

## Stem Cells Cure for Brain Injury: A Novel Method to Cure Brain Trauma

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**Citation:** Kumar PKR, Alukal A. (2020) Stem Cells Cure for Brain Injury: A Novel Method to Cure Brain Trauma. J Stem Cell Res. 1(1):1-11.

**Received:** May 14, 2020 | **Published:** June 01, 2020

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### Abstract

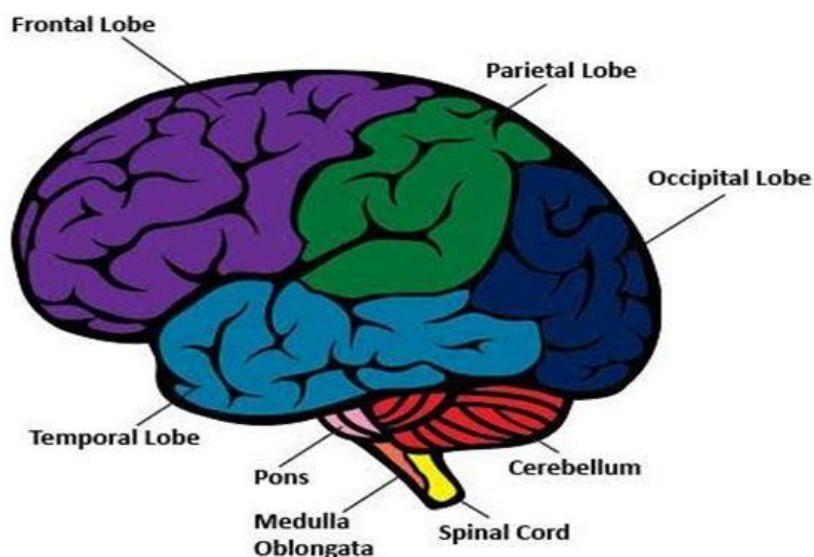
Brain injury has been a major problem to cure, because of its complications in its nerve and cells surrounding it. They pose problem in finding relevant treatment. The complications ensure no effective improvement in neural structure cells and functional recovery of cells. Brain injury is usually lose of white matter, atrophy, neurological impairment. It may cause focal loss, hearing impairment and also loss of sense. These are hallmark brain injury with no cure in sight. Hence stem cells forms highly effective method for cure of major injury in brain. This chapter will discuss exclusively on stem cells and its effect on brain injury.

### Keywords

Neural stem cells; Traumatic brain injury; Parkinsons disease

## Introduction

Brain injury is a worldwide catastrophe. It remains global health problem with limited treatment options. Figure 1 shows parts of brain [1]. The brain consists of cerebrum, cerebellum and medulla oblongata. Many injuries occur in brain. Disorders such as stroke, traumatic brain injury, Parkinson's disease are frequent occurrence in many patients. These disorders pose health issues and succumb to economic liability to an individual [2]. With very limited therapeutic options, hope of sustainable treatment is an issue in research for gene therapy and other novel approaches. Hence an emphasis is placed on stem cell research for spearheading the field of regenerative medicine [3].

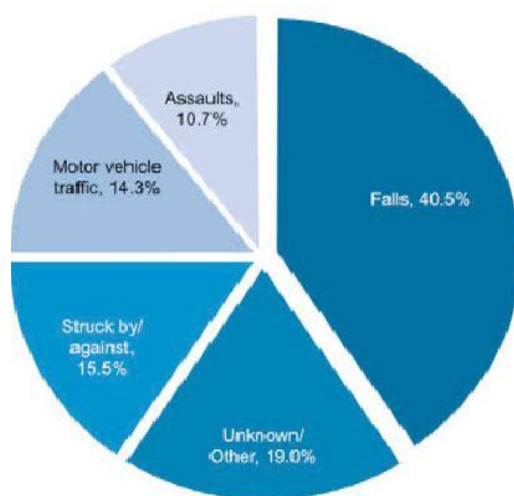


**Figure 1:** Parts of brain.

This therapy promises a future of neuroregenerative capabilities. They help initiating clinical research methodologies, potential cure combinations along with ethical procedures from table to in vitro. Below figure shows the percentage of brain injury caused in human [3].

