



## **A Breakthrough on Stem Cells**

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### **Abstract**

Stem cells are one of the most fascinating areas of biology today. Stem cells have the remarkable potential to become several different cell types in the body serving as a sort of repair system for the body, they can theoretically divide without limit to refill different cells as long as the person or animal is still alive when a stem cell divides, every new cell has the potential to either remain a stem cell or become another variety of cell with a lot of specialized function such as muscle cell, RBC or brain cell. The ability to differentiate is the potential to develop into other cell types. A totipotent stem cell (fertilized egg) can develop into all cell types including membranes. It has been hypothesized by scientists that stem cells may, at some point in the future, become the basis for treating diseases such as Parkinson's diseases, Diabetes.

**Keywords:** Stem cells, repair system, muscle cell, RBC or brain cell Parkinson's diseases, Diabetes.

### **Introduction**

Stem cells are undifferentiated biological cells that can differentiate into specialized cells and can divide (through mitosis) to produce more stem cells. A totipotent stem cell (e.g. fertilized egg) can develop into all cell types including the embryonic membranes. A pluripotent stem cell can develop into cells from all three germinal layers<sup>[1]</sup>.

These are found in multicellular organisms.  
In mammals.

Two broad types of stem cells:

-Embryonic stem cells, which are isolated from the inner cell mass of blastocyte.

-Adult stem cells<sup>[2]</sup>, which are found in various tissues.

In a developing embryo, stem cells can differentiate into all the specialized cells-

1. Ectoderm
2. Endoderm
3. Mesoderm.

## Stem Cell History <sup>[3-4]</sup>

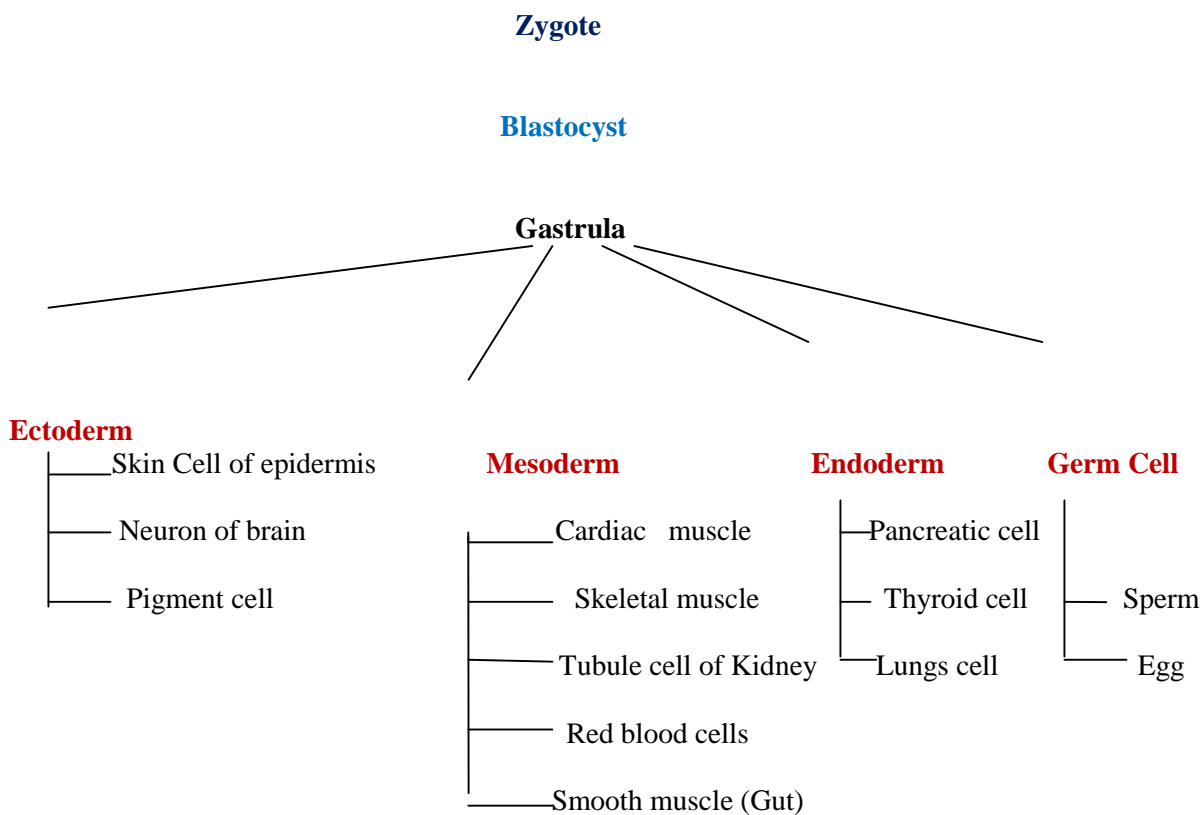
- ❑ 1978- Stem cells were discovered in human cord blood.
- ❑ 1981- First in-vitro stem cell line developed from mice.
- ❑ 1988- Embryonic stem cell lines created from a hamster.

