IJBPAS, January, 2016, 5(1): 285-294

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

# THE ROLE OF STEM CELLS IN RESTORATION AND PREVENTION OF BRAIN TUMOR

**MEHDI GHARBAGHI**

**Faculty of Medicine, Department of Neuroscience, Tehran University, Tehran, Iran**

gharbaghimehdi@gmail.com

## ABSTRACT

Stem cells are non-specialized cellsin the human body which they can convert into cells with special application. A good example of a stem cell is the stem cell of marrow which is a non-specialized cell and tends to differentiate into blood cells such as erythrocytes and leukocytes. The new cells include special functions such as producing antibodies, preventing the creation and spread of infection, and transferring blood gases. Since, the remaining part of an organ should be able to undertake all duties of that organ, it is needed the surgery to be performed as the healthy part can proliferate and perform the function of a healthy organ.Thus, theremainder part needs at least 6 weeks for proliferating, but the stem cell transplantation causes the necessary time for proliferating to be reduced to 2 weeks. This function can also be applied regarding brain cancers which it is the topic of this study. In fact, the study assesses the role of stem cells in restoration and prevention of brain tumors; in other words, it is attempted to show the application of stem cells for restoration and prevention ofbrain tumors and their impact on treatment of brain cancers.

**Keywords: Stem cells, brain tumor, cancer, metastasis**

## INTRODUCTION

Cancer begins in cells that are structural components of the tissue. Tissues make up organs. Normally, cells grow and are divided in necessary time to make up new cells. When the cells grow old, they die and new cells take their place. Sometimes, this normal process gets in problem, so that the new cells are produces when there is no need to them

and the old cells do not die in time. These additional cells can create a large tissue which is called malignity, cancer, or tumor.

The benign tumors are not cancerous, they are rarely life-threatening, and it is possible to remove them without re-growing. Also, they do not attack to adjacent tissues and are not scattered in other parts of the body (Wei HM, Wong P, 2009). The malignant tumors arecancerous, they can be life-threatening, and it is often possible to remove them, but sometimes they re-grow. Also, they often attack to adjacent tissues and damage them as well as they can be scattered in other parts of the body. The cancer cells are separated from primary tumor andenter the circulationor lymphatic system. The cells can attack to other tissues and create new tumors which can damage the tissues. The spread of cancer is calledmetastasis. Most cancers are named from where they started.

It should be noted that stem cells let the patient to get treated with high doses of the drug, irradiation, or both of them. High doses of drug cause the damage of leukemia cells andnormal blood cells in the bone marrow. After receiving high doses of chemotherapy,radiation therapy, or both of them, the patient receives the healthy stem cells through a large vein similar to what is done in blood transfusion. The new blood cells are formed from transplanted stem cells. The new cells are replaced with damaged ones.

The transplantation of stem cells is performed in hospital. The stem cells might be received from the patient or the other person who has granted his stem cells to the patient.Stem cells are provided from few resources such as blood, bone marrow, or umbilical cord. The blood of umbilical cord is obtained from a newborn baby and is stored in a freezer. When the transplantation is performed through receiving the blood of umbilical cord, it is called the cord blood transplant (Chen CP, Lee YJ, 2006).

**Main Body**

Each embryo includes millions of stem cells which total size is not bigger than a point. The cells contain high potential and can convert into tissues of different organs. The high potential of these cells have caused them to be placed at the center of medical research. Picture that the cells couldbring back memories of Alzheimer's patients, restore the skin damaged due to an accident, enable disabled patients to walk, and even be used for restoration of brain tumors. All mentioned capabilities have ledthe researchers to believe that the future of health and medicine depends on stem cells.

The embryonic stem cells finally convert into different cells, tissues, and organs of embryo. In spite of normal cells which can only produce the cells of their types through proliferation, the stem cells are multifunctional and powerful and can convert into any type of cells through proliferation. In fact, these cells do not have specific tasks in the body and they are waiting for their roles to be specified; in other words, stem cells are waiting for the signals to dictate them what to do (Aranda P, Agirre X, 2009).

There are different reasons for stem cells being important. For example, in a 3-5-day-old embryocalled a blastocyst, a small group of stem cells called "inner cell mass" causes hundreds of specialized cells required for creating an organism to be emerged. In some matured tissues such as marrow, muscles, and brain, discrete populations of matured stem cells produce replacements for cellslost due to natural death, injury, or illness. Scientists believe that stem cells will be used as the bases of future treatments regarding diseases such as Parkinson, diabetes, and heart diseases.

The symptoms of brain tumors appearat different ages and in variousforms which the most commonsymptoms are eye disorders. In such cases, usually the patients refer to eye andoptometry clinics. Therefore, understanding ocular symptoms and guessing brain lesionscan be helpful for timely detection of disease and can partly avoid its irrecoverable effects.