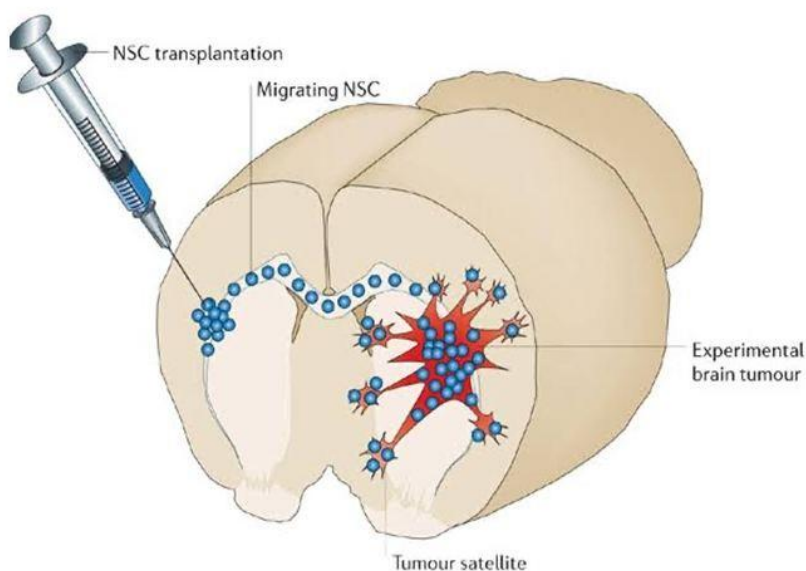
## Neural Stem Cells

There are two methods for modulating neural stem cells, one exogenous and another endogenous neural stem cells [4]. Recent study reveals the existence of multipotent neural stem cells in certain regions of brain. They help in generating glia cells (Figure 2).



**Figure 2:** Leading causes of TBI.

Further research suggests, the endogenous and exogenous cells play regenerative roles in tune with the central nervous system. Below figure shows grafting neural stem cells in brain [5] (Figure 3).

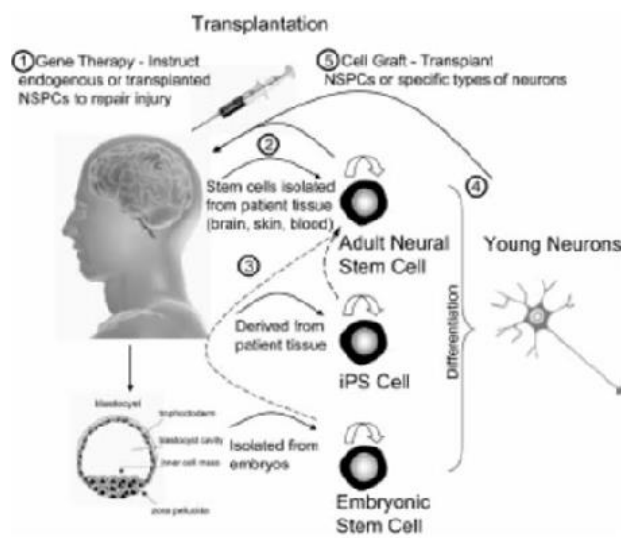


**Figure 3:** Grafting neural stem cells in brain.

In heightened response to these therapies, cell proliferation and neurogenesis has been an highlight. This also suggests that brain has responded to trauma and restored the damaged part [6]. This success

in treatment has urged scientists to further their research in traumatic injuries such as Parkinson's disease and other neurodegenerative diseases [7].

