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Potential Impact and Controversy of Stem Cells in Public Health

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ABSTRACT

Stem cells are versatile in the bodies which are able to both reproduce themselves and to produce more specialized cells. As such, they are of great potential values in repairing and regenerating damaged cells and tissues. Many different kinds of stem cells have been discovered. The most common are embryonic, foetal and adult stem cells. Stem cell research has the potential to provide an increased understanding of development and differentiation, as well as leading to treatments and cures for many diseases. They are important to the future of medicine and public health because with adequate research, stem cells have the potential to treat degenerative conditions through transplanting human stem cells into patients. With sufficient development of stem cell medicine, chronic diseases such as diabetes, heart disease, and Parkinson's disease will be effectively managed. Embryonic stem cell (ESC) research has been a source of ethical, legal, and social controversy which has slowed the pace of stem cell science and shaped many aspects of its subsequent development.

Keywords: Stem Cells, Importance, Public Health, Impact

I. INTRODUCTION

Embryonic stem cells (ES cells) are pluripotent stem cells derived from the inner cell mass of the blastocyst of an early stage embryo. Human embryos reach the blastocyst stage in 4–5 days of post fertilization, at which time they consist of 50–150 cell mass [1]. Isolating the embryoblast or inner cell mass results in destruction of the fertilized human embryo, which raises ethical issues. Those issues include whether or not a human life at the embryonic stage should be granted the moral status of a human being as it is with a child or an adult.

In the broader sense, there are five types of stem cells [2]. i.e. 1.Embryonic stem cells - They are harvested from the inner cell mass of the blastocyst in about seven to ten days after fertilization; 2. Foetal stem cells - These cells are taken from the germ line tissues which will make up the gonads of aborted foetuses; 3. Umbilical cord stem cells - Umbilical cord blood contains stem cells similar to those found in bone marrow; 4. Placenta derived stem cells - Up to ten times as many stem cells can be harvested from a placenta as from cord blood and 5. Adult stem cells - many adult tissues contain stem cells which can be isolated. Stem cells isolated from mature tissues and umbilical cord blood are commonly used in stem cell research. These are not totipotent or pluripotent like embryonic stem cells, but rather more specialized cells i.e. multipotent. Another source of stem cells is the iPS (induced pluripotent stem) cell. This process involves reversing the differentiating cell signals that cause a stem cell to specialize. This type of stem cell is a pluripotent cell [2, 3].

SE cells are also self-sustaining and replicating through cell division. These unique characteristics are a solution as to why stem cell research holds such great promise for the treatment of life-threatening and

debilitating diseases such as Alzheimer's disease, cancer, Parkinson's disease, and juvenile diabetes.

Research in the field of stem cells have been dramatically increasing and the goals of stem cell research includes curing diseases, cloning, and gene line engineering. Cloning is directed towards making duplicate animals or humans whereas gene-line engineering is directed towards permanent change in disease resistance and aesthetic and functional enhancements [2].

II. METHODS AND MATERIAL

1. Wireless sensor Brief History

The history of stem cell research began in the early 1960s when James Till and Ernest McCulloch and their colleagues at the University of Toronto came across reservoirs of cells in mice with the properties of stem cells: the abilities to self-renew and to differentiate into specialized cells. This discovery provided the groundwork for the 1998 development of the first embryonic stem cell lines. They found that these stem cells, which they had discovered in the bone marrow of mice, had the remarkable capacity to make the entire cell type found in blood [4].

In 1964, researchers isolated a single type of cell from a Teratocarcinoma, a tumour now known to derive from a germ cell. These cells replicated and grew in cell culture as a stem cell and are now known as embryonic carcinoma (EC) cells [5]. In 1981, ES cells were independent and first derived from mice embryos by Martin Evans and Matthew Kaufman, University of Cambridge revealing a new technique for culturing the mice embryos in the uterus to allow for an increase in cell numbers as stem cells [6].

Several types of stem cells have been discovered from germ cells, the embryo, foetus and adults. Each of these have promised to revolutionize the future of regenerative medicine through the provision of cell-replacement therapies to treat a variety of debilitating diseases. Stem cell research is politically charged, receives considerable media coverage, raises many ethical and religious debates which generates a great deal of public interest [7]. Scientists believe that stem cell research is important to the future of medicine because with adequate research, stem cells have the potential to treat disease by transplanting human stem cells into patients suffering from degenerative diseases such as Parkinson's disease, diabetes, traumatic spinal cord injury, Purkinje cell degeneration, Duchenne's muscular dystrophy, heart disease, and hearing and vision loss8a With gene therapy, a genetic defect would be corrected by giving a healthy version of the gene to a patient [9b].

