a reserve stem cell and a cytoplasmically partitioned progenitor cell that is dedicated to a particular route. Short-lived, intermediate transit amplifying (TA) cells proliferate heavily where there is a cyclic need for somatic cell renewal before differentiating into adult cells.[13,14]

It's possible that the resident population of various progenitors is chosen for a certain role by being recruited and chosen for their developmental potential. The niche controls stem cell activity to sustain physiological requirements for homeostasis and organismic fluctuations in development, maturation, reproduction, and senescence that might affect stem/progenitor behavior.[15] In addition to being temporary rather than permanent, stem cells and their offspring within the niche may also be able to adapt to atypical circumstances during tissue homeostasis or trauma that impacts or depletes the cell population.[16]

Studies on dormant stem cells reveal that epigenetic, transcriptional, and post-transcriptional mechanisms keep them alive.[17] Signals from niches, like Wnt, which are present in many mammalian organs, keep self-renewing stem cells alive.[18] There are signs that the identity of the stem cell states is fluid and demonstrates plasticity, even while the developmental determination of the stem cells from the quiescent state to active renewing stem and progenitor cells follows a directional lineage.[19] It has been established that quiescent and active stem cells coexist[20], and that quiescent and active cells can interconvert in both directions.[21] The idea of a stem cell as a distinct entity is changing to one of a biological process with some plasticity.[22] Undifferentiated cells, facultative cells, and differentiated cells are now included in the scope of stem cell functionality.[23]

SOMATIC STEM CELL THERAPY

The use of stem cells, which are undifferentiated cells with the capacity to develop into a variety of cell types, in SSC therapy allows the body to repair or replace damaged tissues. Somatic stem cells, often referred to as adult stem cells, are present in a variety of human tissues, including bone marrow, skin, liver, and brain. The treatment aims to use the regenerative capacity of these cells to treat or replace damaged tissue in patients with a variety of illnesses and ailments, such as diabetes, heart disease, and spinal cord injuries. Somatic stem cells can be taken from a donor or the patient's own body (autologous or allogeneic transplantation). The therapy has the benefit of not requiring the killing of embryos, unlike embryonic stem cell therapy, which requires. Additionally, there is a lower chance of immune system responses or rejection since the cells employed in SSC therapy come from the patient's own body. Further research is necessary to fully understand the potential benefits and drawbacks of SSC therapy. [24-26]

Muscle, bone, neuron, and blood cells are just a few of the many cell types that SSCs can differentiate into. As a result, they provide remarkable therapeutic potential for a variety of illnesses and ailments. Somatic stem cell therapy normally entails removing the patient's own or a donor's own cells, isolating, and purifying them, and then injecting the cells into the body part that requires repair. For instance, stem cells may be directly injected into the diseased heart tissue in order to stimulate regeneration and repair in the case of cardiac disease. Somatic stem cells not only have regenerative abilities but also have anti-inflammatory and immunomodulatory capabilities that can aid in reducing inflammation and advancing recovery. The best source and kind of cells to employ, the best techniques for isolating and purifying the cells, as well as the treatment's long-term safety and effectiveness, are all unresolved issues with SSC therapy. Furthermore, as the application of stem cells to medicine is still in its infancy, additional study is required to properly comprehend the possible advantages and disadvantages of these treatments.[27-29]