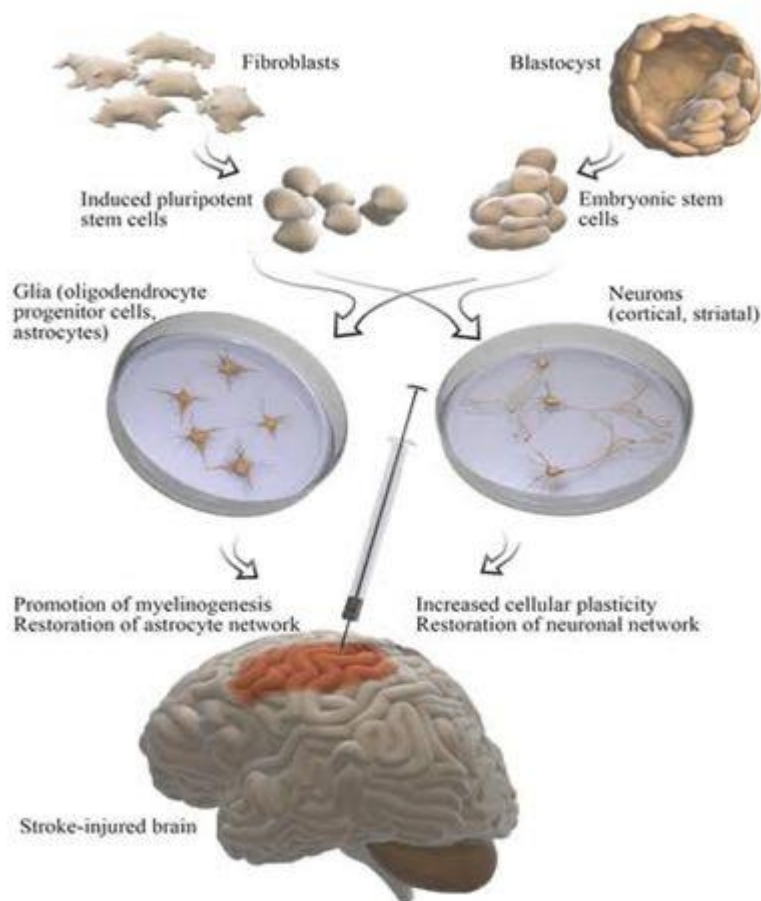
The potential of the transplanted cells is to differentiate into regional specific cells and also to combine with host tissue to replace cells in the injured sites. Alternatively they also provide neurotransmitters to facilitate the host tissue for regeneration. (Figure 4) shows neural stem cells transplantation [8].



**Figure 4:** Neural stem cells transplantation.

## Brain Injury Therapy

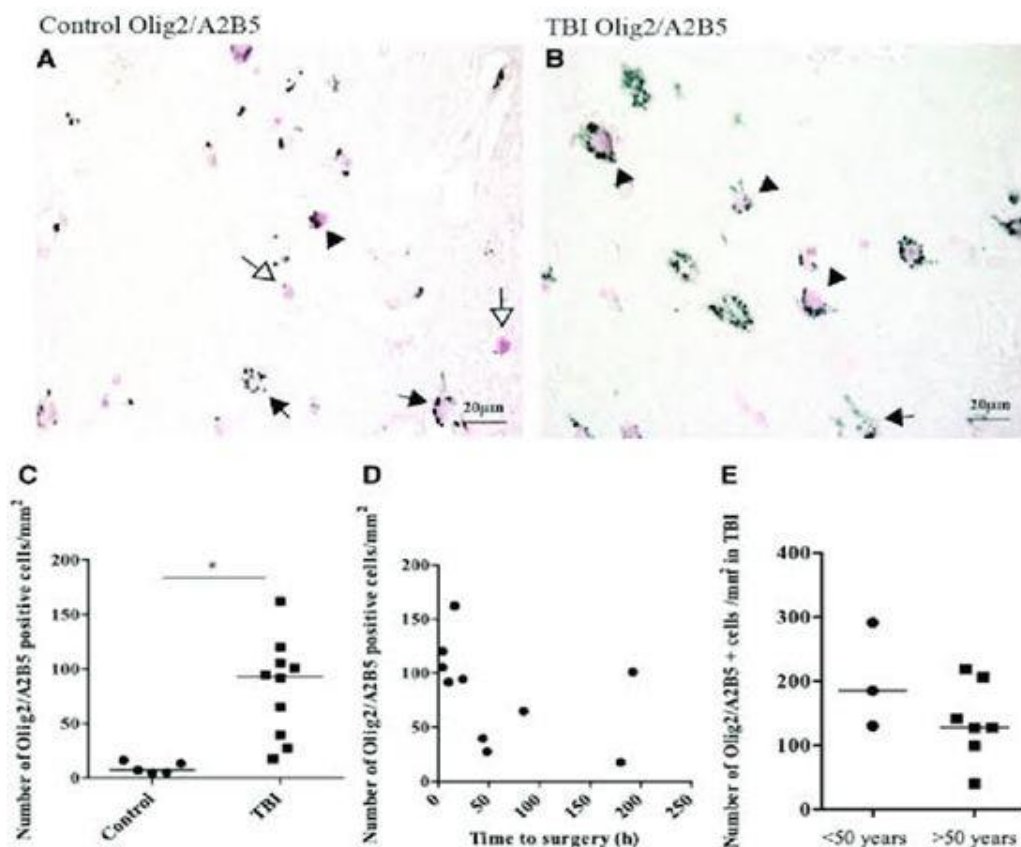
Systematic review in treatments and results, yields potential treatments in diminished sites of brain cells [9]. Therapies combining stem cell transplants have produced amicable solutions and also helped in combination of drugs to take part in effective cure to damaged brain cells [10]. Brain injury generally opens up to research of therapeutics. Specific hormones have functions that benefit cells when combined with stem cells. Various central nervous system disorders are penchant to anti-inflammatory effects. They also encourage the proliferation of progenitor cells and improve traumatic brain injury (Figure 5).



