



## Review on Stem Cells

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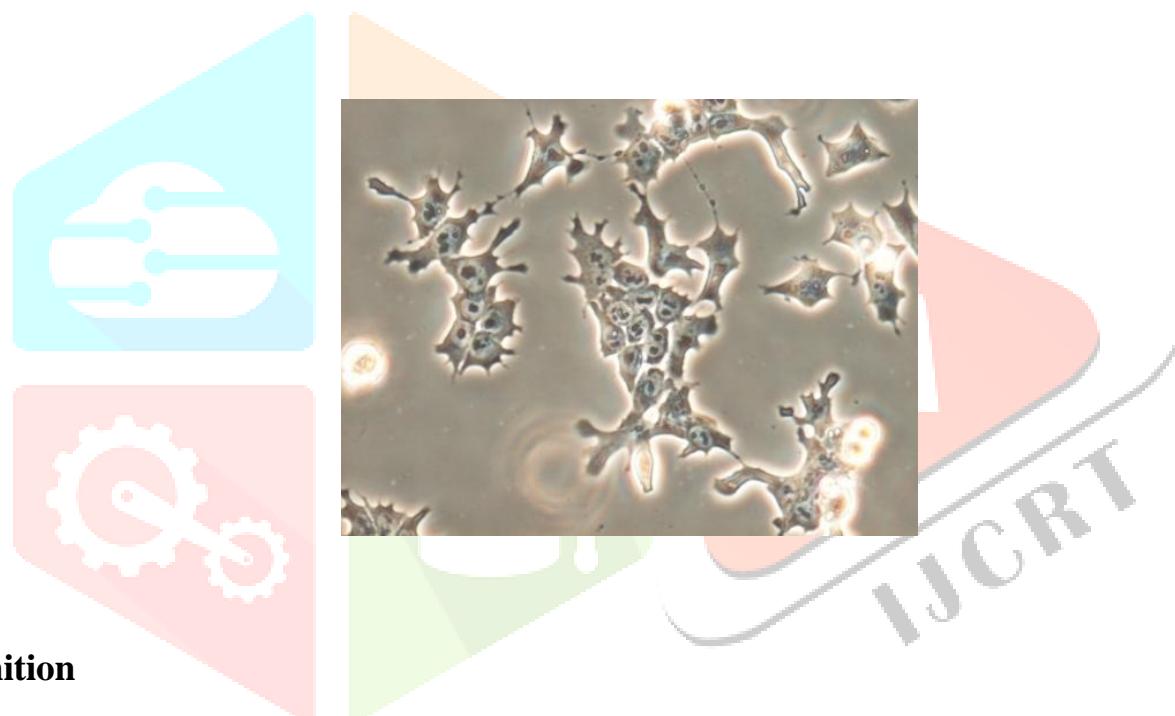
### Abstract

In recent years, stem cell therapy has becomes a very promising and advanced scientific research topic. A stem is an undifferentiated cell in the body with undetermined function capable of forming various tissue under definite signal received from the body. In that, study the focus on blocking the extensive cell death after transplantation are limited. Stem cell therapy is successful approach for repairing and regenerating ischemic cardiac tissue; however, transplanted cells display very high death percent, a problem that affects success of tissue regeneration. Only limited information is available with uses of stem cells in human being. On the various sources of stem cells, umbilical cord, blood stem cell research has shown potential for future treatment in Alzheimer's, Parkinson's, Heart attack, Stroke, and Spinal cord injuries. Only further research and its clinical application will solve the many unanswered queries.

**Keywords:-** Stem cell, Human embryo, Pluripotent, Umbilical cord.

## Introduction

Stem cells are undifferentiated or ‘blank’ cells found in the human body. They develop into many different cells. Cells built to function in a particular organ system and carry out a specific function. Stem cells are those cells that have the capability of self-renewal and differentiation. A stem cell is essentially the building block of the human body. Stem cells are very unique cells. Stem cells can be used as a repair system for the body. When a stem cell divides, each new cell has the potential to either remain a stem cell or become another type of cell with a more specialized function (i.e. a muscle cell, a red blood cell, a brain cell, etc.). Stem cells are capable of dividing and remaining themselves for long periods. They are “unspecialized” and they can give rise to specialized cell types. A stem cell is “uncommitted”, until it receives a signal to develop into a specialized cell. E.g. Red blood cell carries oxygen while white blood cell fights with disease.



## Definition

A cell that has the ability to continuously divide and differentiate (develop) into various other kind(s) of cells/tissues. Stem cells have:

- Self-renewable: Ability to continuously divide
- Pluripotent: Ability to develop into several types of cells
- Repair ability to return function to damaged cells.