Embryonic germ cells have been found to have properties similar to those of embryonic stem cells. These studies were of tremendous scientific interest in stem cells history, for such cells are pluripotent. However, embryonic germ cells have not yet been proven as useful in research as embryonic stem cells, since they do not tend to proliferate in the same large numbers as the embryonic cells [4]. Stem cell investigators today face the critical question of whether one of the two major sorts of human stem cells, adult or embryonic, might prove to be more effective in developing therapies for those with serious conditions or whether research on both should be pursued. Once scientists have an understanding of diseased cells, they will be more successful in creating treatment options. Issues such as morality, funding, and national regulation impede scientists across the world from pursuing research possibilities related to gene therapy and stem cell research. The stem cell research is a vivacious field of science; it is an ethical, political, social and legal war zone.

2. Importance of Stem cells: Medical Perspectives

For decades, researchers have been studying the biology of stem cells to figure out how development works and to find new ways of treating health problems. This is because stem cells can give rise to any tissue found in the body; they provide nearly limitless potential for medical applications. Current studies are researching how stem cells may be used to prevent or cure diseases and injuries such as Parkinson's disease, type 1 diabetes, heart disease, spinal cord injury, and Alzheimer 's disease, strokes, burns, osteoarthritis, rheumatoid arthritis, vision and hearing loss. Stem cells are also used to replace or repair tissue damaged by disease or injury.

A. Stem Cell Therapies

It is a technique for the treatments and involves the transplantation of stem cells, organs, or other cells into

patients to improve the function of diseased or damaged tissues or organs. This area has been steadily advancing. Perhaps more than any other industry, stem cell therapies is poised to make a significant impact all over the world on public health, and many individuals living today may experience stem cell-related therapies.

The most obvious use of stem cells is in cell replacement therapies, but they are also valuable in disease modelling, drug discovery, and drug toxicity assessments. Stem cell therapies are currently being applied to over 50 diseases including heart, lung, neurodegenerative, and eye disease, cancer, and HIV [12].

B. Current Applications

There are many benefits in storing stem cells harvested from cord or adult peripheral (circulating) blood. The stem cell and cord blood stem cell research, which have been conducted both in animal studies and early human clinical trials shows that there are many benefits of stem cells in medical science and public health [13]. The research also highlights the property of stem cells as significant capabilities for growth, repair, and regeneration of damaged cells and tissues in the body.

TABLE I

Malignancies	**Inborn Errors of Metabolism**
Acute lymphocytic leukemia (ALL)	Adrenoleukodystrophy
Acute myelogenous leukemia (AML)	Bare-lymphocyte syndrome
Chronic myelocytic leukemia (CML)	Dyskeratosiscongenita
Myelodysplastic syndrome (MDS)	Familial erythrophagocyticlymphohistiocytosis
Solid Tumors	Gaucher disease
Liposarcoma	Gunter disease
Neuroblastoma	Hunter syndrome
Non-Hodgkin's lymphoma	Hurler syndrome (genetic)
Yolk sac sarcoma	Inherited neuronal ceroid lipofuscinosis
	Krabbe disease
	Langerhans'-cell histiocytosis
	Lesch-Nyhan disease
	Leukocyte adhesion deficiency
	Osteoporosis (genetic)
Hemoglobinopathies & Various Blood Disorders	**Immunodeficiency's**
Amegakaryocytic thrombocytopenia (AMT)	Adenosine deaminase deficiency (ADA or SCID-ADA)
Aplastic anaemia	Severe combined immunodeficiency (SCIDs)
Blackfan-Diamond anaemia	Wiskott-Aldrich syndrome
Congenital cytopenia	X-linked lymphoproliferative disease (XLP)
Fanconi'sanemia (genetic)	
Kostmann's syndrome (genetic)	
Sickle cell anaemia	
Thalassemia	

According to the National Institutes of Health, doctors have been using adult stem cells, the active agents in a bone marrow transplant, for over 40 years to treat leukemia, anemia, blood cancers and immune system dysfunctions. Today, there are over 70 diseases which can be treated with adult stem cells. The list of some of the diseases currently treated by stem cell is below [14]. The only proven stem cell based medical therapies which are currently available rely on adult derived stem cells from bone marrow and skin. Adult stem cells from other tissues may someday provide therapies which stimulate the body's own regenerative potential.

C. Potential Use of stem cells

It is obvious that stem cells have significant capabilities for growth, repair, and regeneration of damaged cells and tissues in the body, similar to built-in repair kit. Tissue therapies include the regeneration of bone, cartilage and organs - most notably the heart and breast. The potential of adult stem cells to impact medicine in this respect is enormous. Research is currently being conducted in the areas of brain, eye, blood, liver, bone marrow, muscles and skin stem cells [15-16].

III. RESULTS AND DISCUSSION

1. Arguments regarding the usage of the knowledge

The debate of the pros and cons of stem cell research clearly illustrates the difficulties in ethics evaluations by researchers [17].

Pros

Stem cell research can potentially help to treat a range of medical problems. It could lead humanity closer to better treatment and possibly cure a number of diseases:

- Parkinson's Disease
- Alzheimer's Disease
- Heart Diseases, Stroke and Diabetes (Type 1)
- Birth Defects
- Spinal Cord Injuries
- Replace or Repair Damaged Organs
- Reduced Risk of Transplantation

Stem cells may play a major role in cancer treatment. Better treatment of these diseases could also give significant social benefits to the individuals and economic gains for society.

