

# Stem Cells Therapy

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**Abstract** - This paper aims to give an overview on the recent development of stem cell research. It will spotlight the classification of stem cells, methods and used materials. In addition, this paper will give insight to some applications that use stem cells in medical treatment. Research on the stem cells will give more chance to develop many scientific areas that have inquiry in the medical field. Stem cells therapy is one of the most challenging areas in the medical research. The goal of the stem cells therapy studies is to improve the human enhancement and to reduce some of the medical problems and diseases by using stem cells as a treatment. These research studies are must have an ethical values and moral criteria. This paper will highlight some of the most important areas that are successfully using stem cell therapy.

**Keywords** - *Stem cells therapy, Regenerative medicine, Tissue engineering, Damaged organs, Transplantations, Cancer therapy.*

## I. INTRODUCTION

The astonishing results that recent stem cells research studies have given the scientists more enthusiasm to continue in this field. Moreover, there is a growing literature on stem cells therapy in the medical research. In fact, there are spectacular results in the biomedical field by using stem cells as treatment to reduce some diseases. This paper will highlight four important areas in medicine that are successfully using stem cells as a treatment.

First, stem cells are biological cells that are usually found in most multi cellular organisms. In fact, the stem cells have unique properties because they can differentiate into diverse specialized cells through mitosis division. Furthermore, the stem cells can self-renew to produce more stem cells with a great potency and identification. Actually, there are two main types of stem cells. First one is embryonic stem cells which are usually isolated from inner cell mass, and the second type is Adult stem cells which are available in most body's tissues [1]. In developing stem cells that can differentiate into all types of cells and cultured in vitro these cells are called (Pluripotent cells). The great potential of the pluripotent stem cells will make a revolution in medical therapy for most critical diseases today. The characteristics of stem cells give them the ability to differentiate and transform artificially into specialized cell types through cell culture [1]. The promising for reducing most of serious diseases that we have today will

dramatically be diminished by using therapeutic cloning of embryonic stem cells. Also, the ability of the stem cells to go through numerous cycles of cell division and self renew give them the feature to play an important role in recent medical research. Moreover, the capacity of the stem cells to differentiate and specialize to any type of cells, appeal the scientists to use them in the medical field. Actually, the great advantages that stem cells have will do a huge different in the clinical application in near future.

Recent medical research studies show that stem cell therapy has the potential to dramatically change the treatment of human diseases. Actually, recent fascinating results already exist to treat some diseases such as Leukemia, breast cancer, damaged liver and others. However, stem cells therapy is still in a progress stag in order to be a professional technique for medical treatment [2].

## II. SOME APPEALING CHARACTERISTIC FOR USING STEM CELLS THERAPY

The challenges of utilizing stem cells therapy in several areas in medicine are significantly increased. Some medical research anticipates that in the near future most diseases will be diminished by using these technologies that derived from stem cells. Likewise, developing some strategies in order to make stem cell therapy a successful path in the medical field is really motivating. Furthermore, the understanding of the functional system by using stem cells in the human body is one of the most complicated challenges for the scientists. Furthermore, providing safety technologies to cure the patients and to use them in clinical applications are a quite challenging. Overall, scientists and researchers have a great opportunity to improve the human enhancement by using the stem cells therapy [3].

Important to realize that in this paper will give a brief overview for involving stem cells in the medical research in order to cure some critical diseases. In fact, the regenerative medicine is based on the embryonic stem cells illuminates to the substantial behavior of these cells for reducing numerous of diseases such as Parkinson disease, different types of cancer, damaged tissues and organs, and transplant organs [4, 5].

### III. RESEARCH GOAL

This research study aims to prove the magnificent quality of using stem cells therapy to cure a variety of medical problems. Moreover, it explains the potential effectiveness for using this technique to improve the human enhancement. The model in this study represents some of the successful areas in the medical field that are using stem cells therapy. In addition, it highlights the fundamental concept of stem cells therapy in four important aspects.

