iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VII **Month of publication:** July 2020

DOI: https://doi.org/10.22214/ijraset.2020.30749

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VII July 2020- Available at www.ijraset.com

Potential Applications of Stem Cell Based Therapy in Human Health Management

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Abstract: ***The stem cell technology is the most promising sector in biotechnology field, on curing and diagnosing human diseases. The specialized stem cells have a very unique way on treating the deadly disease like cancer, Alzheimer's, etc., Some types of it helps in regeneration of tissues by recreation of a distrupted part of the living organisms by obtaining specialized undifferentiated stem cells from various source(liver cells, brain cells) of human body. It make the scientist to understand and design regenerative medicines. In future the researches should be promoted with drug safety followed with increased successful safe clinical trials without regretting the ethical measures. Surely, the stem cell theraphy reduce the intake of drugs in future medicine. Thus, the stem cell theraphy will have potential application human health.***
Keywords: Stem cell theraphy, Tissue regeneration, Disease diagnosis, drug efficacy, Human health.

I. INTRODUCTION

Stem cells are special human cells that are able to develop into various specialized cell types range from brain cell to liver cells etc., Stem cells are commonly referred as undifferentiated cells because they have not yet committed to form a specific tissue or organ. Stem cells possess the ability to construct every tissue in the human body hence it have great power for therapeutic uses especially in tissue regeneration and repair. The stem cell therapy is the use of stem cells to prevent or treat disease which is also known as regenerative medicine. Hematopoietic stem cell transplantation, a form of bone marrow transplantation is the established means of stem cell therapy so far. The potential of stem cell lies even to treat illnesses such Parkinson's, paralysis and Alzheimer's in near future (Biehl and Russell, 2009). However, most of the stem cell applications are at the experimental level due to some ethical and practical issues.

II. CHARACTERISTICS OF STEM CELLS

Stem cells are able to renew themselves almost indefinitely. This is known as proliferation. The unspecialized stem cells are able to give rise to specialized cells. These types of cells are used to detect birth disorders and their possible reasons. Highly have an impact on the tissue regeneration and replacing the dysfunctional or diseased tissues by transplantation. Stem cells are the most needed source on the regenerative medicine (Ian Murnagh, 2018).

A. Sources of stem cells

1) Stem cells are extracted from embryonic, adult and perinatal cells.

B. Embryonic stem cells (ESC)

1) ESCs are stem cells are derived from undifferentiated inner mass cells(IMC)of a blastocyst (early stage of pre-implantation).
2) The embryonic stem cells are derived from the embryos at a developmental stage before the time that implantation would normally occur in the uterus. It is commonly known as Pluripotent stem cells, means they are able to grow (i.e. differentiate) into all derivatives of the three primary germ layers: Ectoderm, Endoderm and Mesoderm.
3) These pluripotent stem cells are isolated from body which is 3-5 days older, then cultured on a layer of "feeder" cells which provide unknown cues for many rounds of proliferation while sustaining their pluripotency.
4) (iPS) 'induced pluripotent stem cells' are induced adult cells back into the pluripotent state by molecular manipulation to yield iPS cells that share some of the characteristic of as embryonic stem cells such as proliferation, morphology and gene expression. These genes are transcribed and translated into proteins that regulate the expression of other genes designed to reprogram the adult nucleus back into embryonic state.
5) Embryonic stem cells are able to develop into any type of cell, Only ES cells of morula are totipotent , these able to produce different cell types.(Yu et al.,2006)

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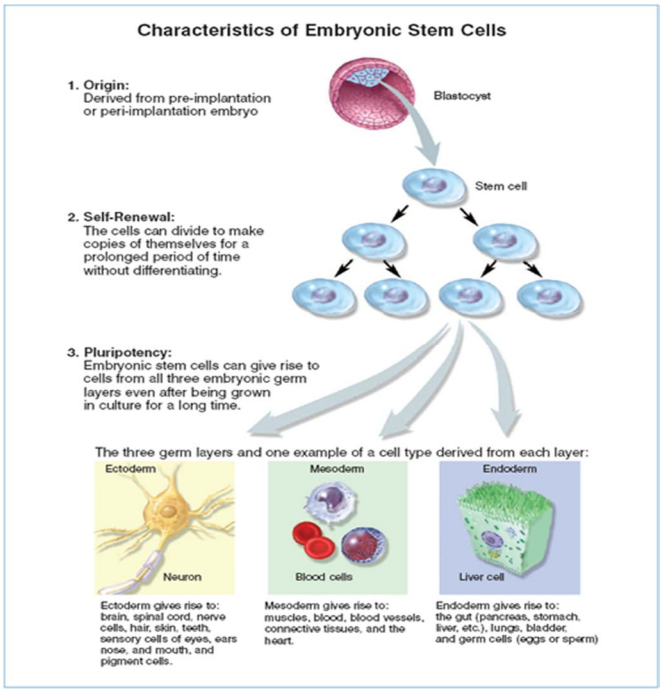