In a study done by Smith and Kennedy regarding 45 patients with Craniopharyngioma, a tumor with embryo origin and located in sellaturcica (Turkish Saddle) part, 50% of patients had referred to the eye clinic for the first time and their major problem especially adult patients' problem was reduction of visibility and optic atrophy. However, the brain tumors with symptoms of increased intracranial pressure causeoptic pathway and lead to papilledema and other visual symptoms. Assessing the role of stem cells in restoration and prevention of brain tumor has shown that the process of differentiation helps for stem cells to perform different tasks in the body. Stem cells are divided into 3 following groups based on their ability of differentiation (Ioaninis D, 2005):

1. **Totipotent cells:** these cells include ultimate capacity and can be converted into different types of cells such as embryonic membranes cells, cells in the body, and primary embryonic stem cells.
2. **Pluripotent stem cells:** these cells can be converted into most, but not

all tissues of an organism such as inner cell mass of an embryo at blastocyst stage.

**Note:** two mentioned groups are called embryonic stem cells, because they only exist in embryo (Oishi K, Kobayadhi I, 2006).

3. **Multipotent stem cells:** these cells can only be converted and evolved into multi potent cells, a group of cells including similar functions such as hematopoietic stem cells. These cells arealso called adult stem cells, because they exist in human or beasts after birth too.

The hypotheses of this study are formed based on the topic "the role of stem cells in restoration and prevention of brain tumor" and include the follows:

**Main hypothesis:** There is a significant relation between the use of stem cells and preventing brain developments.

**Sub-hypotheses:**

**First hypothesis:** there is a significant relation between stem cells and restoration of cancerous organs.

**Second hypothesis:** there is a significant relation betweenthe use of stem cells and reductionof the time needed to heal cancers.

**METHODOLOGY**

In this research, 80 patients with brain tumor who had undergone surgeryusing stem cells in department of neurosurgery of Iran mehr hospital were studied. The information obtained from patients' records,description of operation, and the results of pathology were assessed. The patients who had undergone surgeryseveral times were deleted from the study, because it was likely that thesurgical manipulations were involved in the symptoms. Also, the patients with brain tumor who did not undergo surgery due to their deterioration were deleted. Therefore, after assessing the records of 150 patients, only 80 patients were qualified. Thus, the required data were collected and analyzed.

**Data collection tools**

In this study, according to the variables, a questionnaire was provided and distributed among the population to collect required data of the research.

A questionnaire includes some questions which are developed based on the certain principles and are delivered to individuals in written form. The respondents write the answers according to their diagnoses. The objective of questionnaire is to obtain certain information regarding a specific issue. The size of studied population is a determinant factor for applying the questionnaire and it can help for studying larger samples. The

quality of questionnaire is very important for obtaining accurate and extensible information.

**Data analysis method**

The method used for analyzing the data should be a combined and conceptual method. Here, SPSS software is used to achieve this goal. Therefore, the variables are analyzed by SPSS.

**Discussion and results**

To determine the role of stem cells in restoration and prevention of brain tumors, firstly 80 patients with tumors were selected and divided into 2 groups: a control group and an experimental group. Experimental and control groups include the patients treated with and without stem cells, respectively.

Table 1 interpretation: according to above table, 62.5% and 37.5% of patients in control group are male and female, respectively. The value of mode is reported equal to 1 which it shows the highest frequency for men. In other words, the mode index is a central index which determines the maximum frequency of a distribution. Here, the maximum frequency is reported for men.

**Testing hypotheses**

**Main hypothesis:**there is a significant relation between the use of stem cells and preventing brain developments.

$H_0$:There is not a significant relation between the use of stem cells and preventing brain developments.

$H_1$:There is a significant relation between the use of stem cells and preventing brain developments.

Here, to compare the experimental and control groups regarding the use of stem cells and preventing brain developments, firstly, t-test for independent groups is used, and then the difference between the average values is interpreted. The equality of variances is needed to use t test; hence, Levene's test is firstly used to determine the equality of variances.

According to table 2, the values of F test and P-value shows that the equality of variances is realized at 99% confidence level.

Table 3 interpretation: brain developments of experimental and control groups are compared with each other. According to table 3, it is resulted that the difference is significant at 99% confidence interval. In other word, the $H_0$ hypothesis is rejected and the researcher's hypothesis is accepted. Therefore, there is a significant relation between the use of stem cells and preventing brain developments.

**Testing sub-hypotheses**

**First hypothesis:** there is a significant relation between stem cells and restoration of cancerous organs.

$H_0$: There is not a significant relation between stem cells and restoration of cancerous organs.

$H_1$: There is a significant relation between stem cells and restoration of cancerous organs.