Somatic Stem Cell Applications

Somatic stem cells are a type of adult stem cell that are found in many tissues throughout the body, including the skin, bone marrow, and brain. These cells have the ability to differentiate into various cell types, making them a valuable tool for repairing and regenerating damaged tissues. Compared to embryonic stem cells, SSCs have several advantages. They do not raise the same ethical concerns, as they are not derived from embryos, and they have a lower risk of causing immune rejection when transplanted into patients. Somatic stem cells can be isolated from various tissues using different techniques, such as fluorescence-activated cell sorting (FACS) and magnetic-activated cell sorting (MACS). Once isolated, these cells can be expanded in culture and induced to differentiate into specific cell types using various growth factors and culture conditions. Somatic stem cells have shown promise in a range of applications, including tissue regeneration, immunomodulation, cancer therapy, drug discovery, and disease modeling. However, more research is needed to fully understand their therapeutic potential and ensure their safety and efficacy in clinical settings. Despite their potential, SSCs also have some limitations. For example, they may have a limited capacity for self-renewal and differentiation, and the process of isolating and expanding these cells can be time-consuming and costly. Somatic stem cells are a valuable tool in regenerative medicine and hold great promise for the treatment of a wide range of diseases and injuries. Ongoing research in this field is likely to uncover new applications and approaches for using these cells in clinical settings. Somatic stem cells, also known as adult stem cells, are a type of stem cell that can be found in various tissues in the body. Unlike embryonic stem cells, which are derived from embryos, SSCs are derived from adult tissues and do not have the same ethical concerns associated with their use. Somatic stem cells have the ability to self-renew, which means they can divide and produce more stem cells, as well as differentiate into specialized cell types that make up the tissues and organs of the body. This property makes them a promising tool in regenerative medicine, where they can be used to repair or replace damaged tissues. One of the main advantages of SSCs is that they are less likely to cause an immune response when transplanted into a patient. Somatic stem cells are derived from the patient's own tissues and exhibit genetic similarity to the recipient's cells. This reduces the risk of rejection and the need for immunosuppressive drugs. They can be isolated from various tissues, including bone marrow, adipose tissue, and blood. They can be expanded in culture and induced to differentiate into various cell types, such as bone, muscle, cartilage, and nerve cells. There are many potential applications of SSCs, including tissue regeneration, immunomodulation, and drug discovery. However, much more research is needed to fully understand their therapeutic potential and ensure their safety and efficacy in clinical settings. Despite their promise, SSCs also have some limitations. For example, they have a limited capacity for self-renewal and differentiation, and the process of isolating and expanding these cells can be time-consuming and costly. Despite that, SSCs continue to be a valuable asset in the field of regenerative medicine and demonstrate significant potential for the treatment of various diseases and injuries.[30-37]

Somatic stem cells are a type of adult stem cell that have the ability to differentiate into many different cell types, such as muscle, bone, and nerve cells. They are found in various tissues throughout the body, such as the bone marrow, skin, and brain, and have the potential to be used in regenerative medicine to repair or replace damaged tissues and organs. Compared to embryonic stem cells, SSCs have several advantages. They do not raise the same ethical concerns, as they are not derived from embryos, and they have a lower risk of causing immune rejection when transplanted into patients. Somatic stem cells can also be isolated and expanded more easily than embryonic stem cells. They can be isolated from different tissues using a range of techniques, including FACS, MACS, and tissue-specific isolation methods. Once isolated, these cells can be expanded in culture and induced to differentiate into specific cell types using various growth factors and culture conditions. Somatic stem cells have shown promise in various applications, including tissue engineering, immunomodulation, and drug discovery. They have the potential to be used in the treatment of many diseases and injuries, such as heart disease, diabetes, and spinal cord injuries. Despite their potential, SSCs also have limitations. They may have a limited capacity for self-renewal and differentiation, and the process of isolating and expanding these cells can be time-consuming and expensive. Additionally, the safety and efficacy of SSC therapies need to be established through rigorous clinical trials. Somatic stem cells are a valuable tool in regenerative medicine and hold great promise for the treatment of a wide range of diseases and injuries. Ongoing research in this field is likely to uncover new applications and approaches for using these cells in clinical settings.[38-41]

APPLICATION OF SOMATIC STEM CELL THERAPY

Cardiovascular Diseases

Somatic stem cell therapy has been investigated as a potential treatment for cardiovascular diseases. Cardiovascular diseases include a range of conditions that affect the heart and blood vessels, including coronary artery disease, heart failure, and myocardial infarction. Somatic stem cells, particularly mesenchymal stem cells (MSCs), have been studied for their ability to regenerate heart tissue and improve heart function after a heart attack or other cardiovascular event. MSCs are a type of adult stem cell found in various tissues throughout the body, including bone marrow, adipose tissue, and umbilical cord blood. They have the ability to differentiate into a variety of cell types, including heart muscle cells, and can also release growth factors and other molecules that promote tissue repair and regeneration. Studies in animal models have shown that MSCs can improve heart function and reduce the size of the infarcted area after a heart attack. Clinical trials have also been conducted to investigate the safety and efficacy of MSC therapy in humans. These studies have shown that MSCs can improve heart function and reduce mortality rates in patients with heart failure or a history of myocardial infarction. Other SSCs types, such as cardiac stem cells and endothelial progenitor cells, have also been investigated for their potential to regenerate heart tissue and improve heart function. However, the use of these cell types in clinical settings is still in the early stages of development. Overall, SSC therapy holds promise as a potential treatment for cardiovascular diseases. Ongoing research continues to explore the optimal cell types, delivery methods, and dosages for this type of therapy. Somatic stem cell therapy for cardiovascular diseases is still in the early stages of development, and more research is needed to determine the optimal cell types, delivery methods, and dosages for this type of therapy. However, the potential benefits of SSC therapy for heart disease are significant, and ongoing research continues to explore new possibilities for this promising field.[42-45]

