Summary

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A stem cell is a special kind of cell that has a unique capacity to renew itself and to give rise to specialized cell types. Although most cells of the body, such as heart cells or skin cells, are committed to conduct a specific function, a stem cell is uncommitted and remains uncommitted, until it receives a signal to develop into a specialized cell. Their proliferative capacity combined with the ability to become specialized makes stem cells unique.

The Properties of Stem Cells

Stem cells have two biological properties: firstly, they are capable of *self-renewal.* Secondly, stem cells can also *differentiate* into more specialised cells.

Pluripotent stem cell.

A single pluripotent stem cell has the ability to give rise to types of cells that develop from the three germ layers (mesoderm, endoderm, and ectoderm) from which all the cells of the body arise. The only known sources of human pluripotent stem cells are those isolated and cultured from early human embryos and from fetal tissue.

Embryonic stem cell.

An embryonic stem cell is derived from a group of cells called the inner cell mass, which is part of the early (4- to 5-day) embryo called the blastocyst.

Embryonic germ cell.

An embryonic germ cell is derived from fetal tissue. Specifically, they are isolated from the primordial germ cells of the gonadal ridge of the 5- to

10-week fetus. Embryonic stem cells and embryonic germ cells are pluripotent, but they are not identical in their properties and characteristics.

Umbilical cord stem cells

Umbilical cord blood contains circulating stem cells and the cellular contents of umbilical cord blood appear to be quite distinct from those of bone marrow and adult peripheral blood.

Fetal stem cells

Fetal stem cells are primitive cell types found in the organs of fetuses.

Adult stem cell.

An adult stem cell is an undifferentiated cell that occurs in a differentiated tissue, renews itself, and becomes specialized to yield all of the specialized cell types of the tissue from which it originated. Adult stem cells are capable of making identical copies of themselves for the lifetime of the organism. This property is referred to as "self-renewal." Adult stem cells usually divide to generate progenitor or precursor cells, which then differentiate or develop into "mature" cell types that have characteristic shapes and specialized functions.

Sources of adult stem cells include bone marrow, blood, the cornea and the retina of the eye, brain, skeletal muscle, dental pulp, liver, skin, the lining of the gastrointestinal tract, and pancreas. Hematopoietic stem cells from bone marrow are the most studied and used for clinical applications in restoring various blood and immune components to the bone marrow via transplantation. There are at least two other populations of adult stem cells that have been identified from bone marrow and blood.

Stem cells may hold the key to replacing cells lost in many diseases. There is little doubt that this potential benefit underpins the vast interest about stem cell research. some of these diseases are Parkinson's disease, diabetes, chronic heart disease, ,liver failure, and cancer are just a few for which stem cells have therapeutic potential.

Hematopoietic stem cells

Hematopoietic stem cells give rise to all the types of blood cells: red blood cells, B lymphocytes,T lymphocytes, natural killer cells, neutrophils, basophils, eosinophils, monocytes,macrophages, and platelets.

THE SOURCES OF HEMATOPOIETIC STEM CELLS

1- Bone Marrow: The classic source of HSCs is bone marrow. About 1 in every 100,000 cells in themarrow is a long-term, blood-forming stem cell.
2- Peripheral Blood: As a source of HSCs for medical treatments,
3- Umbilical Cord Blood: The human umbilical cord and placenta was a rich source of HSCs.
4- Fetal Hematopoietic System:An important source of HSCs in research, but not in clinical use.

Hematopoietic stem cells transplantation

Hematopoietic stem cells transplantation are procedures that restore stem cells that have been destroyed by high doses of chemotherapy and/or radiation therapy.

There are three types of transplants: In **autologous transplants**, patients receive their own stem cells. In **syngeneic transplants**, patients

receive stem cells from their identical twin. In **allogeneic transplants**, patients receive stem cells from their brother, sister, or parent. A person who is not related to the patient (an unrelated donor) also may be used.

Clinical Uses Of Hematopoietic Stem Cells

By 1995,more than 40,000 transplants were performed annually world-wide. Currently the main indications for bone marrow transplantation are either hematopoietic cancers (leukemias and lymphomas),or the use of high-dose chemotherapy for non hematopoietic malignancies (cancers in other organs).Other indications include diseases that involve genetic or acquired bone marrow failure, such as aplastic anemia, thalassemia sickle cell anemia.

Complications

Acute complications such as veno-occlusive disease of the liver, acute and chronic graft-vs-host disease (GVHD), and infectious conditions remain major obstacles for the success of allogeneic HSCT. Several delayed toxic effects occur after HSCT and require long-term follow-up and care. Clinical hypothyroidism is rare but may occur as early as 1 year and as late as 15 years after transplantation ,Growth hormone deficiency has been noted in approximately 60% of children conditioned with high-dose TBI and Risk factors for delayed and impaired sexual maturity in boys and girls include the use of single-dose TBI and older age at the time of transplantation.