Here, to compare the experimental and control groups regarding the use of stem cells and restoration of cancerous organs, firstly, t-test for independent groups is used, and then the difference between the average values is interpreted. The equality of variances is needed to use t test; hence, Levene's test is firstly used to determine the equality of variances.

According to table 4, the values of F test and P-value shows that the equality of variances is realized at 99% confidence level.

Table5 interpretation: the restorations of cancerous organsbetween experimental and control groups are compared with each other. According to table 5, it is resulted that the difference is significant at 99% confidence interval. In other word, the $H_0$ hypothesis is rejected and the researcher's hypothesis is accepted. Therefore, there is a significant relation between stem cells and restoration of cancerous organs.

**Second hypothesis:** there is a significant relation between the use of stem cells and reduction of the time needed to heal cancers.

$H_0$:There is not a significant relation between the use of stem cells and reduction of the time needed to heal cancers.

$H_1$:There is a significant relation between the use of stem cells and reduction of the time needed to heal cancers.

Here, to compare the experimental and control groups regarding the use of stem cells and reduction of the time needed to heal cancers, firstly, t-test for independent groups is used, and then the difference between the average values is interpreted. The equality of variances is needed to use t test; hence, Levene's test is firstly used to determine the equality of variances.

According to table 6, the values of F test and P-value shows that the equality of variances is realized at 99% confidence level.

Table 7 interpretation: the reductions of the time needed to heal cancers between experimental and control groups are compared with each other. According to table 7, it is resulted that the difference is significant at 99% confidence interval. In other word, the $H_0$ hypothesis is rejected and the researcher's hypothesis is accepted. Therefore, there is a significant relation

between the use of stem cells and reduction of the time needed to heal cancers.

**The results of research hypotheses**

- There is a significant relation between stem cells and preventing brain developments.

Here, to compare the experimental and control groups regarding the use of stem cells and preventing brain developments, firstly, t-test for independent groups was used, and then the difference between the average values was interpreted. The equality of variances was needed to use t test; hence, Levene's test was firstly used to determine the equality of variances.

Also, the brain developments of experimental and control groups were compared with each other. According to the values of t-test and the observed error it is resulted that the difference is significant at 99% confidence interval. In other word, the $H_0$ hypothesis is rejected and the researcher's hypothesis is accepted. Therefore, there is a significant relation between the use of stem cells and preventing brain developments.

- There is a significant relation between stem cells and restoration of cancerous organs.

Here, the restorations of cancerous organs between experimental and control groups were compared with each other. According to t-test and the observed error, it is resulted that the difference is significant at 99% confidence interval. In other word, the hypothesis$H_0$ is rejected and the researcher's hypothesis is accepted. Therefore, there is a significant relation between stem cells and restoration of cancerous organs.

- There is a significant relation between the use of stem cells and reduction of the time needed to heal cancers.

Here, to compare the experimental and control groups regarding the use of stem cells and reduction of the time needed to heal cancers, firstly, t-test for independent groups was used, and then the difference between the average values was interpreted. The equality of variances was needed to use t test; hence, Levene's test was firstly used to determine the equality of variances. According to t-test and the observed error, it is resulted that the difference is significant at 99% confidence interval. In other word, the hypothesis$H_0$ is rejected and the researcher's hypothesis is accepted. Therefore, there is a significant relation between the use of stem cells and reduction of the time needed to heal cancers.

Substantive progress in stem cells sciences is very promising. Hematopoietic stem cells have caused the treatment of hematological disorders and cancers to be improved

significantly. The researches around the world are working hard to apply the stem cells for treatment and diagnosis of incurable diseases through better identification of stem cells. Scientists are working on new methods to accelerate applying the stem cells for treatment of incurable diseases.

Thus, it is suggested to discover the greater efficiency of stem cells through extensive studies on animal models. Although, long time is needed to use stem cells practically, the researchers and scientists are hopeful about their future. Also, it is suggested that the studies on stem cells be focused on incurable diseases such as spinal cord injuries, diabetes, heart diseases, Parkinson, Alzheimer, and arthritis.