**Figure 5:** This indicates working of progenitor cells (glia) in repairing brain injury [11].

### Endogenous- Exogenous Endothelial Progenitor Cells

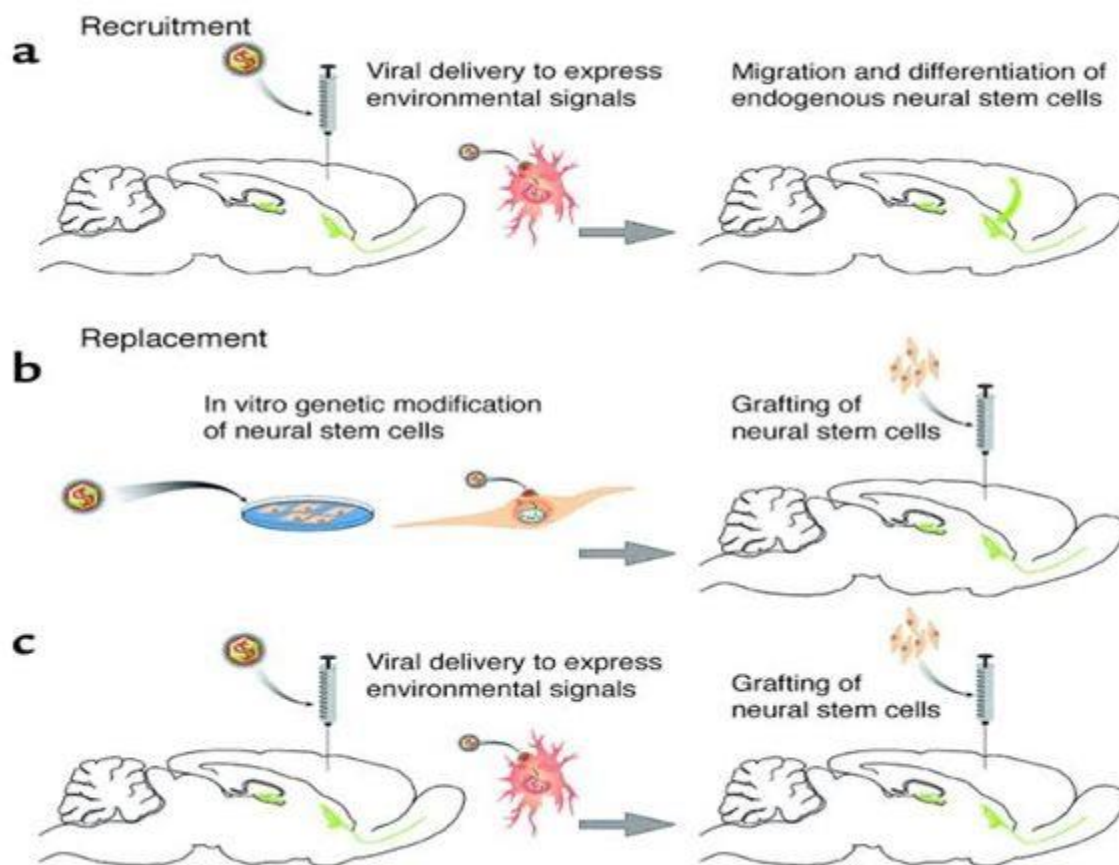
Neuroregeneration promotes progenitor cells for repair of brain cells. In vitro model of testing, rats were injected with endothelial progenitor cells (EPC), results show they expressed enhanced vessel density, occludin expression, reduced edema and increased blood brain barrier integrity [12]. Moreover the progesterone present in barrier reverses integrity as they form facilitator of EPC for brain repair. To further this theory another set of experiments were conducted, results prevailed [13]. Combine together these experiments indicate progesterone help in stimulating regeneration of stem cells in brain injury for cure. Below graph shows different studies in brain injury [14]. Various levels of brain injury and age category [15].



