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Unique Properties of Stem Cells

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Review Article

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ABSTRACT

The disclosure of foundational microorganisms and the resulting finding that there are undeveloped cells in most, if not all, tissues has expanded our comprehension of the science of tissues and creatures. Investigation of foundational microorganisms in situ and in society is giving new bits of knowledge into advancement, cell science, and atomic procedures. What's more, foundational microorganisms have an immense potential for the treatment of numerous illnesses and additionally use in regenerative solution.

INTRODUCTION

A cell is the basic unit of life. In all the organism whether it is single-celled or multicellular, cells serves as structural and functional unit. Multicellular organisms consist of different type of cells such as red blood cells, neurons, bone marrow cells and etc. Cells start dividing soon after the fertilization is completed. Cells start dividing into million or trillion of cells to provide structure or shape of the organism. The vast numbers of cells working in concert with one another such as cells take nutrients from food and help to convert those nutrients into energy which help the body to carry out different functions. Cells also contain the body's hereditary material and can make copies of them. Different cells of the body perform different functions. These cells are too small that can be seen under microscope [1-5].

STEM CELLS

There has been a great attention to the capacities of the stem cells in the recent years. Stem cells are the foundation of each and every organ and tissue of the body. It has potential to self-renewal, differentiation and to act as precursors for somatic cells. When a stem cell divides into different cells, each newly developed cell has the potential to be a stem cell or to become any other type of cell which can perform its specialized function. It can be a muscle cell, a red blood cell, or a brain cell [6-10].

There are two characteristics of stem cells which make it differ from the other type of cells in the body:

Cell Division

Stem cells are unspecialized cells which are having capability to renew themselves by cell division. For example, in some organs like gut and bone marrow, stem cells regularly divide to repair and replace worn out or damaged tissues [11-12].

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Cell Differentiation

Stem cells can induce to become tissue or organ specific cells under some physiological and experimental conditions. For example, in some organs like pancreas and the heart, stem cells only divide under special conditions [12-14].

DISCOVERY OF STEM CELLS

In 1908, Alexander Maksimov, who was a Russian histologist, coined the term 'stem cells' but after he coined this term no significant progress was made in the area of stem cell research, After a long period of time that was after 60 years, Till and McCulloch (Canadian scientists) discovered the self-renewing cells in the bone marrow of mouse. They are unambiguously called the world's discoverers of stem cells. After that a lot of scientists and researchers worked in the field of stem cells and the research is still going on[15,16].

WHERE ARE STEM CELLS FOUND?

Undifferentiated cells are found in the early incipient organism, the embryo, amniotic liquid, the placenta and umbilical line blood. After birth and for whatever is left of life, immature microorganisms keep on residing in numerous locales of the body, including skin, hair follicles, bone marrow and blood, cerebrum and spinal string, the coating of the nose, gut, lung, joint liquid, muscle, fat, and menstrual blood (Figure 1), to give some examples. In the developing body, foundational microorganisms are in charge of producing new tissues, and once development is finished, undeveloped cells are in charge of repair and recovery of harmed and maturing tissues [17,18].

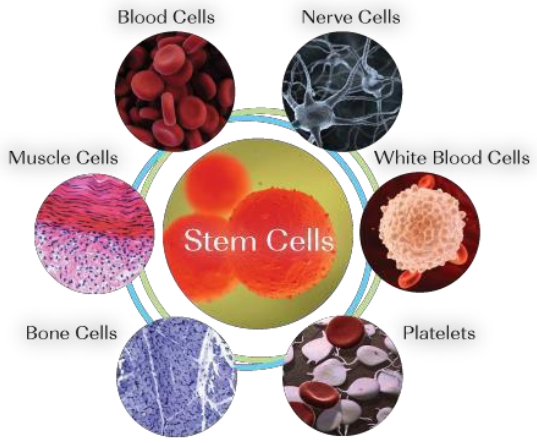

Figure 1: Cells developed from stem cells.

POTENCY OF STEM CELLS

The ability of any cell to differentiate into other specialized cell type is known as potency. On the basis of their potency, degree of plasticity or developmental versatility, stem cells can be classified into[19,20]:

Totipotency

It is the potency of cells to give rise to all type of body cells which also include extraembryonic or placental cells. It is the most versatile stem cells which is able to develop a whole new organism. Soon after fertilization, totipotent cells are produced it continue its division for couple of days [20-22].

Pluripotency

It is the potency of cells to five raises any type of cells except embryonic cells. After four days of fertilization, totipotent stem cells give rise to pluripotent stem cells which is able to produce mature cells in the body, tissue and organ [23-28].