Neurological Disorders

Somatic stem cell therapy has the potential to treat various neurological disorders by replacing or repairing damaged neural tissue. Neurological disorders, including Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), and spinal cord injury, are caused by damage to the neurons or other supporting cells in the nervous system. This damage can result in a range of symptoms, such as muscle weakness, tremors, cognitive impairment, and sensory disturbances. Somatic stem cells, which are derived from adult tissues, can be used to generate new neural tissue to replace damaged or lost tissue in the nervous system. These stem cells can differentiate into various neural cell types, such as neurons, astrocytes, and oligodendrocytes, which play crucial roles in the proper functioning of the nervous system. One of the most promising applications of SSC therapy in neurological disorders is the treatment of spinal cord injury. In preclinical studies, stem cell transplantation has been shown to promote axonal regrowth, remyelination, and functional recovery in animal models of spinal cord injury. Similar approaches have also been explored for the treatment of other neurological disorders, such as ALS and MS, with some promising results. However, there are still many challenges to overcome before SSC therapy can be widely used to treat neurological disorders. These include optimizing the cell types and dosages, developing safe and effective delivery methods, and addressing ethical and regulatory issues. More research is needed to fully understand the mechanisms underlying SSC therapy in neurological disorders and to translate these findings into effective treatments for patients. Somatic stem cell therapy has the potential to treat various neurological disorders by replacing or repairing damaged neural tissue. Neurological disorders, including Alzheimer's disease, Parkinson's disease, ALS, MS, and spinal cord injury, are caused by damage to the neurons or other supporting cells in the nervous system. This damage can result in a range of symptoms, such as muscle weakness, tremors, cognitive impairment, and sensory disturbances. Somatic stem cells, which are derived from adult tissues, can be used to generate new neural tissue to replace damaged or lost tissue in the nervous system. These stem cells can differentiate into various neural cell types, such as neurons, astrocytes, and oligodendrocytes, which play crucial roles in the proper functioning of the nervous system. One of the most promising applications of SSC therapy in neurological disorders is the treatment of spinal cord injury. In preclinical studies, stem cell transplantation has been shown to promote axonal regrowth, remyelination, and functional recovery in animal models of spinal cord injury. 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Somatic stem cell therapy has shown promise in preclinical studies for the treatment of HD by promoting the regeneration of neurons and reducing inflammation in the brain. In one study, the transplantation of neural stem cells (NSCs) into a mouse model of HD resulted in the formation of new neurons in the brain and improved motor function. Another study demonstrated that transplantation of MSCs into a rat model of HD reduced inflammation and oxidative stress in the brain and improved motor function. Despite these promising results, more research is needed to determine the optimal stem cell type, dosage, and delivery method for the treatment of HD. Additionally, ethical and regulatory issues need to be addressed before SSC therapy can be widely used for the treatment of HD in human patients. However, SSC therapy provides a promising approach for the advancement of new treatments for HD, a condition that currently has limited therapeutic choices. 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Additionally, ethical and regulatory issues need to be addressed before SSC therapy can be widely used for the treatment of HD in human patients. However, SSC therapy provides a promising opportunity for the development of innovative treatments for HD, a condition that currently lacks extensive treatment options.[46-54]

Musculoskeletal Disorders

Somatic stem cell therapy has been investigated as a potential treatment for a range of musculoskeletal disorders, including osteoarthritis (OA), rheumatoid arthritis (RA), and bone fractures. Osteoarthritis is a degenerative joint disease characterized by the loss of cartilage and progressive deterioration of the joint. Stem cell therapy has shown promise in preclinical studies for promoting the regeneration of damaged cartilage and improving functional recovery in animal models of OA. In one study, the transplantation of MSCs into a rabbit model of OA resulted in the regeneration of cartilage and improved joint function. Another study demonstrated that injection of MSCs into the knee joint of patients with OA improved pain and function. Rheumatoid arthritis is an autoimmune disease that causes chronic inflammation in the joints and can result in joint damage and deformity. Stem cell therapy has shown potential in preclinical studies for suppressing inflammation and promoting tissue repair in animal models of RA. In one study, transplantation of MSCs into a rat model of RA reduced inflammation in the joints and improved joint function. Another study demonstrated that injection of MSCs into the joints of patients with RA improved pain and function. Bone fractures can result from trauma or osteoporosis, a condition characterized by reduced bone density and increased risk of fracture. Stem cell therapy has shown potential in preclinical studies for promoting the regeneration of damaged bone and improving functional recovery in animal models of bone fracture. In one study, the transplantation of MSCs into a rat model of bone fracture resulted in the regeneration of bone tissue and improved bone healing. Another study demonstrated that injection of MSCs into the site of bone fracture in patients improved fracture healing. Despite these promising results, more research is needed to determine the optimal stem cell type, dosage, and delivery method for the treatment of musculoskeletal disorders. Additionally, ethical and regulatory issues need to be addressed before SSC therapy can be widely used for the treatment of these conditions in human patients. Nevertheless, SSC therapy presents a promising opportunity for the advancement of novel treatments for musculoskeletal disorders, where current treatment options are limited.[55-60]