Fig.1 Characteristics of human embryonic stem cells Source:Es cells/stemcells.nih.gov

C. Adult Stem Cells

1) Adult stem cells are undifferentiated cells, found throughout the body after development and multiply by cell division to replenish dying cells and regenerative damaged tissues.

2) They are also known as somatic stem cells which could be found in juvenile as well as adult stages.

3) Multi-potent stem cells found in bone marrow are best known, because these have been used therapeutically.

4) Adult stem cells make identical copies of themselves for long period of time and this ability is referred to as long-term self-renewal. These cells will give rise to the characteristics such as morphological and specialized functions. For eg. Multi-potent cells derived from the mesoderm of the gastrula undergo a differentiation step restrict them to muscle and connective tissue, so the cells can give rise to only cartilage or only bone. Other examples of multi-potent cells are liver cells, CNS stem cells, epithelial cells etc.,(stemcells.nih.gov)

D. Perinatal Cells

1) Perinatal stem cells are derived from umbilical cord, cord blood, placenta, amniotic fluid etc. these are also known as birth-associated tissue derived stem cells.

2) Aminiotic fluid fills the sac that surrounds and protects a developing fetus in the uterus. The procedure of identifying stem cells in amniotic fluid from pregnant women to test for abnormalities is called amniocentesis. (Zhang et al., 2019)

III. APPLICATIONS

The stem cells are used in the clinical applications by cloning a particular stem cell and develop as a particular cell type. example; pancreatic stem cell, brain cell ,etc., The derived stem cells are used to cure disease like chronic blood-related disorders such as sickle cell disease, Thalesmia.

1) Cell based treatment is also being used in experiments to graft new skin cells to serious burn cases, and to grow new corneas for the sight impaired.

2) Stem cell will allow researchers to test new discoveries of drugs using in human cell line which could speed up new drug development.

3) The umbilical cord blood cells are collected during delivery, which are under cryopreservation could be used for any disease of the baby in future. (Sutton and Bonfield, 2014)

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A. Understanding Diseases

Stem cells and derived products offer great promise for new medical treatments, Researchers and scientists are studying the conditions such as Liver failure, Parkinson's, Multiple sclerosis, motor neuron disease etc.,by using stem cells to understand degenerative conditions of the disease. By watching stem cell mature into cells in bones, heart, liver, nerves, muscles, doctors and scientist may understand better how diseases and conditions are developed.

Table no 1: Stemcell type and applications

S.NO	STEM CELL TYPE	PPLICATION	REFERENCE
1.	Self renewing cancer stem cells	Used against on treating brain tumor Glioma.	*Monica Venere ,cancer stemcells in Gliomas., https://www.ncbi.nlm.nih.gov*
2.	Induced pluripotent stem cells(Dopamine cells)	By introducing new dopamine cells into the brain may help to relocate what is lost in Parkinson's disease	*Stem cells for parkinsons: theraphy and tools for a neurological disorder. https://www.closerlookatstemcells.org*
3.	Bone marrow or heamatipoietic stem cells	Works against the liver cirrhosis.	*Young-Seok Park., Current Prespecttives regarding stem cell based theraphy for liver cirrhosis., https://www.hindwai.com*