Basically, this research study has a strong scientific foundation because it based on several scientific research studies, articles, academic papers, and university library websites. As well as, the references in this paper are taken from valid academic and scientific information. Nevertheless, the difficulties that we can find about recent accurate studies in stem cells therapy, this paper has advanced references to prove the major point of using this technique.

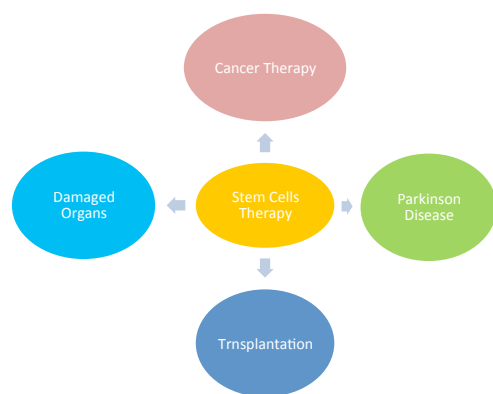


Figure 1: The scientific causal model for the most important sections that are using stem cells therapy.

### IV. THE QUALIFICATION OF USING STEM CELLS THERAPY

The understanding for the potential properties of human stem cells will lead to develop the methods for treatment that utilizing stem cells therapy. In fact, the embryonic, adult, and induced pluripotent have amazing properties that make them a sufficient choice for medical research. Furthermore, the surprising results that stem cells gave in recent medical research made them a promising path that could do marvelous changes in human treatment [10, 11].

Actually, the combination of some other fields of treatments such as the genetic therapy with the stem cells therapy is multiply the beneficial impacts for this technique. Uniquely, the adequacy for cultured embryonic or adult stem cells in vitro and reprogramming them gave them the essential potential to play an important role to improve the quality of

treatment in the medical field. Moreover, producing cells from a living system for treatment is a brilliant method to maintain the quality and design the framework of regenerative medicine [12, 13].

In addition, human pluripotent stem cells provide a great choice to treat or regenerate various types of serious illness and diseases. Therefore, the stem cells therapy represent a qualify option that reflect positively on the human medical enhancement and for the improvement of clinical methodologies [14-16].

### I. EXPLANATION/DISCUSSION OF MODEL

#### Section1: Cancer Therapy

Cancer cells are unnatural cells that start to grow out of control inside the body. In fact, these cells cause damage in DNA inside the cells and instead of repair or dispose these damaged cells as normal living system do, these damaged cells start to aggressively growing in the tissues and make tumor. In some cases such as leukemia, cancer cells do not make tumors but it spread all over the body which makes this kind of cancer difficult to treat. Usually in chemotherapy and radiation, doctors used to treat cancer with high doses of these methods which can damage or destroy the bone marrow. For this reason, the stem cell therapy is replaces the damaged cells and make regeneration and proliferation. In most oncology centers, scientists and medical researchers try to understand the structure and function of the cancer cells so they can provide better method for cancer treatment [17, 18].

In fact, cancer cells have a very similar metabolic features comparing with embryonic stem cells. Therefore, this characteristic of embryonic stem cells gives the potential to utilize them in the medical treatment for cancer [19] p. 22. Stem cells treatment has been tested in recent medical research studies and it proved the efficiency of this technique. Usually, stem cells are harvested from bone marrow of the patient themselves before they get cancer. Then, in case the patient has any kind of cancer, they can transplant these stem cells in the patient to reduce the cancer cells. Moreover, there are extraordinary results that show how scientist can use the stem cells therapy to target the cancer cells and reduce them [20, 21] [22-27].

The discovery of using stem cells to diminish cancer cells could completely change the traditional methods of treating cancer such as chemotherapy or radiological therapy. The intrinsic factors that could give the strength of using stem cells as a therapy for cancer are the unique properties in them and how manipulate cancer cells and execute them. More importantly, using the reprogramming (Pluripotent) stem cells made a huge different in cancer therapy recently. The regenerative medicine based on stem cells therapy can dramatically reduce the cancer tumor in the patient's body and manage the immune system back to normal [28].