Autoimmune Diseases

Somatic stem cell therapy has shown promise in the treatment of autoimmune diseases. Autoimmune diseases occur when the immune system attacks and damages healthy tissues in the body. Stem cell therapy is being explored as a potential treatment option for these conditions due to the ability of stem cells to differentiate into various types of cells and modulate the immune system. One example of an autoimmune disease being investigated for stem cell therapy is MS. Multiple sclerosis is a neurological disorder that affects the myelin sheath surrounding nerve fibers in the central nervous system. Somatic stem cell therapy has been studied as a potential treatment option for MS by transplanting HSCs, which have the potential to differentiate into immune cells, and MSCs, which can modulate the immune response and promote tissue repair. Other autoimmune diseases that have been studied for stem cell therapy include type 1 diabetes, systemic lupus erythematosus, RA, and inflammatory bowel disease. While the results of these studies have been promising, more research is needed to determine the optimal stem cell type, dosage, and delivery method for the treatment of autoimmune diseases. Furthermore, ethical and regulatory issues need to be addressed before SSC therapy can be widely used for the treatment of autoimmune diseases in human patients. Despite this, SSC therapy presents a promising path for the advancement of novel treatments for autoimmune diseases, which currently face limited treatment options.[61-64]

Skin Disorders

Somatic stem cell therapy for skin disorders involves the use of stem cells to promote the regeneration of damaged or diseased skin tissues. The therapy can be used to treat a variety of skin conditions such as burns, scars, vitiligo, and chronic wounds. Stem cells derived from the skin itself, such as epidermal stem cells and dermal papilla cells, have been used in clinical trials for skin regeneration. Additionally, MSCs from bone marrow and adipose tissue have also shown potential for skin regeneration due to their ability to differentiate into various cell types and secrete growth factors that stimulate tissue regeneration. The use of stem cells in skin regeneration can lead to faster and more effective wound healing, reduced scarring, and improved skin texture and appearance. However, more research is needed to fully understand the potential of SSC therapy for skin disorders and to optimize the techniques for clinical use. Somatic stem cell therapy holds great promise for the treatment of a variety of skin disorders, and ongoing research is focused on optimizing the techniques and identifying the most effective sources of stem cells for different applications.[65-67]

Cancer

Somatic stem cell therapy for cancer involves using stem cells to treat or prevent cancer, as well as managing the side effects of cancer treatment. The primary focus of stem cell therapy in cancer is to regenerate and repair the immune system, which can be damaged by chemotherapy, radiation therapy, or other cancer treatments. One of the most promising applications of SSC therapy in cancer is HSC transplantation, which involves replacing damaged bone marrow with healthy stem cells. This treatment can be used to treat a variety of blood cancers, including leukemia, lymphoma, and multiple myeloma. In addition to HSC transplantation, researchers are also exploring the use of SSC for other types of cancer, including solid tumors. These therapies may involve genetically modifying the stem cells to specifically target and destroy cancer cells, or using stem cells to deliver targeted therapies directly to tumors. Overall, SSC therapy holds great promise for the treatment of cancer, but more research is needed to fully understand its potential and develop effective therapies. In addition to HSC transplantation, SSC therapy is being investigated for various types of solid tumors, including breast cancer, brain tumors, and lung cancer. One approach involves using genetically modified stem cells to deliver targeted therapies directly to tumors. These stem cells can be engineered to produce proteins or other molecules that specifically target cancer cells, which can help to minimize side effects and increase the effectiveness of treatment. Another approach involves using SSCs to stimulate the immune system to attack cancer cells. This can be done by using stem cells to produce dendritic cells, which are specialized immune cells that can activate the immune system to target cancer cells. Researchers are also exploring the use of SSCs to create CAR-T cells, which are immune cells that have been genetically modified to recognize and destroy cancer cells. Somatic stem cells may also be used to manage the side effects of cancer treatment, such as chemotherapy-induced neuropathy and radiation-induced tissue damage. Stem cells can help to regenerate damaged tissues and promote healing, which can reduce the severity of these side effects and improve the overall quality of life for cancer patients. However, while SSC therapy holds great promise for the treatment of cancer, there are also challenges and risks associated with these treatments. For example, there is a risk of stem cells developing into cancer cells themselves, and there is also a risk of rejection by the immune system. More research is needed to fully understand these risks and develop safe and effective stem cell therapies for cancer.[68-72]