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Induced Pluripotency

It is the potency of cell where adult cells are genetically reprogrammed to an embryonic stem cell. It is programmed by the "forced" expression of certain genes and transcription factors. These cells are able to meet the defining criteria for pluripotent stem cells [29-37].

Multipotency

It is the potency of cells to give rise to other types of cells but it is limited in its ability to differentiate.These cells are committed to produce specific cell types which have specific purpose and function [38-39].

Oligopotency

It is the potency of cells which have ability to differentiate into only a few types of cell. It can give rise to the various blood cells but the different type of blood cells [39-40].

Unipotency

It is the potency of cells to five rises to only one type of cells. These cells arise from multipotent stem cells [39-40].

TYPE OF STEM CELLS

Embryonic Stem Cells

Embryonic stem cells are procured from embryos. These cells that are attained from the inner cell mass of a blastocyst after the first differentiation phase during embryonic expansion. These cells are pluripotent, self-renewing cells [40-43]. It is having the capacity to divide for long periods and retain their ability to make all cell types within the organism. There are main two properties of embryonic stem cells:

- As these cells are obtained from the early blastocyst stage, they are at a very early developmental stage, and are having pliability to become any of the cell type that make the human body. When ESS get combination of signals, they are accordingly developed into mature cells which function as neurons, muscles, bone, blood or many other required cell types [44-48].
- ESS is having ability to endure in an undifferentiated state and to divide unspecified period of time. Therefore, unlimited numbers of identical, well-defined, genetically or genomically characterized stem cells can be produced in culture for medical use [49-51].

Adult Stem Cells

Adult stem cells which are also known as somatic stem cell, are found in both children, as well as adults. They can produce different type of cells that maintain the tissues and organs of the body and they are able to reproduce and divide indefinitely. They are thought to live in a specific area of each tissue (Figure 2), where they may abide supine for years, dividing and creating new cells only when they are activated by tissue injury, disease or anything else that makes the body demand more cells [52-55].

There are main two properties of adult stem cells:

- They are having ability to make identical copies of themselves for a long period of time, this property is known as long-term self-renewal.

- They are having proficiency to develop mature cell type that have attribute morphology and perform special functions.

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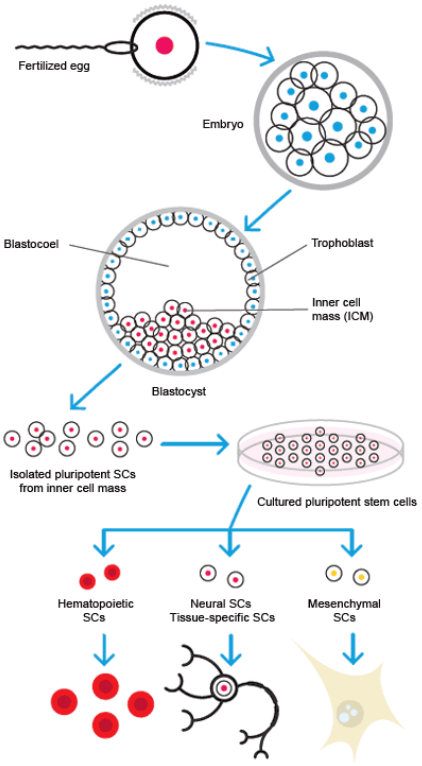

Figure 2: Embryonic stem cells.

There is an intermediate cell that is also called as precursor or progenitor cell that is generated by the stem cells. This stage of cell is developed before the cell achieves their fully differentiated state (Figure 3). Adult stem cells are partly differentiated cells that can divide and engender to differentiated cells [55-59].

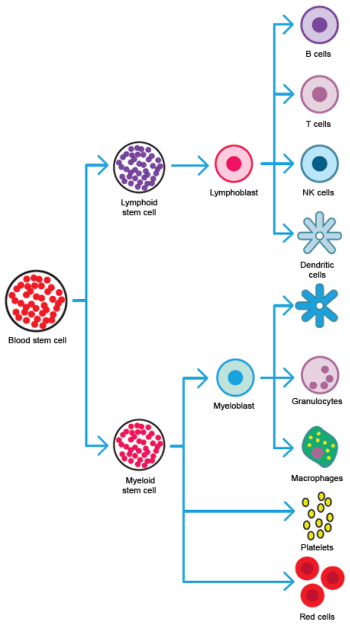

Figure 3: Adult stem cells.

APPLICATIONS OF STEM CELLS

Stem Cells are being used to help people undergoing pain, distress or hardship from dozens of diseases and conditions which includes malignancies, blood disorders and immune deficiencies etc. Stem cells work by providing

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new cells to replace damaged, diseased, or defective cells. The following list unveil the wide range of applications that adult stem cells are having right now [60,61].