The main goal of using stem cells therapy for cancer patient is to highly decrease the serious impacts that could happen from the traditional treatment ways for cancer. Although some complications can occur like many other

treatments, the successful progress that it does in cancer therapy makes this technique recommended. Indeed, Stem cells therapy is designed to be part of the human enhancement and to improve the quality of people life.

## Section 2: Damaged Organs (Tissue Engineering)

The great ability of stem cells to differentiate into multiple types of cells gives them exciting possibilities to enhance therapies that would be used to regenerate and repair damaged tissues and organs. In fact, stem cells isolated from the embryo, fetus, and adult and also the umbilical cord and placenta are being widely tested. Recent studies show that human fetal membranes also harbor cells with stem cell like properties [29] p. 19.” [30].

The regenerative medicine is the process of using stem cells to replace or regenerate the human cells, tissues, or organs to restore the normal function of the damaged part. In fact, the regenerative medicine plays a major role in the tissue engineering research. Furthermore, a recent study showed that multipotent renotective stem cells can be designed to treat severely damaged kidney [29, 31-34].

Stem cells therapy helps the body to heal itself. The natural properties of stem cells make them a perfect choice for treating damaged organs. Initial studies used the patient’s own stem cells that derived from their bone marrow to help them cure damaged tissues or organs. Actually, some physicians found that using stem cells therapy has successful benefits for people who have heart diseases. Some cardiologists who work in Cleveland Clinic they said that using stem cells therapy for damaged heart has been proven significant results [35, 36]. Moreover, the patients who have damaged hearts could be healed in only one week after using stem cells treatment. Overall, the recovery from damaged heart tissue after using stem cells therapy that derived from the patients themselves has been achieved. This marvelous progress gave a hope for many of patients who are suffering from damaged heart after heart attack. [33, 34, 37-39].

The innovation of using bio products of stem cells as a technique to cure different types of damaged organs is a promising method in regenerative medicine. Namely, repairing organs by using stem cells will amazingly increase the possibility of curing different types of damaged tissues and organs [40, 41].

## Section 3: Parkinson Disease

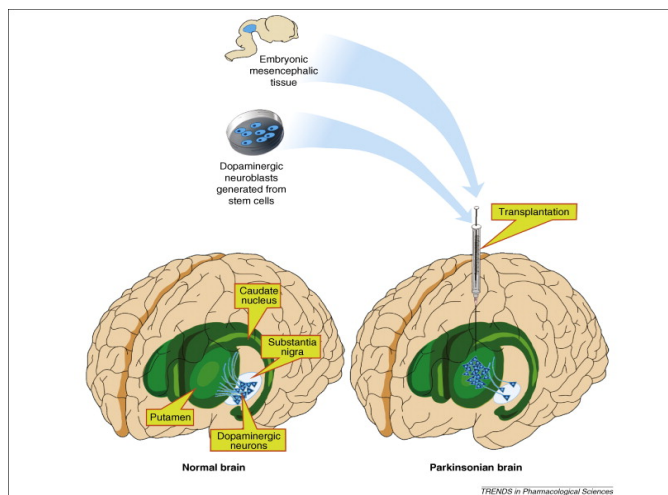
One of the most challenging areas in medicine today is the neuroscience field. Actually, the understanding of neurons in order to develop better therapies for Parkinson Disease is very important. “Parkinson” disease is the degeneration of neurons and that is reducing the controlling of the body movement. The essential aim by using stem cells therapy is to replace or restore those damaged neurons. The procedure done by taking stem cells from the adipose tissue of the patients themselves then

inject them into the patient’s spinal cord. Therefore, these stem cells will find their way up to the brain and it will migrate to the damaged area. This has been proven by the latest neuroscience studies in regenerative medicine. Furthermore, human induced pluripotent stem cells conceder as an excellent bio tool that has astonishing advantages in neurological treatment. However, improving this method to determine the degeneration in Parkinson disease is really very challenging [42] p. 25.