Genetic Disorders

Somatic stem cell therapy for genetic disorders involves the use of stem cells to replace or repair damaged or dysfunctional cells or tissues in the body that are affected by a genetic disease. The goal of this approach is to correct the underlying genetic defect and restore normal function to the affected cells or tissues. Somatic stem cell therapy for genetic disorders can involve several different strategies, depending on the specific disease and the affected tissue. One approach is to use gene editing technologies to correct the genetic mutation in the stem cells themselves, which can then be differentiated into the desired cell type and transplanted back into the patient. Another approach is to use SSC to replace damaged or dysfunctional cells or tissues with healthy cells that are derived from the patient's own cells, such as induced iPSCs. While the use of SSCs for genetic disorders is still in the experimental stage, there has been some promising research in this area, particularly for diseases such as sickle cell anemia and certain forms of inherited blindness. However, there are still many technical and ethical challenges that need to be addressed before SSC therapy can become a routine treatment for genetic disorders. Somatic stem cell therapy for genetic disorders has the potential to provide a personalized and potentially curative treatment option for patients with genetic diseases. However, more research is needed to fully understand the safety and efficacy of this approach and to develop new strategies for delivering and targeting stem cells to specific tissues and organs in the body. Somatic stem cell therapy for genetic disorders has the potential to revolutionize the treatment of a wide range of inherited diseases, including those that affect the blood, nervous system, muscle, and other tissues. While SSC therapy for genetic disorders holds great promise, there are still many challenges that need to be addressed before this approach can become a routine treatment option. These challenges include developing safe and effective gene editing technologies, ensuring the long-term safety and efficacy of stem cell therapies, and addressing ethical and regulatory concerns surrounding the use of human embryonic stem cells. Despite these challenges, there has been significant progress in SSC therapy for genetic disorders in recent years, and this approach is likely to play an increasingly important role in the treatment of inherited diseases in the future.[73-76]

In conclusion, SSCs are also known as adult stem cells. Somatic stem cells are derived from many tissues and stem cells. They have a wide range of uses in modern and regenerative medicine disciplines. It is a significant correlation that diseases increase with the development of modern medicine and high technology. Research scientists are working feverishly on alternative therapeutic strategies. Somatic stem cell therapy is a very useful and practical method that can provide beneficial results. One of the reasons why adult body stem cells are preferred is their ability to differentiate into desired tissues or cells. Therefore, SSC therapy has become a preferred method. The somatic stem cell therapy approach is applied to many diseases defined in the medical literature. In this chapter, the definition, properties, applications, and usage areas of SSCs and their potential for diseases are examined.

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REFERENCES

1. Birbrair A. Stem Cells Heterogeneity. Adv Exp Med Biol. 2019;1123:1-3.
2. Eve DJ, Sanberg PR, Buzanska L, Sarnowska A, Domanska-Janik K. Human Somatic Stem Cell Neural Differentiation Potential. Results Probl Cell Differ. 2018;66:21-87.
3. Davis EA, Dailey MJ. A direct effect of the autonomic nervous system on somatic stem cell proliferation? Am J Physiol Regul Integr Comp Physiol. 2019 Jan 1;316:R1-5.
4. Karagiannis P, Takahashi K, Saito M, Yoshida Y, Okita K, Watanabe A, et al. Induced Pluripotent Stem Cells and Their Use in Human Models of Disease and Development. Physiol Rev. 2019 Jan 1;99:79-114.
5. Gurusamy N, Alsayari A, Rajasingh S, Rajasingh J. Adult Stem Cells for Regenerative Therapy. Prog Mol Biol Transl Sci. 2018;160:1-22.
6. Cable J, Fuchs E, Weissman I, Jasper H, Glass D, Rando TA, et al. Adult stem cells and regenerative medicine-a symposium report. Ann N Y Acad Sci. 2020 Feb;1462:27-36.
7. National Cancer Institute. 2005. Blood-forming stem cell transplants. September 9, 2005 Accessed April 17, 2019. Available from: https://www.cancer.gov/about-cancer/treatment/types/stem-cell-transplant
8. U.S. Food and Drug Administration. 2019. Approved cellular and gene therapy products. May 24, 2019 Accessed August 28, 2019. Available from: https://www.fda.gov/vaccines-blood-biologics/cellular-gene-therapy-products/approved-cellular-and-gene-therapy-products
9. European Medicines Agency. 2018. Holoclar. September 17, 2018 Accessed April 17, 2019. Available from: https://www.ema.europa.eu/en/medicines/human/EPAR/holoclar
10. Slack JM. Origin of stem cells in organogenesis. Science. 2008 Dec 5;322(5907):1498-501.
11. Jones DL, Wagers AJ. No place like home: anatomy and function of the stem cell niche. Nat Rev Mol Cell Biol. 2008 Jan;9:11-21.
12. Spradling A, Drummond-Barbosa D, Kai T. Stem cells find their niche. Nature. 2001 Nov 1;414:98-104.
13. Sell S. Stem cell origin of cancer and differentiation therapy. Crit Rev Oncol Hematol. 2004 Jul;51:1-28.
14. Scadden DT. The stem-cell niche as an entity of action. Nature. 2006 Jun 29;441:1075-9.
15. Moore KA, Lemischka IR. Stem cells and their niches. Science. 2006 Mar 31;311:1880-5.
16. Hortu I, Ozceltik G, Sahin C, Akman L, Yildirim N, Erbas O. Granulocyte Colony-Stimulating Factor Prevents

