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Stem Cells: Boon for Mankind – A Review

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Abstract

In recent years stem cell therapy has become a very promising advanced scientific research topic. The development of treatment methods evoked great expectations. The paper is focused on discovery on different and potential therapy based on the cells. The genesis of stem cells is followed by laboratory steps of control stem cells culturing and derivations. Among many types of stem tissue application and potential of these therapies require attention due to their versatility. This review is summarized by challenges that stem cell therapy must overcome to be accepted worldwide and variety of possibilities make this cutting edge a modern medicine, providing hope for untreatable disease.

Keywords: Stem cell, culturing, genesis, disease, therapy

Introduction

Stem Cells

Stem cells are special human cells that have ability to develop into many different cell types. they are the foundation cells for every organ and tissue in our body the highly specialized cell that make up this tissues original came from initial pool of stem cells formed shortly after fertilization. All humans start out on only one cell that have ability to divide and make and indefinite number of copies of themselves Stem cells have to keep properties:

1. The ability to self renewal dividing in a way that makes copies of themselves and
2. Ability to differentiate giving rise to mature types of cells that make up our organ and tissue.

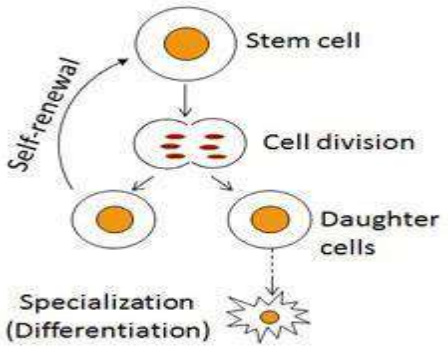

Figure 1 Cell Division

Stem cells history

Since 19th century scientists from all over the world have studied Stem cells, from plants, to mice, to patient in search of a cure for their disease

1. 1868 - The term "Stem cells" appears in scientific literature, when German biologist Ernst Haeckel uses the phrase stem cells to describe the fertilized eggs that become an organism, and also describe the single celled organism that acted as the ancestors cell to all living things in history.
2. 1886 - William Setgwick uses the term "stem cells" to describe parts of a plant that grow and regenerate
3. 1998 - researchers first extract Stem cells from human embryos
4. 1999 - First successful human transplant of insulin- making cells from cadavers
5. 2001 - President Bush restricts federal funding for embryonic stem-cell research.
6. 2003 - California ok stem cells research-terminated.
7. 2004 - Hard work researchers grow stem cells from embryos using private funding.
8. 2006 - Researchers made another breakthrough by the identifying new type of stem cells, called induced pluripotent stem cells (iPSCs) through genetically reprogramming of specialized adult.
9. 2009 - President Barack Obama remove certain restrictions on federal funding for

research involving new lines of human embryonic stem cells

10. 2010 - Janenisch's successfully treated transgenic mice caring the human gene for sickle-cell anemia by giving them him hemotopotic derived from those mice's gene-repaired Ips. [1,2]

Stem cells characteristics

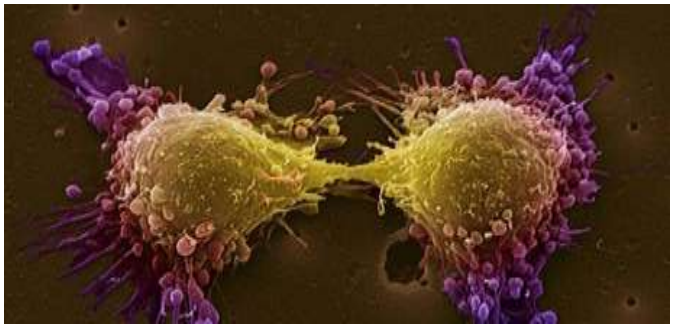

Figure 2 3D view of division

1. Blank cells (they are unspecialized)
2. They are capable of dividing in renewing themselves from long period of time (proliferation and renewal)
3. They undergo differentiation and have the potential to give rise to specialized stem cells

Kinds of stem cells

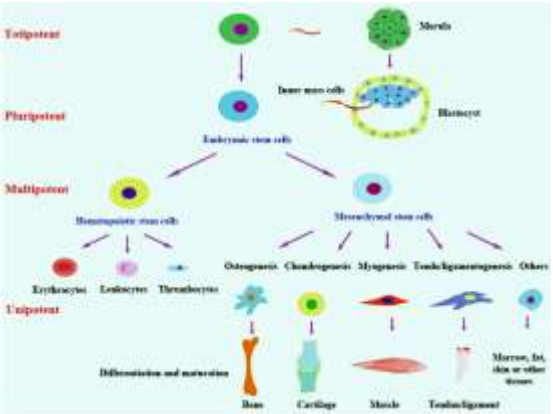

Figure 3 Division of stem cells

Table 1 Different kind of stem cells

Stem cell type	Description	Example
Totipotent (omnipotent)	Development of each cell into a new individual	Cell of a rely embryos 1-3 days
Pluripotent	Cell can form over 200 cell type	Some cells of blastosis "5 to 14 days"
Multipotent	Cells undergo diiferntiation but cab form number of other itissue	Mesenchynal stem cells
Oligopotent cells	They are similar to (multipotent stem cells) but restricted in there capacity to differntiate	Hematipoitic stem cells
Unipotent stem cells	They are least potent and most limited type of stem cells	Muscle stem cells