- ❑ 1995- First embryonic stem cell line derived from a primate.
- ❑ 1997- Cloned lamb from stem cells.
- ❑ 1997- Leukaemia origin found as haematopoietic stem cell indicating possible proof of cancer stem cells.

## Definition :

Stem cells are undifferentiated biological cells that can differentiate into specialized cells and can divide (through mitosis) to produce more stem cells <sup>[5]</sup>.

## Stem cell <sup>[6]</sup> :



## Characteristics that distinguish them from other types of cells <sup>[8]</sup>:-

1. They are unspecialized cells that renew themselves for long periods through cell division.
2. That under certain physiological or experimental conditions, they can be induced to become cells with special functions such as the beating cells of the heart muscle or the insulin producing cells of the pancreas.

## Properties of ideal stem cells <sup>[10]</sup>

- Stem cells differ from other kinds of cells in the body. All stem cells—regardless of their source have three general properties:
  1. They are capable of dividing and renewing themselves for long periods.
  2. They are unspecialized.
  3. They can give rise to specialized cell types.

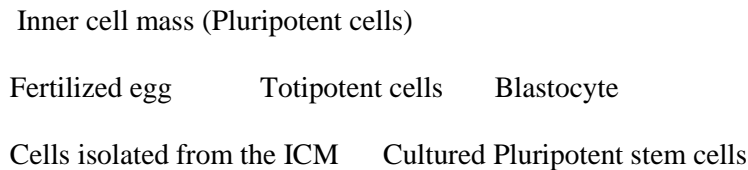
### Embryonic stem cells <sup>[7]</sup>:-

➤ Embryonic stem cells are derived from embryos that develop from eggs that have been fertilized in vitro—in an in vitro fertilization clinic.

➤ They are not derived from eggs fertilized in a woman's body.

The embryos from which human embryonic stem cells are derived are typically four or five days old and are a hollow microscopic ball of cells called the blastocyst.

### Blastocyst diagram :



### Embryonic stem cells culture in laboratory <sup>[11]</sup>

The cells divide and spread over the surface of the culture media dish. The inner surface of the culture dish is typically coated with mouse embryonic skin cells that have been treated.

The feeder cells release nutrients into the culture medium. Over the course of several days, the cells of the inner cell mass proliferate and begin to crowd the culture dish. When this occurs, they are removed gently and plated into several fresh culture dishes. The process of replanting the cells is repeated many times and for many months

After six months or more, the original 30 cells of the inner cell mass yield millions of embryonic stem cells. Embryonic stem cells that have proliferated in cell culture for six or more months without differentiating, are pluripotent, and appear genetically normal are referred to as an embryonic stem cell line.

### Adult Stem Cells <sup>[14]</sup>

An adult stem cell is an undifferentiated cell found among differentiated cells in a tissue or organ, can renew itself, and can differentiate to yield the major specialized cell types of the tissue or organ.

- Skin
- Fat Cells

- Bone marrow
- Brain
- Many other organs & tissues

### Adult stem cells culture in laboratory <sup>[17]</sup>:

Labeling the cells in a living tissue with molecular markers and then determining the specialized cell types.

Isolation of cells, growing them in cell culture, and manipulating them, often by adding growth factors or introducing new genes.

Also, a single adult stem cell should be able to generate a line of genetically identical cells—known as a clone—which then gives rise to all the appropriate differentiated cell types of the tissue.

### Stem cells to treatment of parkinson's disease <sup>[19]</sup>

➤ Parkinson's disease (PD) is a very common neurodegenerative disorder.

➤ **It is thought that PD may be the first disease to be amenable to treatment using stem cell transplantation.**

➤ In a recent study, scientists directed mouse embryonic stem cells to differentiate into DA neurons by introducing the **gene**. When transplanted into the brains of a rat model of PD, released dopamine and improved motor function.