Ischemia/Reperfusion-Induced Ovarian Injury in Rats: Evaluation of Histological and Biochemical Parameters. Reprod Sci. 2019 Oct;26:1389-94.

17. Cheung TH, Rando TA. Molecular regulation of stem cell quiescence. Nat Rev Mol Cell Biol. 2013 Jun;14:329-40.
18. Clevers H, Loh KM, Nusse R. Stem cell signaling. An integral program for tissue renewal and regeneration: Wnt signaling and stem cell control. Science. 2014 Oct 3;346:1248012.
19. Tang DG. Understanding cancer stem cell heterogeneity and plasticity. Cell Res. 2012 Mar;22:457-72.
20. Li L, Clevers H. Coexistence of quiescent and active adult stem cells in mammals. Science. 2010 Jan 29;327:542-5.
21. Takeda N, Jain R, LeBoeuf MR, Wang Q, Lu MM, Epstein JA. Interconversion between intestinal stem cell populations in distinct niches. Science. 2011 Dec 9;334:1420-4.
22. Blau HM, Brazelton TR, Weimann JM. The evolving concept of a stem cell: entity or function? Cell. 2001 Jun 29;105:829-41.
23. Clevers H. STEM CELLS. What is an adult stem cell? Science. 2015 Dec 11;350:1319-20.
24. Weiss DJ. Concise review: current status of stem cells and regenerative medicine in lung biology and diseases. Stem Cells. 2014 Jan;32:16-25.
25. Trounson A, McDonald C. Stem Cell Therapies in Clinical Trials: Progress and Challenges. Cell Stem Cell. 2015 Jul 2;17:11-22.
26. Nombela-Arrieta C, Ritz J, Silberstein LE. The elusive nature and function of mesenchymal stem cells. Nat Rev Mol Cell Biol. 2011 Feb;12:126-31.
27. Daley GQ, Scadden DT. Prospects for stem cell-based therapy. Cell. 2008 Feb 22;132:544-8.
28. Kørbling M, Estrov Z. Adult stem cells for tissue repair - a new therapeutic concept? N Engl J Med. 2003 Aug 7;349:570-82.
29. Hosseinkhani M, Mehrabani D, Karimfar MH, Bakhtiyari S, Manafi A, Shirazi R. Tissue engineered scaffolds in regenerative medicine. World J Plast Surg. 2014 Jan;3:3-7.
30. Langer R, Vacanti JP. Tissue engineering. Science. 1993 May 14;260:920-6.
31. Atala A. Regenerative medicine strategies. J Pediatr Surg. 2012 Jan;47:17-28.
32. Forbes SJ, Newsome PN. Liver regeneration - mechanisms and models to clinical application. Nat Rev Gastroenterol Hepatol. 2016 Aug;13:473-85.
33. Swinney DC, Anthony J. How were new medicines discovered? Nat Rev Drug Discov. 2011 Jun 24;10:507-19.
34. Hay M, Thomas DW, Craighead JL, Economides C, Rosenthal J. Clinical development success rates for investigational drugs. Nat Biotechnol. 2014 Jan;32:40-51.
35. Chong JJ, Murry CE. Cardiac regeneration using pluripotent stem cells--progression to large animal models. Stem Cell Res. 2014 Nov;13:654-65.
36. Gheorghiade M, Bonow RO. Chronic heart failure in the United States: a manifestation of coronary artery disease. Circulation. 1998 Jan 27;97:282-9.
37. Shapiro AM. Islet transplantation in type 1 diabetes: ongoing challenges, refined procedures, and long-term outcome. Rev Diabet Stud. 2012 Winter;9:385-406.