B. Regenerative medicine

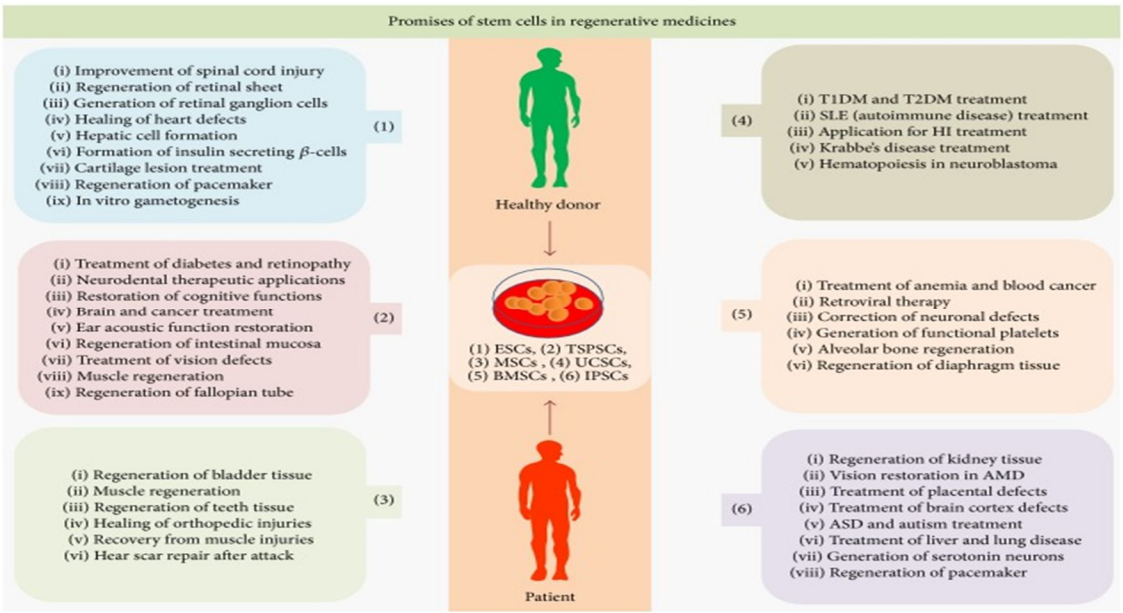


Fig. 2. Stem cell applications in regenerative medicine and disease therapeutics. *source: www.ncbi.nlm.nih.gov*

Regenerative medicine, the most recent and emerging branch of medical science, which deals with the functional regeneration of specific tissue and organ of a patients suffering with severe injuries or chronic conditions, in the state which the body's own restoration activity do not suffice, regenerative stem cell therapy act as an alternative source of treatment. Stem cells pave foundation for all tissues and organ systems of the body and mediate diverse role in disease progression, development and tissue repair process in host. On the basis of regenerative application, stem cells can be classified as ESCs, Tissue specific Progenitor stem cells(TSPSCs), Mesenchymal stem cells, Umblical cord stem cells, Bone marrow stem cells and iPSCs. The transplantation of stem cell can be autologus, allogenic and syngeneic for induction of tissue regeneration and immunolysis of pathogen or malignant cells.*(Mahla,2016).*

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C. Testing Drug Efficacy:\

Discovery of developing cell based products which lead to efforts of using stem cell biology to identify and develop small molecule drugs to target endogenous stem cell population. For eg.to stimulate neurogenesis for treating stroke, traumatic brain damage, Parkinson's or other disorders or to inhibit stem cells like cells in solid tumors. The main concept is that stem cell can give a new mean of studying the pathological basis of disease, screening for drug leads, testing candidate drug efficacy, safety and selecting patient population for clinical testing. For each patients, iPSCs would be generated, expanded and redifferentiated to the type of cells most affected in the disease of interest. eg; motor neurons in Amyotrophic lateral Sclerosis or Spinal muscular autrophy and to the most commonly affected by drug side effects(cardio myocytes and hepatocytes).The abnormalities assigned with the mortalized cells will control the confidence value and number of lead molecule for drug development. The use of specialized primary culture models like hepatocytes, human umbilical endothelial cells and keratinocytes offer limited usage due to their restricted expandability. Bone marrow derived MSCs offer an attractive high throughput screening for new drug innovation. These stem cells can be readily expanded in vitro and can be isolated from a variety of tissue sources, such as lung, liver, brain,etc., (Rubin and Haston, 2011).

IV. SCOPE AND ETHICAL ISSUES

The future of stem cell research and therapy is bright in near future. Over the period of time,it is likely that at least one or more stem cell therapy protocols will become the standard of care for cardiac patients, However, there will be a need over the next few years for scientific due diligence to maximize the efficacy of stem cell therapy and the number of patients receiving benefit . It is unlikely that pluripotent stem cell sources will enter standard practice in the cardiac field in the immediate future.Stem cell will also reduce the intake of drugs for diabetes and other lifestyle associated diseases (Brunt et al.,2012).