The body is made up of about 200 different kinds of specialized cells such as muscle cells, nerve cells, fat cells and skin cells.

## History

1998- Researchers first extract stem cells from human embryos

1999-First successful human transplant of insulin-making cells from cadavers

2001- President Bush restricts federal funding for embryonic stem-cell research

2002-Juvenile Diabetes Research Foundation International creates \$20 million fund-raising effort to support stem-cell research

2002- California stem cell research.

2004-Harvard researchers grow stem cells from embryos using private funding

2004-Ballot measure for \$ Billion bond for stem cells

2012-Shinya Yamanaka, Japanese physician and researchers shared the Nobel Prize for Physiology or Medicine with British developmental biologist John B.Gurdon for the discovery on how the mature cells cloud is reprogrammed.

### **Categories of stem cell**

The potency of a stem cell is defined by the types of more

Differentiated cells that the stem cell can make.

Stem cells can be either:

Totipotent- cells have the capability to produce all cell types of the developing organism, including both embryonic and extraembryonic (e.g. Placenta) tissues. E.g. cells from early (1-3days )embryos.

Pluripotent- cells can only make cells of the embryo proper, but make all cells of the embryo including germ cells and cells from any of the germ layers. Therefore, they can make any cell of the body. E.g. some cells of blastocyst (5 to 14 days)

Multipotent- cells can only make cells within a given germ layer.

E.g. Fetal tissue, cord blood adult stem cells.

Unipotent- cells make cells of a single cell type. An E.g. germ cell stem cell that makes the cells that mature to become egg or sperm, but not other cell types.

### **Types of stem cells**

A. Embryonic stem cells:

- Human embryonic germ cells
- Amniotic epithelial cells

B. Umbilical cord blood stem cells:

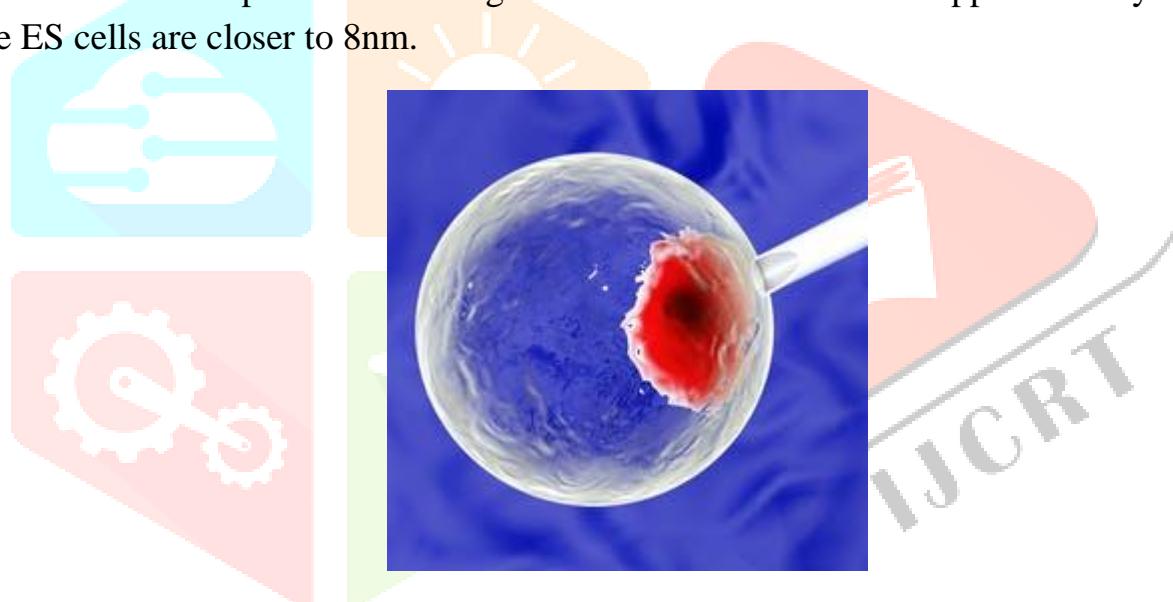
C. Human adult stem cells:

- Hematopoietic stem cells

- Mesenchymal stem cells
- Neural stem cells
- Pancreatic stem cells
- Skin stem cells

### A. Embryonic stem cell

Embryonic stem cells come from a five to six-day-old embryo. They have the ability to form virtually any type of cell found in the human body. Embryonic stem cells are obtained from the inner cell mass of the blastocyst. These stem cells are said to be pluripotent, which means they can change into any cell in the body. Isolation the embryo blast or inner cell mass (ICM) results in destruction of the blastocyst, which raises ethical issues, including whether or not embryo's at the pre-implantation stage should be considered to have the same moral or legal status as more developed human beings. Human ES cells measure approximately 14nm while mouse ES cells are closer to 8nm.