An interesting study is show the effectively of using stem cells therapy in Parkinson disease. The researchers are selectively taking the human Amniotic fluid from fetuses. These cells are very active and expand extensively but they are not tumorigenic. After they isolated these cells and cultured them in vitro, they injected them in the patients who have Parkinson. As a result, they found positive impacts on the patients. [43-48].

A recent research on Parkinson disease by using stem cells therapy was funded by the Harvard Stem Cell Institute Translational Neuroscience Fund, the National Institutes of Health, the Orchard Foundation, the Harold and Ronna Cooper family, the Consolidated Anti-Aging Foundation, the Poul Hansen family, the National Center for Research Resources, and the Office of Research Infrastructure Programs. This indicate to how important this technique to help Parkinson patients.

In the Scripps Research Institute in San Diego, the scientists tried to derive induced Pluripotent stem cells from fibroblasts of the shoulders. After they are engineer and culture these cells in the lab, they are transplanting it in the brain tissues in order to replace the brain damaged cells. The ambitious goal for this procedure is to relieve the movement difficulties that could happen because of Parkinson syndrome. The result was successfully satisfying [43, 45, 49-51].



Figur2: The mechanism of using stem cells in Parkinson disease

Namely, the understanding of neuroscience diseases can cure or even prevent these illnesses. In addition, using Induced

Pluripotent stem cells and inject them in the neuronal circuits will dramatically decrease the symptoms of Parkinson disease [42].

#### Section 4: Stem Cells Transplant

Stem cells transplant is a procedure that replaces the damaged cells in the patient with healthy ones. This process of stem cells transplant treats a variety of diseases such as Leukemia and other of certain cancers. Also, in some blood diseases such as Thalassemia, Aplastic Anemia, Sickle Cell Anemia, the body function does not produce enough red cells or they do not work well. Therefore, the stem cells transplant helps to maintain the healthy cells in the body. Moreover, in some immune deficiency diseases, the body prevents to produce white cells which increase the possibility of having infections or inflammation. Thus, stem cells therapy gives spectacular results on these kinds of diseases.

There are two types of stem cells transplants. The first one is autologous which is taken the stem cells from the patients themselves then use them for the transplantation. The second one is allogenic which is taken the stem cells from a donor and it has to be match with patient tissue cells then implant them in the patient [52]. Usually, the sources that are derived stem cells from them are umbilical cord blood, peripheral blood cells, and bone marrow. Currently, utilizing stem cells that derived from bone marrow have been investigated in wide variety in clinical trials and more specifically in transplantation. Some impressive impacts are shown after using stem cells therapy in different kind of transplantations. In particular, recent study has shown that the stem cells have the strongest potential to repair tissues after liver transplantation [52-54].

Mesenchyme stem cells (MSCs) are a unique type of cell present in almost all human tissues. Clinical utilization of these cells was initially based on their bone marrow (BM) supportive activity and the ability to repair bone and cartilage. However, more recent data indicate that MSCs do immunological responses through their interactions with various immune cells and participate in tissue repair via paracrine effects, such as secretion of cytokines and growth factors. Currently, MSCs that are derived from BM are being investigated in a wide variety of clinical trials, including in the field of solid organ transplantation [55].

