

# The biology of neural stem cells essay sample



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Stem cells are originally defined in the haematological system, but recently have been found in a multitude of other sites. These cells all share the same features of self-renewal and multipotentiality and different types and therapeutic strategies have been defined with respect to the nervous system.

There are three known accessible sources of autologous adult stem cells in humans: Bone marrow, Adipose tissue (fat cells) and Blood. Stem cells or mother cells have the remarkable potential to develop into many different cell types in the body. Serving as a form of remedy system for the body.

When a stem cell divides, each new cell was the prospective to either remain a stem cell or become another type of cell with a more specialized function, such as brain cells. Stem cells differ from other kinds of cells in the body. All stem cells in any case of their source have three general properties:

Capable of dividing and renewing themselves.

Unspecialized; and they can give rise to specialized cell types.

Unlike blood cells and nerve cells - which is not normally replicated themselves - stem cells may replicate many times.

New insights into the biology of neural stem cells (NSCs) have advanced expectations for their utilize in the therapy of neurologic diseases. NSC transplantation was propose as a means of substitute cells in central nervous system diseases that result in cell loss. Neurodegeneration is the cumulative loss of structure and function of neurons, including death of it. Many

neurodegenerative diseases including Parkinson's and Alzheimer's occur as a result of neurodegenerative processes.

One of the landmark events in neuroscience research was the establishment of neural stem cells (NSCs) as a life-long source of neurons, a concept that smash the tenet that the nervous system lacked regenerative power. Stem cells endure the pliability to generate and repair nervous system function.

So, the present state of the art focuses on three objectives:

(1) to provide a review on the different types of stem cells and how they have been applied to neurological disease in general,

(2) to synthesize information on understanding Alzheimer's disease and Parkinson's disease through the investigation of the rare, clearly inherited forms of these diseases and

(3) to synthesize further important discoveries and novel therapies based on the application of these powerful cells.

## INTRODUCTION

Neurodegenerative diseases affect so many people worldwide, Alzheimer's disease and Parkinson's disease are the most normal types. More than five million people are living with Alzheimer's disease, and at least 500, 000 one live with Parkinson's disease, although some estimates are much higher.

Neurodegenerative diseases occur when nerve cells in the brain or peripheral nervous system lose function over time and ultimately die.

Although treatments may help relieve some of the physical or mental

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symptoms associated with neurodegenerative diseases, there is currently no cure or way to slow disease progression. It is an understatement to say that practical applications of stem cell research have been game changers for the field of neuroscience. When the term “ stem cell” was used 25 years ago, the context was typically adult tissue homeostasis and mouse genetics. Today it would be difficult to consider adult neurogenesis without reference to endogenous neural stem cells. Neural stem cells (NSCs) are capable of self-renewing, proliferating, and differentiating into cells of the neural lineage, including neurons and oligodendroglia.

While the neurological deficits from congenital lesions may not be completely docile to any sort of medical therapy, stem cells may offer a regeneration of neurons from the place where the growth has stood.

Scientists have been working on the process of utilizing stem cells to accomplish the damaged cells. (Gore A. et al., 2013; Yoo J. et al., 2011) the recent advances in cultivation of human embryonic stem cells and the recognition of plasticity in the human nervous system have created new visualizations into the possibility of using stem-like cells to treat neurological conditions. Though at present, very little experimental work has the potential to reach clinical trial level, there is substantial evidence to believe that stem cells can act as recovery of damaged neurons by reducing inflammation.

Stem cells have the ability to produce neurotrophic or immunosuppressive factors thus forming a convenient milieu for brain tissue repair and long-term survival of transplanted cells in the central nervous system (Lescaudron L. et al., 2012). In animal studies, benefits of stem cell-mediated gene transfer of

therapeutic genes such as neurotrophic factors and enzymes have been demonstrated (Kim Su. et al., 2013). Overall, neural progenitor/stem cells present a promising therapy strategy in the treatment of various neuronal diseases.