### B. Umbilical cord stem cells (UCS)

Also Known as Wharton's Jelly. Isolated prior to/ immediately following birth.

Hematopoietic stem cells (Majority). 100000 stem cells per mL in UCB.

Umbilical cord blood stem cell transplant are less prone to rejection than either bone marrow and peripheral blood stem cells. This is probably because they have not yet developed the features that can be recognized and attacked by the recipient's immune system. Umbilical cord blood is also known as placental blood. It is the blood that flows in the circulation of the developing fetus in the womb. After the baby's birth, the left over blood in the umbilical cord and placenta is called cord blood. Stored cord blood stem cells from a child are the perfect match for that child. This allows for an autologous transplant if needed with no risk of Graft-vs-Host Disease (GVHD).



## Functions of UCS

It serves as a blood source for the neonate. This is especially important because the fetus is unable to breathe (having neither functioning lungs nor an oxygen source) and thus allows the fetus to obtain the oxygen it needs to live. Because the fetus has no way of taking food, the umbilical cord also serves as a source of nutrients, including calories, proteins, fats, as well as vitamins and nutrients. Finally, the umbilical cord also serves to transfer waste products and deoxygenated blood away from the fetus to the maternal circulation, where it can be processed and excreted.

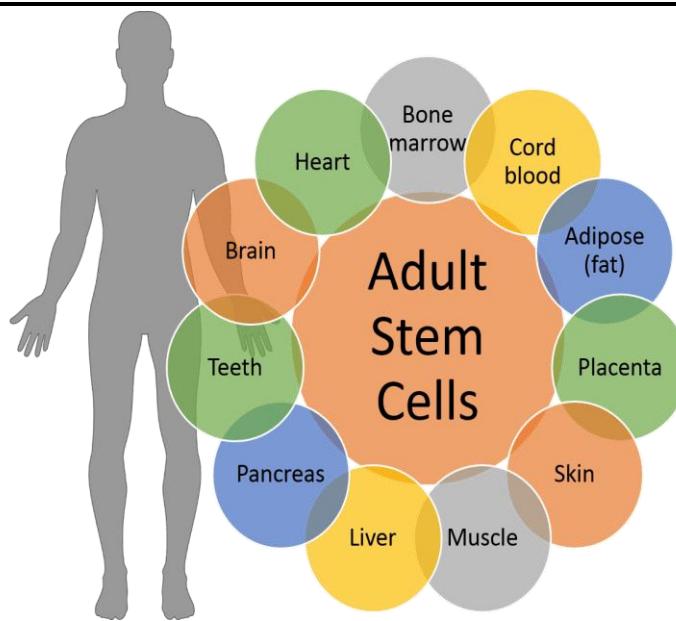
### Cord Blood banking

It involves:

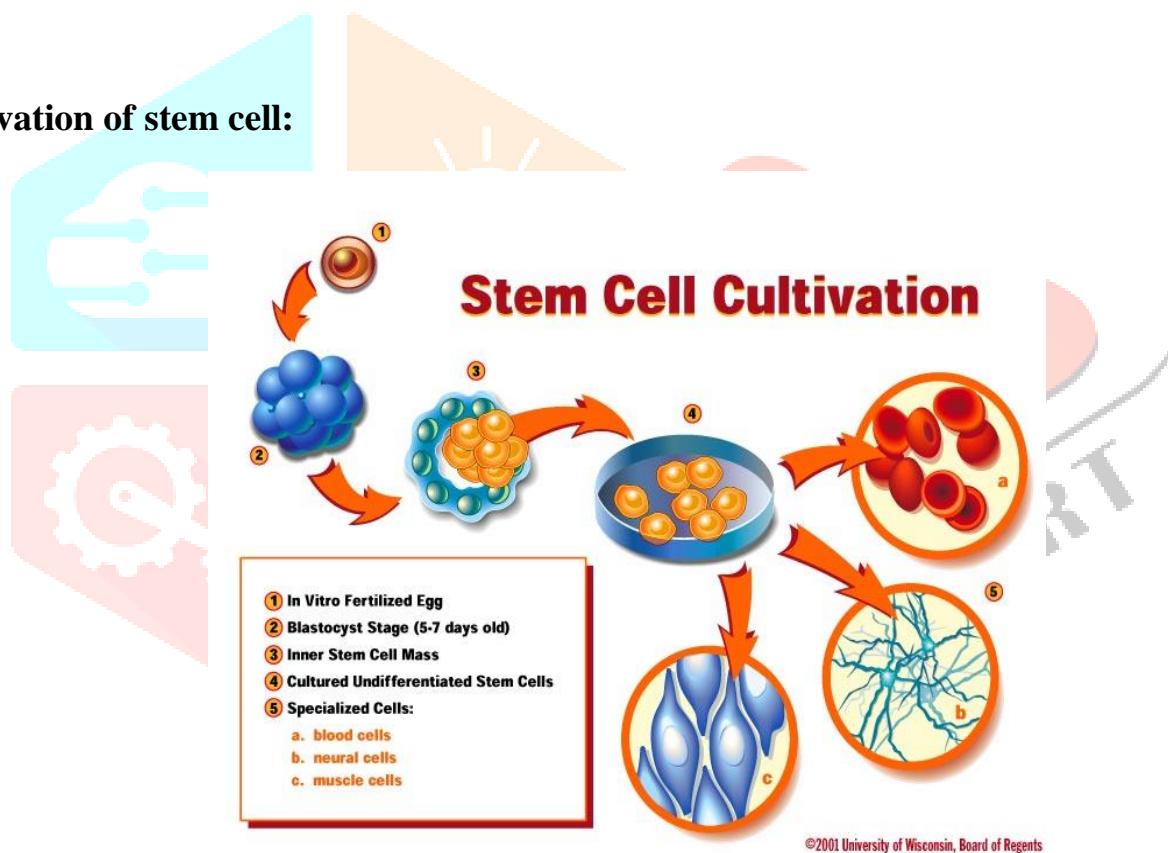
Recruitment, Consent, Testing of maternal donors, Collection, Processing, Cryopreservation, Testing, Releasing cord blood unit to transplant center.

