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Future Prospects of Stem Cells in CNS Disorders

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Abstract: ***There are several types of disorders among which some are high profile disorders of central nervous system which affects millions of people in every year. Neuro-degeneration actually is the loss of neurons causing structural abnormalities or failure to function which leads to disorders of central nervous system. The neural stem cells of adult brain, with limited potentiality, are able to develop functional neurons during injury. The main characteristics of stem cells are their endogenous trophic support, replacing ability of nonfunctional cells. For these reasons they are being utilized in recovering central nervous system (CNS) disorders. Some major CNS disorders are Parkinson's disease (PD), Hungtington disease (HD), Amyotrophic lateral sclerosis (ALS), Ischemia, Spinal Cord Injuries, Epilepsy etc.***

Keywords: Neural stem cell, neuro-degeneration, Parkinson'e diserase, Hungtington desease, Amyotrophic lateral sclerosis (ALS), Ischemia, Spinal Cord injuries, Epilepsy, stem cell based therapy.

1. Introduction

The function of stem cells is to maintain of homeostasis by giving trophic support and to serve as a reservoir to replace dysfunctional and senescent cells of the organism throughout the whole life [1]

The main objectives of stem cell based therapies in CNS disorders are to restore neurological functions and to recover of neural circuitry [2]. The presence of neural stem cells in the adult CNS of mammals was first supported by the fact of neuronal turn over in the hippocampus of adult mammals [3]. We know that the new neuronal cells are not produces in adult brain but present in the embryonic state only [4].

2. Stem Cell based Therapeutic Strategies for CNS disorders

The stem cell based therapy have been developed to restore the functional activity and to recover the CNS disorders by applying cell replacement methods, gene therapy and neuro-protection. The concept of cell replacement or re-establishing functional activity and to compensate the cells in case of CNS disorders is now a promising research works. The cell replacement could improve functional deficits in the adult brain through different mechanism.

2.1 Therapeutic aspects for Parkiuson's disease

According to the World Health organization, the number of PD (Parkiuson's disease) patients was gradually increased [5]. The cell replacement therapy has been applied for functional restoration of dopaminergic neurotransmission in the striatum of patients with PD. The studies on animal model of PD demonstrated that the improvement of striatal function by regulation of dopamine receptor activity and dopamine receptor sensitivity as well as re-establishing both afferent and efferent connection in the striatum were done after cellular transplantation [6].

2.2 Huntington Disease (HD)

Proper treatment for HD (Huntionton disease) is not available now. Phase I clinical trials have been performed using intrastriatal implantation of fetal striatal primordium from the fore brain in HD [7]. Phase I clinical trials have been done in 5 HD patients but 3HD patients shows improvement of patients in cognitive abilities and motor functions after neural cell transplantation [8]. In cell replacement, different degrees of functional improvement have been observed in animal models. The functional improvement may be the recovery of learning capabilities [9] and the restoration of cognitive functions [10]. Though several cell replacement strategies have been done in HD, but the assessment of functional recovery is needed.

2.3Amyotrophic lateral Sclerosis

Another name of the disease amyotrophic lateral sclerosis is Lou Gchrig's disease, where destruction of motor neurons in spinal cord in noted. Several treatments, based on stem cell have been studied in amyotrophic lateral sclerosis (ALS). Human NT-2 cell line derived neurons have reduced development of ALS disease in mice after spinal grafts [11].

Ischemia

The stem cell transplantation therapy has been proposed as a potential treatment in brain injuries. The genetically modified stem cells could be exploited as a neuroprotective material and also for lost cells. The cell transplantation strategy has been applied in the treatment of ischemic animal model. It have been found that neural precursors derived from mouse ESC's differentiating into motor neurous and glial cells with electro physiological properties [12] after transplantation into ischemic rat survive up to 12 weeks.

Another report finds the better neurological activity, if fetal human NSCs (Neural stem cells) and human NPCs are delivered into the focal ischemic lesions and these cells differentiating into cells that providing neuronal as well as glial markers (MAP – 2 NeuN, and GFAP), forming synaptic connections between host cells and graft derived

neurons [13]. It has been observed that when human NSCs are delivered intravenously in ischemic rat model, can move to the hippocampus lesion sites and promoting functional activities [14].

Umbilical cord blood cells help in short term relief after stroke in rat [15]. The stem cells may release growth factor. It has been evidenced that stem cells like NSCs, BMSCs can release growth factors and cytokines [15].

Epilepsy

Epilepsy is one type of CNS disorder where the cell replacement strategies include gentrification of transplanted cells, but transplantation therapy is quite difficult for the heterogeneity of epilepsy. The restoration of local networks by cellular transplantation has been possible in seizure condition in special epilepsy cases such as temporal lobe epilepsy [16].

Spinal cord injuries

Spinal cord injuries are a field of profound research. Generally the neuron cells in spinal cord injuries mostly destroyed as a result of it, communication between the spinal cord and brain became affected. Although in many spinal cord traumas, the cord is not totally damaged. Some of the existing neuronal axons transmit message as a result they survive normally, but the myelin producing cells going to lost. Scientists have tried to replenish the lost myelin producing cells by injecting cultured human ES (embryonic stem) cells into the spinal cord of chemically de-myelinated rat models [17].

3. Conclusions

Therapeutic approach of stem cells has created a scientific revolution in the treatment of various central nervous system disorders. The concept of cell replacement to restore function and to compensate of lost cells in case of CNS disorders is a great promising research works. The cell replacement could improve functional deficits in the adult brain through different mechanism. The knowledge of cellular and molecular mechanism of stem cell based therapy in CNS Disorder will be essential for the development of therapeutic strategies of various neurological disorders in human central nervous system. Rapid progress has been developed to understand stem cell based therapy, applicable in CNS disorders. The therapeutic applications of stem cells and sources have created so much discussion regarding on its ethical and scientific perspectives.

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