## STEM CELLS

Stem cells load a great expectation for treating different neurological diseases, due to its ability to maintain self – renewal and differentiate to various cell types. This ability to mature and differentiate to different phenotypes contains composite events which can be affected by various regulatory molecules (Tohill M. et al., 2004). Non-neuroectodermal stem cells as bone marrow, blood and dental pulp can induce neurogenesis when attached along with neural stem cells.

The neuro-regenerative influence of stem cells can be through a number of mechanisms.

Stem cells can act through inducing endogenous neurogenesis and angiogenesis through its tropic effects (Huang WH. et al., 2013).

Mesenchymal stem cells (MSCs) in addition to its alteration ability can secrete neuroregulatory mediators that aid in neurogenesis, immunomodulation, inhibition of apoptosis and glial scar formation, neural as well as glial cell survival and lastly neuroprotective activities on different levels. This effect can be activated by secretomes which also improve integration of local progenitor cells in neuroregeneration process opening the access for its upcoming therapeutic application (Glavaski-Joksimovic A and Bohn MC. 2013).

Human mesenchymal stem cells (MSCs) are adult stem cells, which have the capability for multi-lineage differentiation, open-handed increase to a variety of mesenchymal phenotypes such as osteoblasts (bone), adipocytes (fat), and chondrocytes (cartilage). Mesenchymal stem cells generally reside in the bone marrow stroma, but have also been found in adipose, liver, peripheral blood, umbilical cord blood, and other mesenchymal tissues. Owing to their ability for self-renewal over long periods of time and the ability to differentiate into specialized cells, interest in understanding the biology of MSC cultures has improved, especially for their therapeutic potential for a variety of diseases.

## 2. 1 CLASSIFICATION OF STEM CELLS ON THE BASIS OF POTENCY

Stem cells can be categorized by the ambit to which they can differentiate into different cell types. These four main categorizations are totipotent, pluripotent, multipotent and unipotent.

2. 1. 1 Totipotent The ability to differentiate into all probable cell types.

Examples are the zygote formed at egg fertilization and the first rare cells that result from the division of the zygote.

2. 1. 2 Pluripotent The ability to differentiate into almost all cell types.

Examples contain embryonic stem cells and cells that are resulting from the mesoderm, endoderm, and ectoderm germ layers that are formed in the beginning stages of embryonic stem cell differentiation (Thomson JA. Et al., 1998).

2. 1. 3 Multipotent

The ability to differentiate into a strictly related family of cells. Examples include hematopoietic (adult) stem cells that can become red and white

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blood cells or platelets.

#### 2. 1. 4 Unipotent

The ability to only produce cells of their own type, but have the property of self-renewal wanted to be labeled a stem cell. Examples contain (adult) muscle stem cells.

#### 2. 1. 5 Oligopotent

The oligopotent stem cells are similar to the prior category multipotent stem cells but they become further restricted in their capacity to differentiate (Shamblott MJ. Et al., 1998).

### 2. 2 CLASSIFICATION OF STEM CELLS ON THE BASIS OF THEIR SOURCES

The easy way to classify stem cells is by dividing them into two types: Early or embryonic and mature or adult. Early stem cells, often named embryonic stem cells, are found in the internal cell mass of a blastocyst after nearly five days of development. Mature stem cells are found in specific mature body tissues as well as the umbilical cord and placenta after birth (Jones EA. et al., 2002).

#### 2. 2. 1 Embryonic stem cells

Embryonic stem cells are self-replicating pluripotent cells that are actually deathless (Roszek K and Czarneka J (2014). They are derived from embryos at a developing period before the phase of implantation would normally occur in the uterus (Avasthi, R. N. et al ., 2008). The main roles of adult stem cells in a living organism are to keep and renovate the tissue in which they are found. Unlike embryonic stem cells, which are well-defined by their origin. The origin of adult stem cells in certain mature tissues is still beneath investigation.

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## 2. 2. 2 Pluripotent stem cells

Recently, a third type of stem cell, with properties parallel to embryonic stem cells, has emerged (Ulloa-Montoya. et al., 2005).