### C. Adult stem cells

Stem cells that are found in developed tissue, regardless of the age of the organism at the time are referred to as adult stem cells. The adult stem cell can renew itself and can differentiate to yield some or all of the major specialized cell types of the tissue or organ. Adult stem cells from bone marrow and umbilical cords appear to be as flexible as the embryonic type. Adult stem cells naturally exist in our bodies and they provide a natural repair mechanism for many tissues. Based on current research they appear to have a more restricted ability to produce different cell types and to self-renew. These are also known as tissue specific stem cells. Adult stem cells supply new cells as an organism grows and to replace cells that get damaged. E.g. Blood-forming stem cells in the bone marrow can give rise to red blood cells, white blood cells and platelets. However, blood-forming stem cells don't generate liver or lung or brain cells.



### Cultivation of stem cell:



## Applications of stem cells:

### Alzheimer disease

Alzheimer's disease is a degenerative condition that results in the loss of brain cells. Mesenchymal stem cells (MSCs) could promote survival, increased metabolic activity and help to rescue the AD cell model in vitro. Stem cell improve functional memory and also improve overall functional recovery. Stem cells regenerate neurons. Replace damaged cells with health cells.

### Parkinson disease

In Parkinson's disease (PD) cells that make the chemical messenger dopamine degenerate and die. Introducing new dopamine cells into the brain may help replace what is lost in PD and reduce its symptoms. Stem cell research could help scientists better define Parkinson's pathology, screen new drugs and develop new treatments. It also used in patients with problematic levodopa-Induced side effects, although this may also result in significant neuropsychiatric adverse effects and speech problems.

### Asthma

Stem cell therapy in patients with asthma increases resistance to cold and infectious disease reducing the frequency of exacerbations. It reduces the allergic response of the organism to allergens including house dust, animal dander, pollen and foods. A study led by scientists at Monash University has shown that a new therapy developed through stem cell technology for chronic asthma.

### Diabetes

The use of stem cell and/or gene therapy for diabetes. Cure of hyperglycemia. Response to glucose tolerance test. Evidence of appropriate C-peptide secretion. Weight gain. Prompt return of diabetes when the transfecting gene and/or insulin producing cells are removed. No islet regeneration of streptozotocin-treated animals and no re-generation of pancreas in pancreatectomies animals. Presence of insulin storage granules in the treated cells.

### Spinal cord injury

The use of stem/progenitor cells for spinal cord injury also need to be resolved before effective therapies can be developed. The use of stem cells harvested from tissue from an adult has facilitated the use of stem cells in the clinical because it has partially dismissed the moral objections surrounding the use of stem cells derived from an embryo.<sup>20</sup> Spinal cord injury (SCI) causes myelopathy, damage to white matter and myelinated fiber tracts that carry sensation and myelinated fiber tracts that carry sensation and motor signals to and from the brain.

## Conclusion

1. Studies of human ES cells have demonstrated an enormous potential for generating tissues of therapeutic value.
2. A recent study showed that transplantation of adult bone marrow-derived cells reduces hyperglycemia in diabetic mice.
3. In cancer, Parkinson's, Orthopedic'.

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