**Graph 1:** The above graph indicates the number of progenitor cells present before and after control, at time of surgery and age factors

### MSC Enhance Erythropoietin (EPO) Hormones

MSCs help in producing enhanced hormones called erythropoietin. These hormones occur naturally and help in reducing blood cells which in turn helps in curing brain injury [16]. It has neurotrophic, angiogenic and anti-inflammatory effects. Tested in vitro using mouse models, EPO combined by MSC churned an enhanced cell proliferation, glial cell activation and increase in vessel density. Figure 6 helps us understand NSC work in brain injury [17].

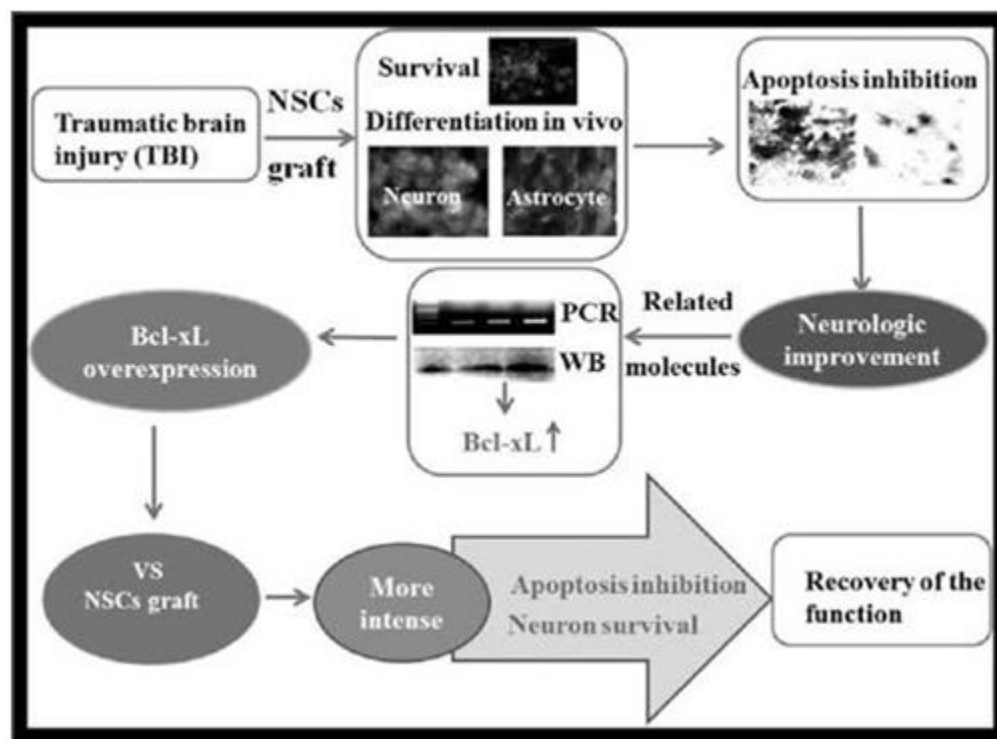


**Figure 6:** NSC work in brain injury.

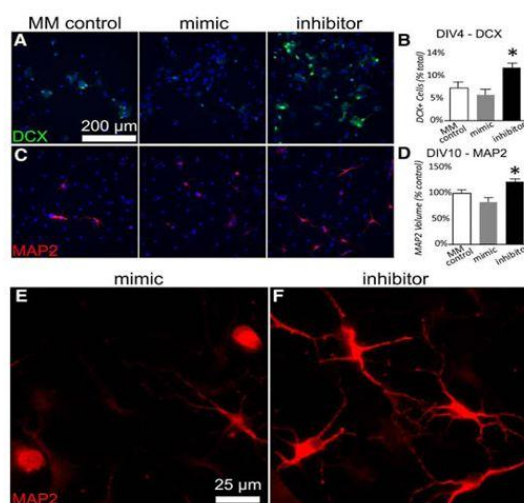
### Neural Stem Cell Factors

Most anti-inflammatory cells have been counteracting the stem cells work in brain. They ensure migration of cells from desired target and interrupt proliferation creating an hazardous environment in brain injury site. Hence biocompatible scaffolding is used to deliver cells to attain target for cure. With extensive framework of chitosam, heparin and fibroblast NSC cells may be incorporated into traumatic brain injury sites for enhanced treatment and cure. They improve functional recovery and also help in survival of NSC s until the brain cells are recovered and cured [14-17]. Figure 7 is a clear understanding of NSC after brain injury [18]. Lot of studies conducted has shown endogenous cells for brain injury causes cell proliferation. They have robust growth after injury repair, usually indicating generation of new neurons for better recovery of cells. Such studies strongly indicate the brain repair and regenerate are done through endogenous NSCs [19]. The endogenous degree is increased via exogenous means for augmentation of neural stem cells, a potential therapy for brain injury. Figure 8 shows marker of

endogenous cells in brain [20].