Classification of Stem Cells

Embryonic stem cell

1. Embryonic stem cells are derived from 5-6 days old embryo (development stage).
2. Cells found a early (less than 2 weeks) in development of an embryo
3. Embryonic stem cells are the most versatile because they can become any cell in body including foetal stem cells and adult stem cells
4. Embryonic stem cells are taken from, a very early stage of embryo the blastocyst is a ball

of about 50-100 cells and it is not yet implanted in the womb

5. Is it is made up of outer layer of cells, a fluid-filled space and a group of cells called inner cell. Embryo stem cells are found in inner cell mass.

Embryonic stem cells are obtained from the inner cell mass of blastocyst, a mainly hollow ball of self that, in the human, forms 3 to 5 days after an Egg is fertilized by sperm. A human blastocyst is about the size of the "i." In normal development, the cell inside the inner mass will give rise to more specialized cell that give rise to entire body- all of our tissues and organs. However, when scientists extract the inner cell mass and grow these cells in special laboratory conditions, they retain the properties of embryonic stem cells. Embryonic stem cells are pluripotent that means they can give rise to every cell type in the full form body, but not the Placenta and umbilical cord.

Embryonic stem cells have been derived from a variety of species, including humans, and described as pluri potent meaning that they can generate all the different type of cells in the body. Embryonic stem cells can be obtained from the blast cyst , a very early stage of development that consists of a mostly hollow wall of approximately 150-200 cells and is barely visible to the nake eye .At this is , there are no organs, not even blood, Just an "inner cell mass" From which embryonic stem cells can be obtained human embryonic Stem cells are drived primary from blastocyst that were created by *in vitro* fertilization where reproduction were no longer needed. The fertilized egg and the cell that are immediately arising in the first division are "Totipotent". This means that, under the right condition, they can generate a variable embryo (including support tissue such as the Placenta) within a matter of days, however, these cells transition to become pluripotent. None of the currently studied embryonic stem cells lines are alone capable of generating viable embryo (i.e. they are pluripotent not totipotent.[3-5]

Embryonic germ cells

Embryonic germ cells are the cells in embryo that will produces gametes or reproductive cells i.e. egg or ova.

Adult stem cells

Adult stem cells are the undifferentiated cells, found throughout the body after the development, that multiply by cell division to replenish deing cells and regenerated damage tissue.

Adult stem cell shared these characteristics:-

1. The ability to proliferate (long term cell renewal)
2. They can give rise to mature cell type that has a specialized function.
3. Adult stem cells are found in human body and in umbilical cord blood.
4. The most well known source of adult stem cells in the body is bone marrow but they are

also found in many organs and tissues; even in the blood.

5. Adult stem cells are more specialized since they are assigned to a specific cell family such as blood cells, Nerve cells etc.
6. Recently it was discovered that an adult stem cell from one tissue may act as a stem cells for another tissue, i.e. blood to neural.[6-8]

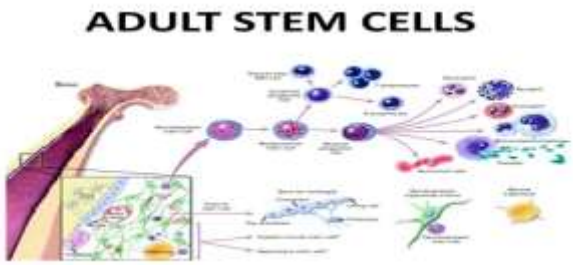

Figure 4 Adult Stem Cells

Tissue specific stem cells

Tissue-specific stem cells also called as "Adult" or "Somatic" stem cells are more specialized then embryonic stem cells and can produce some or all of the mature cell type found within the particular tissue or organ in which they reside. Some tissue and organ contain small catches of tissue specific stem cells whose job is to replace cell from that tissue that are lost in normal day-to-day living or in injury , Tissue-specific stem cells can be difficult to find in human body and they don't seem to self-renew in culture as easily as embryonic stem cells do. However study of these cells has increased over general knowledge about normal development, what changes in ageing and happens with Injury disease.

Induced pluripotent stem cells

They are type of pluripotent stem cells that can generate directly from somatic cells one of the hottest topic in stem cell research today is induced pluripotent stem cells. These are adult cells (eg skin cells) that are engineered or "reprogrammed" , to become pluripotent , i.e. behave like in embryonic stem cells. The most well-known type of pluripotent stem cells involves destruction of the preimplantation stage of embryo there has been much controversy surrounding their use. Further, because embryonic stem cells can only be derived from embryos it has so far not be fusible patient- match embryonic stem cells line. It is not yet completely understood how these three to four "Reprogramming" genes are able to induce pluripotency; this question is focus of ongoing research. In addition, recent studies have focused on alternative ways of reprogramming cells using method that are safer for use in clinical settings.[9]