**Table 1: frequency distribution by gender of control group**

| variables | Frequency | Frequency percentage | Valid Percentage | Mode |
|---|---|---|---|---|
| Male | 25 | 62.5% | 62.5% | 1 |
| Female | 15 | 37.5% | 37.5% | |
| Total | 40 | 100% | 100% | |

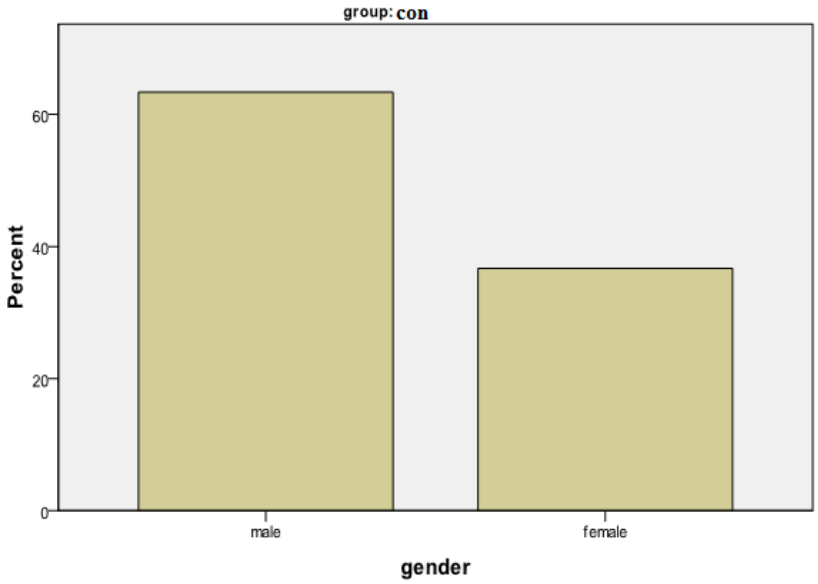


**Figure 1: Frequency distribution by gender of control group**

**Table 2: Levene's test to determinetheequality of variances**

| Variable | F test | P-value |
|---|---|---|
| Prevention of brain development | 13.901 | 0.000 |

**Table 3: the estimation of t-test for independent groups**

| Variable | t-statistics | Freedom degree | P-value |
|---|---|---|---|
| Stem cells and prevention of brain development | 15.605 | 78 | 0.000 |

**Table 4: Levene's test to determine the equality of variances**

| Variable | F test | P-value |
|---|---|---|
| Restoration of cancerous organs | 61.725 | 0.000 |

**Table 5: the estimation of t-test for independent groups**

| Variable | t-statistics | Freedom degree | P-value |
|---|---|---|---|
| stem cells and restoration of cancerous organs | -11.644 | 78 | 0.000 |

**Table 6: Levene's test to determine the equality of variances**

| Variable | F test | P-value |
|---|---|---|
| The time needed to heal cancers | 14.553 | 0.000 |

**Table 7: the estimation of t-test for independent groups**

| Variable | t-statistics | Freedom degree | P-value |
|---|---|---|---|
| The comparison of the time needed to heal cancers | 11.092 | 78 | 0.000 |

## CONCLUSION

In this study, the role of stem cells in restoration and prevention of brain tumors was assessed. It was concluded that these cells include high potential for being used regarding cancerous cells. Such capability has caused the researchers to pay attention to the power of these cells in tracking secondary cancer cells and preventing metastasis. In addition, the use of stem cells for tumors treatment provides the possibility of chemotherapy with high dosesfor patients without adverse effects to other organs.

According to New Scientist, Karen Aboodi *et al*. have managed to produce cytosine deaminase through changing the genetic structure of neural stem cells derived from human embryos.Thisenzyme can convert the inactive material of 5-fluorocytosine into an active chemotherapy drug called 5-fluorouracil.

In fact, the team injected genetically modified stem cells into the brain of mice with a type of malignant tumor, and then 5-fluorouracil was given to them. The size of mice tumor was reduced up to 70% in comparison with other mice.

Also, FDA (U S Food and Drug Administration)has agreed with safety test on maximum 20 patients with regressive Glioma. These patients' life expectancy is not more than 3-6 months. The stem cells will be injected into the cavity resulted from previous surgeries done for reducing the size of tumor. After 4 days, the patients will receive 5-fluorouracil every day for a week.

In some cases, cancer cells penetrate deep into normal brain cells; as a result, the metastasis occurs. Aboodi hopes that their method can prevent the return of tumor.

### Total results of the research

1. The causes of most tumors are unknown.
2. The tests used for examination of the brain and spinal cord can be uses for diagnosis of brain and spinal cord tumors as well.
3. Some tumors can be identified throughimaging experiments and

specific factors affect the probability of recovery.

4. Stem cells can be used for treatment of liver disease, but they might lead to liver cancer too.
5. The stem cells used for PBSCT (Peripheral Blood Stem Cell Transplant) are obtained from blood. The process of apheresis (the removal ofleukocyte) is used for obtaining PBSC for transplant.
6. After injection of stem cells into the blood flow, they enter marrow where they beginto produce Leukocyte, erythrocytes, and platelets through the process of engraftment.
7. Recurrence of breast cancer can be resulted from newly discovered stem cells.
8. The efficiency and effectiveness of cancer treatment can be evaluated due to the size of removed tumor. However, the remainder stem cells can be activated and create a new tumor.