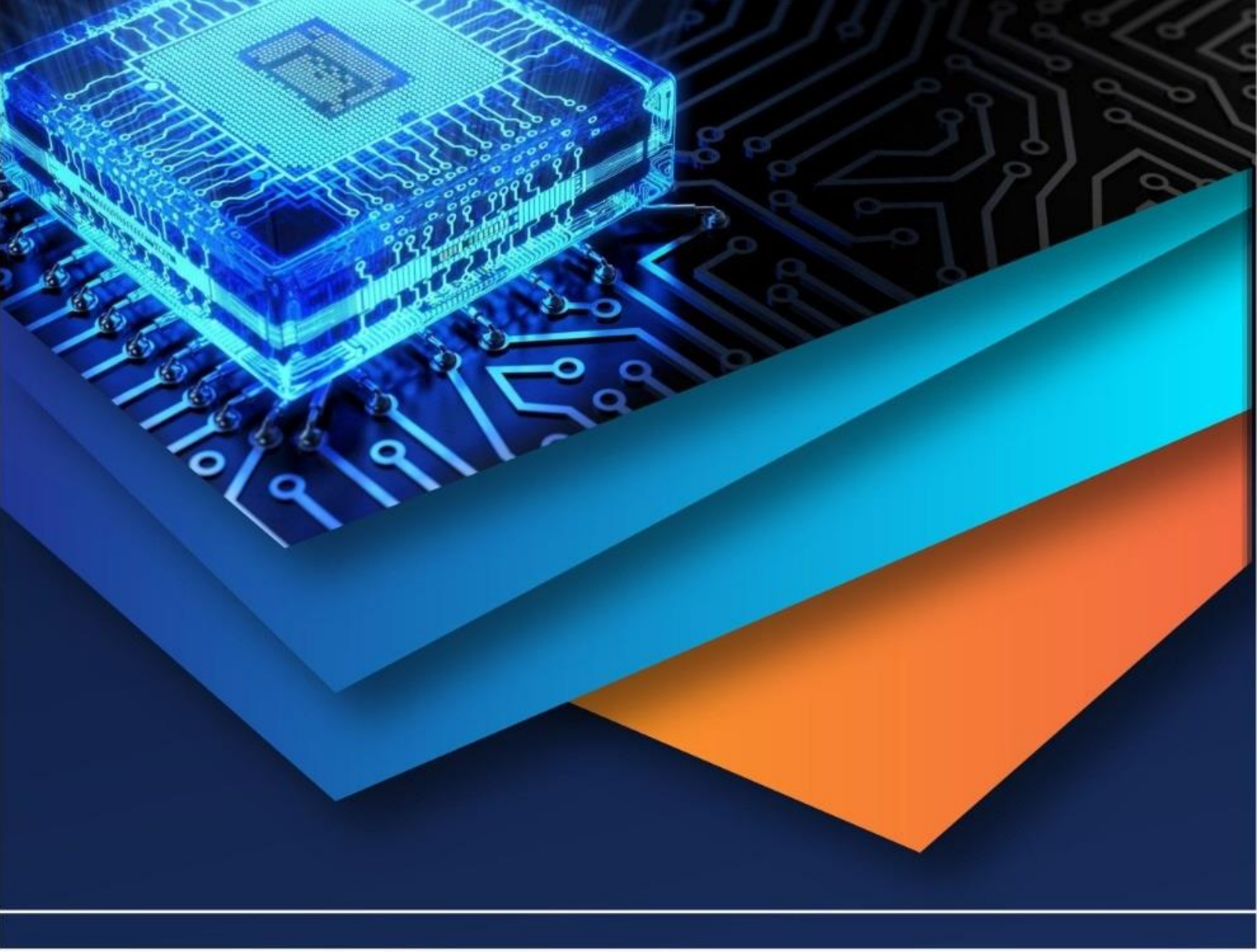
V. CONCLUSION

It is quite apparent that stem cell research proposes many ethical problems. We need to consider the possible benefits the stem cell therapy able to deliver in treating some specific medical conditions. The overall aim of stem cell research is to be able to improve the medical treatment of diabetes, mental illness, spinal cord oriented problems, etc., The research in future should be improved to satisfy all human need in medicos field by solving ethical issues and creating awareness about it.We hope that this field will achieve as successful treatment process in future.

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