38. Trounson A, DeWitt ND. Pluripotent stem cells progressing to the clinic. Nat Rev Mol Cell Biol. 2016 Mar;17:194-200.
39. Takahashi K, Yamanaka S. A decade of transcription factor-mediated reprogramming to pluripotency. Nat Rev Mol Cell Biol. 2016 Mar;17:183-93.
40. Trounson A. New perspectives in human stem cell therapeutic research. BMC Med. 2009 Jun 11;7:29.
41. Ghiroldi A, Piccoli M, Cirillo F, Monasky MM, Ciconte G, Pappone C, et al. Cell-Based Therapies for Cardiac Regeneration: A Comprehensive Review of Past and Ongoing Strategies. Int J Mol Sci. 2018 Oct 16;19:3194.
42. Wollert KC, Drexler H. Clinical applications of stem cells for the heart. Circ Res. 2005 Feb 4;96:151-63.
43. Traverse JH, Henry TD, Pepine CJ, Willerson JT, Chugh A, Yang PC, et al. TIME Trial: Effect of Timing of Stem Cell Delivery Following ST-Elevation Myocardial Infarction on the Recovery of Global and Regional Left Ventricular Function: Final 2-Year Analysis. Circ Res. 2018 Feb 2;122:479-88.
44. Mathur A, Martin JF. Stem cells and repair of the heart. Lancet. 2004 Jul 10-16;364(9429):183-92.
45. Matsuura K, Honda A, Nagai T, Fukushima N, Iwanaga K, Tokunaga M, et al. Transplantation of cardiac progenitor cells ameliorates cardiac dysfunction after myocardial infarction in mice. J Clin Invest. 2009 Aug;119:2204-17.
46. Barker RA, Götz M, Parmar M. New approaches for brain repair-from rescue to reprogramming. Nature. 2018 May;557:329-34.
47. Li X, Zhu H, Sun X, Zuo F, Lei J, Wang Z, et al. Human Neural Stem Cell Transplantation Rescues Cognitive Defects in APP/PS1 Model of Alzheimer's Disease by Enhancing Neuronal Connectivity and Metabolic Activity. Front Aging Neurosci. 2016 Nov 23;8:282.
48. Bernau K, Lewis CM, Petelinsek AM, Reagan MS, Niles DJ, Mattis VB, et al. In Vivo Tracking of Human Neural Progenitor Cells in the Rat Brain Using Magnetic Resonance Imaging Is Not Enhanced by Ferritin Expression. Cell Transplant. 2016;25:575-92.
49. Ruff CA, Wilcox JT, Fehlings MG. Cell-based transplantation strategies to promote plasticity following spinal cord injury. Exp Neurol. 2012 May;235:78-90.
50. Hefferan MP, Galik J, Kakinohana O, Sekerkova G, Santucci C, Marsala S, et al. Human neural stem cell replacement therapy for amyotrophic lateral sclerosis by spinal transplantation. PLoS One. 2012;7:e42614.
51. Pala HG, Pala EE, Artunc Ulkumen B, Aktug H, Yavasoglu A, Korkmaz HA, et al. The protective effect of granulocyte colony-stimulating factor on endometrium and ovary in a rat model of diabetes mellitus. Gynecol Obstet Invest. 2014;78:94-100.
52. Dokuyucu R, Kokacya H, Inanir S, Copoglu US, Erbas O. Antipsychotic-like effect of minocycline in a rat model. Int J Clin Exp Med. 2014 Oct 15;7:3354-61.
53. Solmaz V, Tekatas A, Erdoğan MA, Erbaş O. Exenatide, a GLP-1 analog, has healing effects on LPS-induced autism