## Patho-physio-therapeutical significance of stem cells<sup>[18]</sup>:-

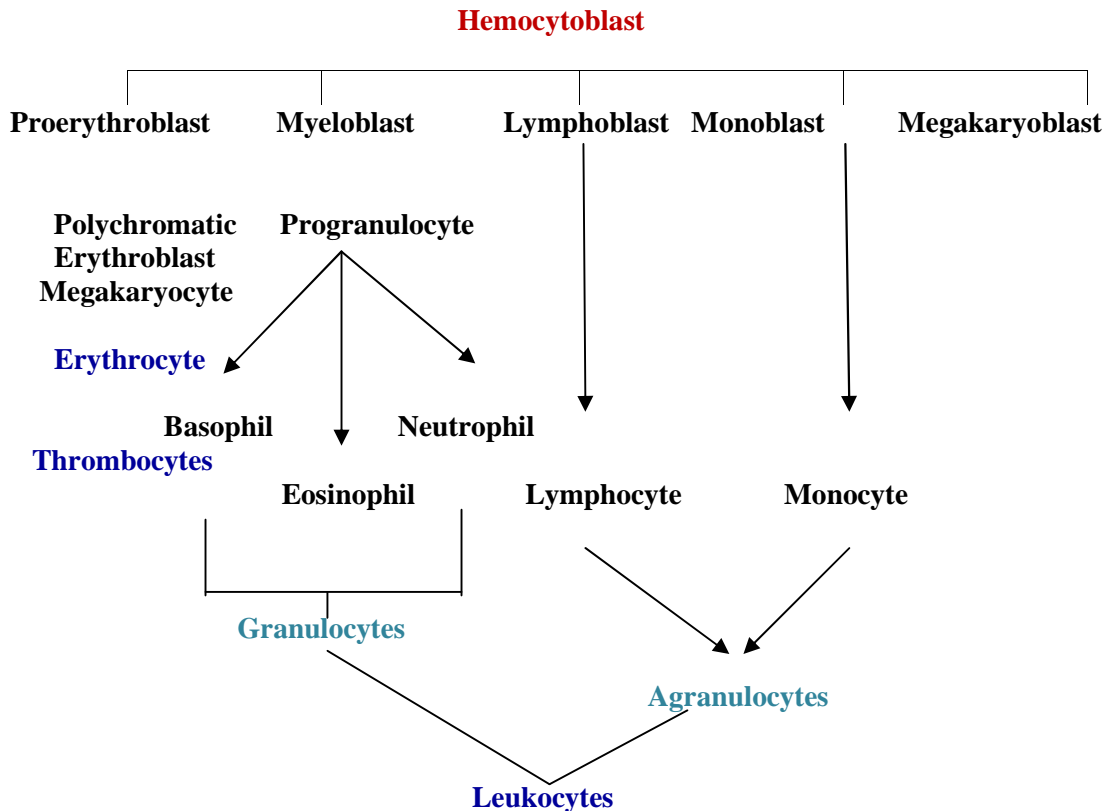
*Dead nerve cells not producing dopamine*

*Implanted stem cells*

*New nerve cells producing dopamine*

*Dopamine transmits nerve signal*

## Blood Cell Formation



## Stem Cells to Treatment of diabetes<sup>[20]</sup>

Adult stem cells from the pancreas have been elusive so far. However, a recent report of a clone from mouse pancreas that can generate both pancreatic and neural cell lines is exciting, as is a second report that adult small hepatocytes (liver cells) can be induced to produce insulin. Both reports offer hope for using adult stem cells as a treatment and cure for diabetes.

## Baldness:-

Hair follicles also contain stem cells.

➤ This treatment is expected to work by activating already existing stem cells on the scalp<sup>[21]</sup>.

➤ Later treatments may be able to simply signal follicle stem cells to transfer chemical signals to nearby follicle cells which have shrunk during the ageing process, which in turn respond to these signals by regenerating and once again making healthy hair.

## Stem Cell Applications<sup>[22]</sup>

- Tissue repair - nerve, heart, muscle, organ, skin.
- Cancers.
- Autoimmune diseases - diabetes, rheumatoid arthritis

## Tissue repair <sup>[23]</sup>:-

During development, stem cells divide and produce more specialized cells. Stem cells are also present in the adult in far lesser numbers. The role of adult stem cells (also called somatic stem cells) is believed to be replacement of damaged and injured tissue

## Disadvantage:-

1. A disadvantage of most adult stem cells is that they are pre-specialized, for instance blood stem cells make only blood, & brain stem cells make only brain cells. These are derived from embryos that are not a patient's own & the patient's body may reject them.
2. Embryonic stem cells<sup>[24]</sup> may not be the solution for all ailments.
3. It is envisaged from latest study that stem cell therapy <sup>[25]</sup> has limitation on cardiovascular system which found as narrower coronary arteries.

## Conclusion

Though the research on stem cell has some limitation across the globe, it is expected it will come as a boon to the ailing human being in the decades ahead, overcoming all the drawbacks & limitations.

## Conflict of interest

The authors declare no conflict of interest.

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