However, the stem cells transplantation is a very complicated procedures that demand professional physicians. Also, patients who have this procedure may be have chance to have infection because their body may reject the donors stem cells especially among children. [56-61]

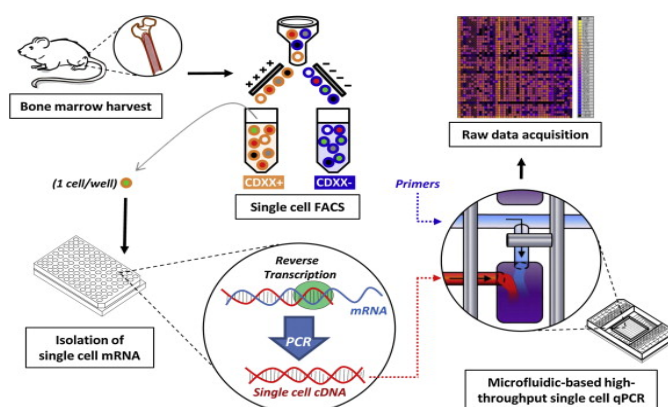
#### V. THE CHALLENGES AND FUTURE WORK IN STEM CELLS THERAPY

Stem cell therapy achieved extraordinary impacts in recent medical research studies. The understanding of the biological mechanism of the stem cells therapy, it could revolutionary

change the traditional methods of treatments. Recent advanced research in biomedical engineering, genetic engineering and biomaterial engineering found that stem cells therapy already has the potential to be an excellent choice for treatment in different medical areas. The innovative method for how to harvest, isolate, identify, grow and culture these cells make a brilliant translation for the advanced studied and transfer them to the clinical therapies [11, 62].

Although there are many of advantages of using stem cells therapy, still there are more challenges for this technology to be widely approved. The therapeutic manipulation of stem cells to utilize them in the clinical trials still need more work to be valid method.

Some future works that will use stem cells therapy are under experimental manipulation such as using stem cells in the lab on a chip technique. This new technology will dramatically transform biotechnology and pharmacology into information technology. Moreover, in near future, this intelligent technology could personalize medicine. Most importantly, scientists will diminish the possibility of diseases that people could have and make people more healthy [3, 11, 62, 63]. Another application is drug delivery and bioengineered scaffold which are show great results in treatment and wound healing.



Figur3: Utilizing Stem Cells in the Biotechnology- Lab o Chip

#### VI. EXPLANATION/DISCUSSION OF MODEL

The model gives a brief notion about the most important medical areas that use stem cells as a therapy. Furthermore, these medical areas are making the reader thinking how important the stem cells therapy in different aspects in the medical field. In addition, most of figures that are used in this paper are taken from valid scientific research studies. Each section in the model evaluates the efficiency of using stem cells therapy for different diseases. Basically, the model shows the most important areas that successfully used stem cells therapy.

## VII. NEW INSIGHT

The astonishing potential of the stem cell therapy will revolutionize the modern medicine. In fact, with all outstanding impacts that scientists and researchers already have now, they will ultimately improve the stem cells therapy to be more efficient. Furthermore, the challenges for using stem cells therapy based on biotechnology will increase the chance for having more adequacies in treatment. Overall, stem cell therapy is a promising path to treat variety of diseases in the near future.

However, while stem cells therapy is a very promising technique that will definitely improve the quality of human life, it is ethically questionable in some cases—modifying fetuses for instance. Overall, scientists should have ethical principles, valuable criteria, and lofty goal to improve the human health.

## VIII. CONCLUSION

In summary, using stem cell therapy in different medical areas such as cancer, damaged organs, Parkinson disease, and transplantation will change the traditional methods of treatment. Moreover, there is no doubt that stem cells therapy has enormous potential to make significant contributions in medicine over the next decade. All kinds of stem cells embryonic, adult, and induced pluripotent stem cells (iPS) have the extraordinary properties to treat variety of diseases. Stem cell therapy is a brilliant path that can build a strong bridge for the human healthcare and a sophisticated method to enhance the quality of people life.

## AUTHORS BIOGRAPHY

Sukainah Al Hajji holds a Bachelor of Science degree in Biology from King Faisal University. Currently, she's a graduate student in Biomedical Engineering at University of Bridgeport.

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