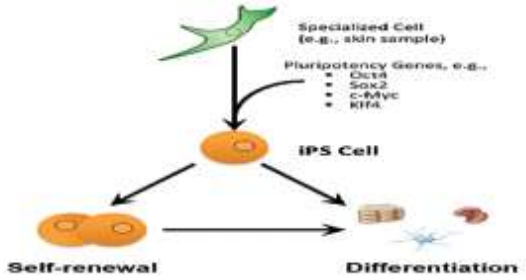

Figure 5 Differentiation

Hematopoietic stem cells

1. Hematopoietic stem cells are those cells from where all blood cells originate.

2. Discovery of hematopoietic stem cells in cord blood was made in the year 1974
3. In the year 1982 Broxmeyer suggested umbilical cord blood contains significant amount of hematopoietic stem cells suitable for transplantation.
4. Pluripotent:- red blood cell ,white blood cell and platelets
5. High proliferated capacity: 1 cell in a million

Source of hematopoietic stem cells in human **[10-11]**

1. Umbilical cord blood
2. Peripheral blood
3. Bone marrow

Cord blood

Umbilical cord blood is also known as placental blood. It is the blood that flows in the circulation of the developing foetus in the womb. After the baby's birth the leftover blood in the umbilical cord and Placenta is called cord blood cord blood and it is a rich source of stem cells.

Uses for cord blood stem cells

Today, umbilical cord blood, with its high concentration of "hematopoietic" stem cells, brings these types of transplantation into the 21st century.

Cord blood stem cells have been used to treat more than 45 malignant and genetic diseases. Leukemia is the most common condition being treated. A Current research shows great promise for the treatment of heart disease, liver disease, diabetes stroke, multiple sclerosis, Alzheimer's disease, Parkinson disease, spinal cord injury and systemic lupus.

Stored cord blood stem cells from a child are the perfect match for that child. This allows for autologous transplants if needed, with no risk of graft-vs-host disease (GVHD). GVHD is where the body rejects the donor stem cells and may prevent engraftment from occurring. Cord blood stem cells are also a close match for siblings or family members in case of need with low risk of GVHD.[12]

Source of stem cells

Stem cells may be obtained from sources such as bone marrow, umbilical cord, adipose tissue; amniotic fluid histocompatibility is prior for transplantation of allergenic stem cells. Foetal tissue is the best current tissue source of human neural stem cells.[13]

Placenta as a source of stem cells

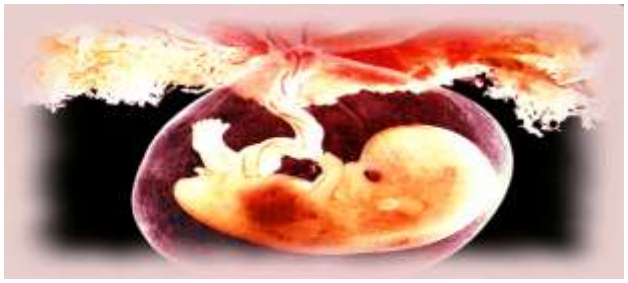

Figure 6 Placenta a source of stem cells

Placental stem cells, like umbilical cord blood and bone marrow stem cells, can be used to cure chronic blood related disorders such as Sickle Cell disease, thalasemia and leukaemia.[14]

Applications of stem cells [15-16]

Treatment of Diseases - diabetes, spinal cord injury, Parkinson disease, heart disease, Genetic base disease like cystic fibroses, Huntington's disease.

Cell Replacement Therapies - Cells could be stimulated to develop into specialized cell that represent Renewable Sources of cells and tissue for transplantation. Cell replacement therapy could treat injuries and various genetic and degenerative condition including Muscular dystrophy, retinal degeneration, Alzheimer disease, Parkinson disease, Arthritis, diabetes, spinal cord injuries and blood disorder such as hemophilia.

Current therapies

Blood stem cells are currently the most frequently used stem cells for therapy. For more than 50 years doctors have been using bone marrow transplants to transfer blood stem cells to patients, and more advanced techniques for collecting blood stem cells are now being used to treat leukaemia, lymphoma and several inherited blood disorders. Umbilical cord blood, like bone marrow, is often collected as a source of blood stem cells and in certain cases is is being used as an alternative to bone marrow transplantation. Additionally, some bone, skin and corneal disease or injuries can be treated by grafting issues that are drived from or maintained by stem cells. These therapies have also been shown to be safe and effective.

Conclusion

The vast possibilities of what stem cell research could achieve mean that the Expectations for this research from both the public and scientific community are huge. However there are some clinical trials with stem cell therapies in the UK, few stem cells treatment are currently common place in UK Hospitals it could the misleading for this Publication to suggest that stem cell therapy from PS cells will be available soon in UK Hospital. Most scientists would acknowledge that much work is needed to investigate the characteristics, control, safety and reliability of PS cells. In particular, what the similarities and differences are between PS cells and ES cells. These issues must be considered before the research can be termed into medical treatment. Some feel that the use of PS cells to model human disease will be the technology that is available first. This would allow treatments and drugs to be tested for their effect on diseased human cells and whether they are toxic to the cell or not. Some early experiments have already been carried out that demonstrate this potential.

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