model: Inflammation, oxidative stress, gliosis, cerebral GABA, and serotonin interactions. Int J Dev Neurosci. 2020 Nov;80:601-12.

54. Candan Balkan B, Erbaş O. Recent advances in stem cell-based therapeutics in ophthalmology. D J Med Sci 2023;9:175-82.
55. Song I, Rim J, Lee J, Jang I, Jung B, Kim K, et al. Therapeutic Potential of Human Fetal Mesenchymal Stem Cells in Musculoskeletal Disorders: A Narrative Review. Int J Mol Sci. 2022 Jan 27;23:1439.
56. Dubey NK, Mishra VK, Dubey R, Syed-Abdul S, Wang JR, Wang PD, et al. Combating Osteoarthritis through Stem Cell Therapies by Rejuvenating Cartilage: A Review. Stem Cells Int. 2018 Mar 22;2018:5421019.
57. Torres-Torrillas M, Rubio M, Damia E, Cuervo B, Del Romero A, Peláez P, et al. Adipose-Derived Mesenchymal Stem Cells: A Promising Tool in the Treatment of Musculoskeletal Diseases. Int J Mol Sci. 2019 Jun 25;20:3105.
58. Shang Z, Wanyan P, Zhang B, Wang M, Wang X. A systematic review, umbrella review, and quality assessment on clinical translation of stem cell therapy for knee osteoarthritis: Are we there yet? Stem Cell Res Ther. 2023 Apr 15;14:91.
59. Borakati A, Mafi R, Mafi P, Khan WS. A Systematic Review And Meta-Analysis of Clinical Trials of Mesenchymal Stem Cell Therapy for Cartilage Repair. Curr Stem Cell Res Ther. 2018 Feb 23;13:215-25.
60. Wyles CC, Houdek MT, Behfar A, Sierra RJ. Mesenchymal stem cell therapy for osteoarthritis: current perspectives. Stem Cells Cloning. 2015 Aug 28;8:117-24.
61. Liu P, Qian Y, Liu X, Zhu X, Zhang X, Lv Y, Xiang J. Immunomodulatory role of mesenchymal stem cell therapy in liver fibrosis. Front Immunol. 2023 Jan 4;13:1096402.
62. Li SW, Cai Y, Mao XL, He SQ, Chen YH, Yan LL, et al. The Immunomodulatory Properties of Mesenchymal Stem Cells Play a Critical Role in Inducing Immune Tolerance after Liver Transplantation. Stem Cells Int. 2021 Sep 4;2021:6930263.
63. Cai J, Li W, Su H, Qin D, Yang J, Zhu F, et al. Generation of human induced pluripotent stem cells from umbilical cord matrix and amniotic membrane mesenchymal cells. J Biol Chem. 2010 Apr 9;285:11227-34.
64. Bai L, Lennon DP, Eaton V, Maier K, Caplan AI, Miller SD, et al. Human bone marrow-derived mesenchymal stem cells induce Th2-polarized immune response and promote endogenous repair in animal models of multiple sclerosis. Glia. 2009 Aug 15;57:1192-203.
65. McLaughlin C, Datta P, Singh YP, Lo A, Horchler S, Elcheva IA, et al. Mesenchymal Stem Cell-Derived Extracellular Vesicles for Therapeutic Use and in Bioengineering Applications. Cells. 2022 Oct 25;11:3366.
66. Isakson M, de Blacam C, Whelan D, McArdle A, Clover AJ. Mesenchymal Stem Cells and Cutaneous Wound Healing: Current Evidence and Future Potential. Stem Cells Int. 2015;2015:831095.
67. Xu YF, Wu YX, Wang HM, Gao CH, Xu YY, Yan Y. Bone marrow-derived mesenchymal stem cell-conditioned medium ameliorates diabetic foot ulcers in rats. Clinics (Sao Paulo). 2023 Mar 20;78:100181.
68. Shah K. Stem cell-based therapies for tumors in the brain: are we there yet? Neuro Oncol. 2016 Aug;18:1066-78.
69. Bexell D, Scheding S, Bengzon J. Toward brain tumor gene therapy using multipotent mesenchymal stromal cell vectors. Mol Ther. 2010 Jun;18:1067-75.
70. Sünnetçi E, Solmaz V, Erbaş O. Chronic Oxytocin treatment has long lasting therapeutic potential in a rat model of neonatal hypercapnic-hypoxia injury, through enhanced GABAergic signaling and by reducing hippocampal gliosis with its anti-inflammatory feature. Peptides. 2021 Jan;135:170398.
71. Mount CW, Majzner RG, Sundaresh S, Arnold EP, Kadapakkam M, Haile S, et al. Potent antitumor efficacy of anti-GD2 CAR T cells in H3-K27M+ diffuse midline gliomas. Nat Med. 2018 May;24:572-9.
72. Clément F, Grockowiak E, Zylbersztejn F, Fossard G, Gobert S, Maguer-Satta V. Stem cell manipulation, gene therapy and the risk of cancer stem cell emergence. Stem Cell Investig. 2017 Jul 25;4:67.
73. Pera MF, Reubinoff B, Trounson A. Human embryonic stem cells. J Cell Sci. 2000 Jan;113:5-10.
74. Sorgun O, Erbaş O. Adipose-derived mesenchymal stem cells mitigate methotrexate-induced liver cirrhosis (fibrosis) model. Eur Rev Med Pharmacol Sci. 2023 Dec;27:11882-9.
75. Kaufman DS, Hanson ET, Lewis RL, Auerbach R, Thomson JA. Hematopoietic colony-forming cells derived from human embryonic stem cells. Proc Natl Acad Sci U S A. 2001 Sep 11;98:10716-21.
76. Reubinoff BE, Pera MF, Fong CY, Trounson A, Bongso A. Embryonic stem cell lines from human blastocysts: somatic differentiation in vitro. Nat Biotechnol. 2000 Apr;18:399-404.