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## Review article on stem cell therapy

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### ABSTRACT

In this modern life, introduced to new diseases and disorders in which many organs and tissues get damaged. To treat this, stem cell therapy is one of the best treatment choices. A stem cell is an undifferentiated cell that can regenerate into any body tissue. This versatile nature of the stem cell made it possible to treat damaged tissues and organs. Stem cells are of two types embryonic and adult stem cells. An embryonic stem cell is pluripotent, and an adult stem cell is multipotent. Hematopoietic stem cell therapy is used to treat anaemia, and different types of cancer. Skin stem cell therapy treats chronic wound healing, chronic burns, etc.; neural stem cell therapy treats Alzheimer's and Parkinsonism's disease. Whereas mesenchymal stem cell therapy is used in the treatment of degenerative changes in the joint. This review article mainly discusses hematopoietic, skin, mesenchymal, and neural stem cell therapy.

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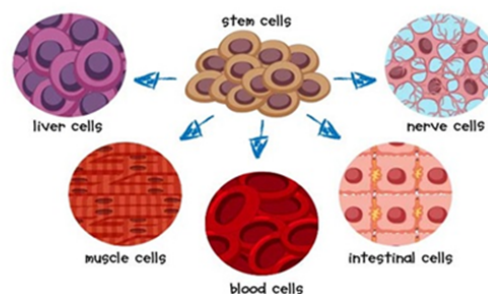
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### INTRODUCTION

A stem cell is a set of undeveloped tissues fore-runner cells capable of self-regenerated and replacing damaged tissues of different types. Stem cells are the body's resource cells from which all other cells with unique functions are generated. Under the desired condition in the laboratory or within the body, stem cells cleave to produce more cells called daughter cells [Figure 1]. These daughter cells will be divided either as a new stem cell or differentiate into cells which has unique functions or specialized cells such as nerve cells, blood cells, bone cells, brain

cells, heart muscle cells, etc. except stem cells, no other cells under any circumstance in the body has the natural ability to produce a new cell [1].

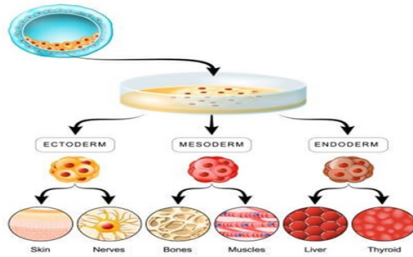


**Figure 1: Stem cell applications**

Types of stem cells: stem cells are mainly categorized into two kinds. They are embryonic stem cells and adult stem cells.

Embryonic stem cells are formed in the inner cell mass of the human blastocyst that is 3 to 5 days old. The blastocyst has roughly about 150-160 cells. These stem cells are pluripotent so that they can

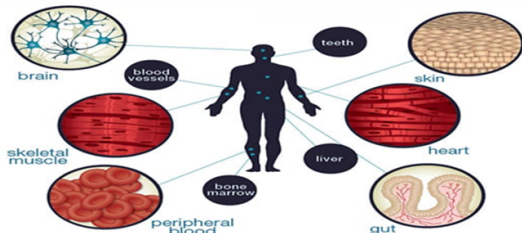
increase endlessly into new stem cells or cells with specialised function [Figure 2]. This property of the embryonic stem cells to be used to renew or repair damaged cells and tissues. These cells can also be synthesized or cultured in the laboratory under appropriate circumstances or the optimal condition at which the cells proliferate endlessly [2].



**Figure 2: Embryonic stem cell**

### Adult stem cells

Adult stem cells are undifferentiated stem cells found in other tissues in the body. These adult stems differentiate into different types of tissues, but this process is limited to some tissues only. In other words, adult stem cells are called somatic stem cells [3]. They are multipotent. Adult stem cells are found in the skin, brain, liver, heart, and bone marrow. Different types of adult stem cells include neural stem cells, skin stem cells, epithelial stem cells, mesenchymal stem cells, and hematopoietic stem cells [Figure 3].



**Figure 3: Adult stem cell**

### Stem cell therapy

Stem cell therapy is one of the most valuable and powerful regenerative therapies under progress. As stem cells have the remarkable potential to regenerate or differentiate into different tissue with special functions, they are used to treat the damaged organ. They are also used to treat other diseases and disorders, which is a game-changer in the medical science model [4]. Currently, stem cell therapy treats various illnesses in multiple body systems. Mainly they use embryonic stem than adult stem cells; as

mentioned above, using adult stem cells is promising, and the adult stem cells' process of differentiating or regenerating is limited. In easier words, adult stem cells can be differentiated into some kinds of tissues only. In this review article, we will briefly discuss Hematopoietic stem cells, skin stem cells, neural stem cells, mesenchymal stem cell

**Hematopoietic Stem Cell:** as we know that blood is one of the essential components in our body, which supplies nutrients, oxygen, and other materials to each cell and tissue. The blood has many components, such as plasma, platelets, red blood cells, and white blood cells. Many diseases and disorders can obstruct or affect the blood components such as anaemia, leukopenia, thrombocytopenia, thrombocytosis, leucocytosis, leukaemia, erythrocytosis and many. By transferring hematopoietic stem cells; we can treat all the above-mentioned conditions with highest success rate. They also remove the waste material from the body with the help of kidneys [5].