- Stem cells can diligently divide and produce new blood cells within two to six weeks.
- stimulate rebirth of the blood components in the bone marrow, those are damaged by high doses of chemotherapy or radiation. This oft occurs in leukemia or lymphoma cases, for example, when the bone marrow is diseased and must be devastate.
- Stem cells can correct excrescence in children with inherited or inborn blunders of metabolism by replacing these faulted cells in the bone marrow with new and non-defective cells.
- Stem cells can produce other types of cells that tramp to the brain, liver, and all other organs. Research is currently being done on these other uses [62-64].

RESEARCH WITH STEM CELLS

Scientists and researchers are fascinated in stem cells for multiple reasons. Although stem cells do not minister any one function, many have the capacity to perform any function after they are indoctrinated to specialize. Each cell of the body is derived from first few stem cells formed in the early stages of embryological development. Therefore, stem cells which are extracted from embryos can induced to become any desired cell type. This property of stem cells makes them potent enough to regenerate detrimental tissue under the right conditions[65-67].

Organ and Tissue Regeneration

Tissue regeneration is certainly the most important feasible application of stem cell research. Currently, organs must be provided or donated by someone and transplanted, but the demand for organs far exceeds supply. Stem cells could potentially be used to grow a any type of tissue or organ if directed to differentiate in a certain way. For example, Stem cells that lie just beneath the skin have been used to engineer new skin tissue that can be grafted on to burn victims [68-73].

Cardiovascular Disease Treatment

A team of researchers reported in PNAS Early Edition that they were able to create blood vessels in laboratory mice using human stem cells. The scientists excerpted vascular precursor cells obtained from human-induced pluripotent stem cells from one group of adults with type 1diabetes as well as from another group of “healthy” adults. They were then implanted onto the superficial of the brains of the mice. Within two weeks of implanting the stem cells, netting of blood-perfused vessels had been formed and they were able to last for 280 days. These newly developed blood vessels were as good as the adjacent natural ones. Therefore, using stem cells to repair or regenerate blood vessels could eventually help treat human patients with cardiovascular and vascular diseases.[74-78].

Brain Disease Treatment

Substitution cells and tissues might be utilized to regard cerebrum infection, for example, Parkinson's and Alzheimer's by renewing harmed tissue, bringing back the particular mind cells that keep unneeded muscles from moving. Embryonic foundational microorganisms have as of late been coordinated to separate into these sorts of cells, thus medicines are promising [79-83].

Cell Deficiency Therapy

Solid heart cells created in a research center may one day be transplanted into patients with coronary illness, repopulating the heart with sound tissue. Correspondingly, individuals with sort I diabetes may get pancreatic cells to supplant the insulin-delivering cells that have been lost or demolished by the patient's own particular resistant framework. The main current treatment is a pancreatic transplant, and it is unrealistic to happen because of a little supply of pancreases accessible for transplant [84-88].

Blood Disease Treatments

Grown-up hematopoietic foundational microorganisms found in blood and bone marrow have been utilized for a considerable length of time to regard ailments, for example, leukemia, sickle cell pallor, and different immune

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deficiencies. These cells are fit for creating all platelet sorts, for example, red platelets that convey oxygen to white platelets that battle ailment. Challenges emerge in the extraction of these cells using intrusive bone marrow transplants. However hematopoietic undifferentiated organisms have likewise been found in the umbilical string and placenta. This has driven a few researchers to require an umbilical rope blood donation center to make these capable cells all the more effortlessly reachable and to diminish the odds of a body's dismissing treatment [89-94].

DISADVANTAGES

Foundational microorganism medicines may require immunosuppression in view of a necessity for radiation before the transplant to expel the patient's past cells, or on the grounds that the patient's resistant framework may focus on the immature microorganisms. One way to deal with maintains a strategic distance from the second plausibility is to utilize immature microorganisms from the same patient who is being dealt with. Pluripotency in certain undifferentiated cells could likewise make it hard to acquire a particular cell sort. It is likewise hard to get the accurate cell sort required, in light of the fact that not all cells in a populace separate consistently. Undifferentiated cells can make tissues other than coveted sorts. Some foundational microorganisms structure tumors after transplantation; pluripotency is connected to tumor arrangement particularly in embryonic undifferentiated organisms, fetal appropriate undeveloped cells and prompted pluripotent immature microorganisms. Fetal legitimate undifferentiated cells structure tumors in spite of Multipotency [96-100].

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