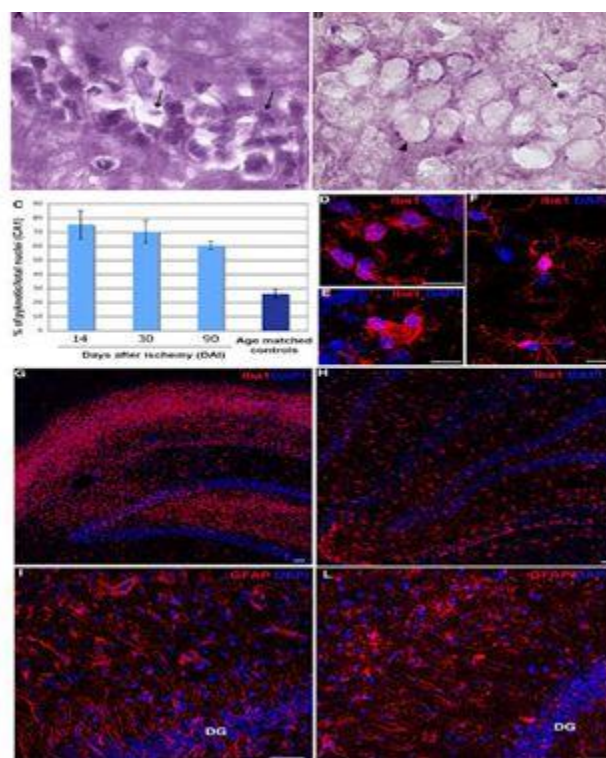
**Figure 7:** This figure is a clear understanding of NSC after brain injury.



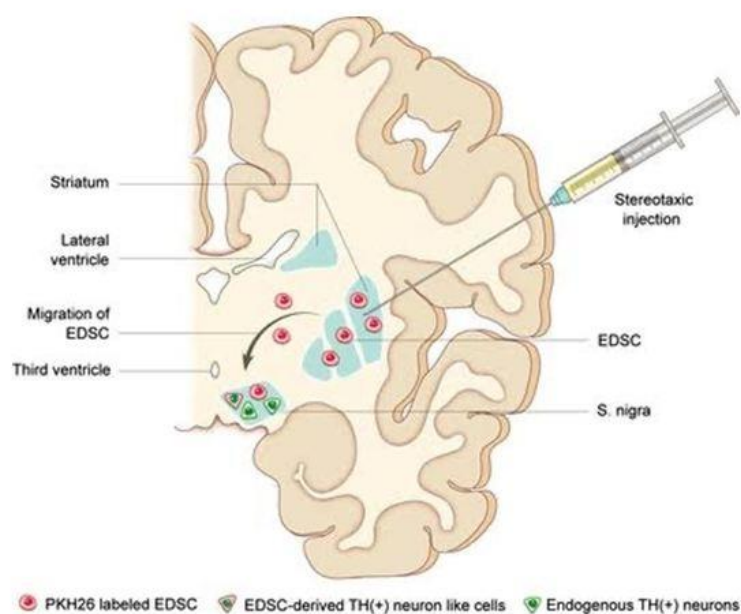
**Figure 8:** Marker of endogenous cells in brain.

So far endogenous neural stem cells have been best for treating brain injury [21,22]. Intravenous method into the brain has shown, they help grow cells rather proliferate and improve functional recovery of traumatic brain injury [23]. Below figure shows intravenous injection of NSCs (Figure 9,10)

[24].



**Figure 9:** This shows markers for NSC that last in the brain for repair [22].



**Figure 10:** Intravenous injection of NSCs.

## Conclusion

Over the past few decades, various sources for neural regeneration have been explored. Even mesenchymal stem cells method was adopted. The array of cell sources determine to show potential, but nothing stood out as neural stem cells to proliferate and target and repair brain injury. They proved to survive, proliferate and migrate into cortex differentiating into neurons and astrocytes with improved functional recovery rate. NSC also has shown improved motor and spatial learning functions to survive upto 13 weeks in injured sites and fully cure the cells. Some studies have shown NSCs possess mature glial cells properties demonstrating regional cell properties.

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