The hematopoietic stem cell is found in the bone marrow and the blood. These stem cells can produce or regenerate mature red blood cells, white blood cells, and other components. These stem cells can restore the damaged cells in blood disorders. Therefore, they are used to treat many diseases and conditions of the blood. They can treat cancerous and non-malignant forms of illness to regenerate the patient's hematopoietic system. This type of treatment is called hematopoietic stem cell transplantation.

**How Does Hematopoietic Stem Cell Are Collected:** There are about three methods by which hematopoietic stem cells are collected and transplanted to treat the blood disease and disorder: peripheral blood cells, umbilical cord blood, and stem cells from bone marrow.

Peripheral blood cells are the cell products of the hematopoietic stem cells. It is collected with the help of a machine. The tubes from the device are connected to the donor's arm using the needle, and the other end is connected to another arm of the donor. The blood is allowed to flow through the machine, and the machine separates the stem cells and the other blood components by a process like centrifugation. And once the stem cells are removed, the remaining part of the blood is sent back into the donor's body [6]. The donor can administer recombinant hematopoietic growth factor to increase the number of hematopoietic stem cells; The collected stem cell can be infused directly into the patient under one condition – when the donor's cell type matches the receiver. In case of delayed transfusion, the stem cells can be stored in the refrigerator, or

they can be stored in liquid nitrogen.

**Umbilical Cord Blood:** the umbilical cord blood consists of immature stem cells. The gynecologist should carefully collect the blood from the umbilical cord under sterile conditions after the baby's delivery. The collected blood should undergo some process in which the unwanted blood cells are removed, and the stem cell is refrigerated.

**Stem Cell from Bone Marrow:** the stem cell collected from the bone marrow also contains hematopoietic stem cell init. This method includes minor surgery. In this surgery, the donor is treated with anesthetics. The physician collects the bone marrow from the bones, majorly in the hip bones, using a hollow needle. The collected bone marrow is treated with anticoagulants to avoid clot formation [7]. Then the bone marrow undergoes several sterilization processes to remove the unwanted and waste materials from the stem cells. The stem cell is then stored under suitable conditions for utilization.

**Skin Stem Cell/ Epidermal Stem Cell:** The skin is considered one of the body's most essential organs due to its vital functions as a protective barrier against infections and temperature regulators. It is made up of three layers epidermis, dermis, and hypodermis. Severe skin injuries require immediate and effective treatment, but wound healing is natural and time-consuming. In some conditions like burns, and diabetics, it takes more time than usual [8].

Multipotent cells include epidermis stem cells. This aid in the development and division of the functional epidermis. Different niches where epidermal stem cells are found have unique markers and roles. The upregulation of SOX9 and TCF4, which act as beneficial mediators of wound re-epithelialization, is required for epidermal fate flipping. Because of their advantages, which include accessibility, ease of isolation, and skin regenerative capability since 1970, epidermis stem cells are being considered a realistic target in wound management. Epidermal stem cells have been commonly available since 1988 and were first used in 1981 to treat wounds. There isn't a clear structure that identifies it precisely.

The process of healing a wound is complex and strictly controlled. Epigenetic mechanisms contain epidermal stem cells during the healing process of wounds. The growth of the epidermis and hair follicles depends on histone deacetylases and histone methyltransferases. Since epidermal stem cells can regenerate skin, they are used in topical epidermal stem cell applications, direct injections, and systemic circulation as cell delivery to lesions. A novel treatment approach involves genetically alter-

ing epidermal stem cells.

It is used to treat burn wounds, chronic wounds, other epithelial regenerations like urethral regeneration, limbal stem cell deficiency, stable vitiligo, and gene therapy of epidermolysis bullosa [9].

### Neural Stem Cell

Neural stem cells are the stem cells of the nervous system. During development, they give rise to the nervous system as a whole. The cell must be capable of generating all neural lineages (neurons, astrocytes, and oligodendrocytes) and have the capacity for self-renewal. Able to give rise to cell types and themselves through asymmetric cell division. The neural stem cells have the potential to give rise to offspring cells that grow and differentiate into neurons and glial cells. These stem cells are found in dentate gyrus (part of the hippocampus), in the striatum (part of the basal ganglia), the neocortex (outer part of cerebral cortex) and the spinal cord. The neural stem cells are differentiated into four categories neural tube epithelial cells, radial glial neurons, neuroblasts, and neural precursor cells.

### Mesenchymal Stem Cell

Mesenchymal stem cells are stromal cells that can self-renew and exhibit multi lineage differentiation. Mesenchymal stem cells can be isolated from various tissues such as umbilical cord, endometrial polyps, menses blood, bone marrow, and adipose tissue.

Mesenchymal stem cells are multipotent stem cells found in the bone marrow. Making and repairing skeletal tissues, such as cartilage, bone, and the fat in the bone marrow. Mesenchymal stem cells are used to treat degenerative joint changes and reconstruct bones and cartilage.

They are used in plastic surgeries and the repair of damaged musculoskeletal tissues. These cells are categorized as embryonic stem cells (ESCs), induced pluripotent stem cells (iPSCs), and adult stem cells. The cells are isolated from human and animal sources.

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The authors declare no conflict of interest, financial or otherwise.

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