Cons

- We should not mess with human life.
- Humans should not try to play God.
- Some argue that stem cell research in the far future

  can lead to knowledge on how to clone humans.

2. ES Cell debate

Human stem cell research still remains one of the widely debated topics. There is still a lot of ambiguity of surrounding this. Stem cell the therapies are not new. Doctors have been performing bone marrow stem cell transplants for decades but when scientists learn how to remove stem cells from human embryos in 1998 bot excitement and controversy ensued. Why was the debate regarding the stem cell research so intense? the reasons are cleared as [18]

- First, it was a matter of life - something impossible to measure. And in this case, researchers had to do exactly that: measure life against life.
- Both an abortion and someone dying, suffering from a possible curable disease, is a tragedy. Which have the highest value? Does a big breakthrough in the research justify the use of the method in the present?
- Would the benefits of studying abortions outweigh the costs? The choice was subjective: Nobody knows all the risks or all the possible outcomes, so we had to value it with our perception of the outcome. Perception is influenced by our individual feelings, morals and knowledge about the issue.

Second, at the time we did not know whether the research was necessary and sufficient to give us the mentioned health benefits.

Third, other consequences of the research are uncertain. Could the research be misused in the future or not? We simply do not know. All knowledge acquired, within research or other arenas may be used for evil causes in the future - it is impossible to know. The Stem cell research-debate is an example on how people value various aspects differently. It is also an example of how critics and debates can lead to significant improvements for both sides. New breakthroughs may soon bring this debate to an end. Scientists have learned how to stimulate a patient's own cells to behave like embryonic stem cells. These so-called induced pluripotent stem (iPS) cells are reducing the need for human embryos in research and opening up exciting new possibilities for stem cell therapies [19]. Although there are some controversies regarding stem cell research but we may not be ignorant about the specific issues that have made this one of the most sensitive topics of our time. Some advantages and disadvantages of human stem cell research are given below [19]:

Advantages

- It provides the medical benefits in the fields of therapeutic cloning and regenerative medicine.
- It provides the great potential for discovering treatments and cures to a plethora of diseases including schizophrenia, Alzheimer's disease, cancer, spinal cord injuries, diabetes and many more.
- Limbs and organs could be grown in a lab from stem cells and then used in transplants or to help treat illness.
- It will help scientists to learn about human growth and cell development.
- Scientists and doctors will be able to test millions of potential drugs and medicine, without the use of animals or human testers. This necessitates a process of stimulating the effect the drug has on a

specific population of cells. This would tell if the drug is useful or has any problem.

- Stem cell research also benefits the study of development stages which cannot be studied directly in a human embryo, which are sometimes linked with the major clinical consequences such as birth defects, pregnancy loss and fertility. A more comprehensive understanding of normal development will ultimately allow the prevention or treatment of abnormal human development.
- Another advantage is that it holds the key of reserving the effects of aging prolonging our lives. It has already found many treatments that help in slowing the aging process, and a bonus of further research is a possible cure for the aging altogether.
- An advantage of the usage of adult stem cells to treat the disease is that a patient's own cells could be used to treat a patient. Risks would be relatively reduced because patients' bodies would not reject their own cells.
- Embryonic stem cells can develop into any cell type within the body, and then be more versatile than adult stem cells.

Disadvantages

- The use of embryonic stem cell involves the destruction of blastocysts formed from laboratory fertilized human eggs. For those people who believe that life begins at conception, the blastocyst is a human life and to destroy it is immoral and unacceptable.
- Like any other new technology, it is also completely unknown what the long term effects of such interference with nature could materialize.
- Embryonic stem cells may not be the solution to all ailments.
- According to new research, it is used in heart disease patients. It is found that it can make their coronary arteries narrower. One drawback is that they are pre specialized e.g. blood stem cells make only blood, and brain stem cells make only brain cells.
- ES are derived from the embryos that are not patients own, and the patient's body may reject them. Truly, the controversy will continue to rage furiously.

IV. CONCLUSION

Embryonic Stem cell research is a scientific process which pertains the harvesting of embryonic stem cells and manipulating them to differentiate into an organ of desire. This research area has drawn significant scientific interest, can save lives and restores happiness and dignity to patients because of the possibility of treating debilitating diseases caused by organ failure or abnormalities.

Furthermore, the potential for stem cell therapeutics and regenerative medicine to mitigate or cure disease represents an enormous economic opportunity. However, stem cell research has also drawn significant controversies due to the ethical implications of using human embryos to harvest the stem cells. An analysis of most of the controversies raised also indicates that they lack sound ethical or scientific arguments. While the benefits of stem cell research may seem to be out of reach for the immediate future, with continued research, stem cell therapies are predicted to one day become a common treatment for degenerative diseases. In order for this field to become successful, researchers must collaborate and share limited resources. With increases in funding and continued interest from private investors, stem cell research is expected to evolve rapidly in the next decade.

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