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Commentary

Neural Stem Cells for Traumatic Brain Injury

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DESCRIPTION

In the last two decades, Neural Stem Cells (NSCs) have piqued scientific and commercial interest. NSCs have been proposed for neurotoxicity testing, cellular therapies to treat CNS diseases, neural tissue engineering and repair, drug target validation and testing; and personalization due to their plasticity, defined as the ability to develop into different phenotypes inside and outside of the nervous system, with a capacity of almost unlimited self-renewal, releasing trophic and immunomodulatory factors, and exploiting temporal and spatial dynamics Furthermore, given the increased interest in developing cell-based therapeutics to treat neurodegenerative illnesses, recent advances in producing NSCs from human induced pluripotent stem cells has resulted in the creation of an analogue of endogenous NSCs. The current understanding of emerging conceptual and technological topics in the neural stem cell field, such as deep characterization of the human compartment, single-cell spatial-temporal dynamics, reprogramming from somatic cells, and NSC manipulation and monitoring. Together, these factors help to further disentangle NSC plasticity in order to better leverage the cells' potential, which could lead to innovative brain therapy treatments in the future [1-3].

Traumatic Brain Injury (TBI) is a very prevalent and serious condition. TBI will become the leading cause of human mortality and morbidity after 2020, according to the World Health Organization, putting a significant financial strain on patients and their families. TBI is an illness that causes normal brain function to be destroyed, resulting in major physical, cognitive, and emotional problems. The breakage of the Blood-Brain Barrier (BBB), severe neuroinflammation, diffuses axonal damage, and neurodegenerative abnormalities are all part of the pathophysiology of TBI. Loss of normal tissue structure, destruction of neuronal cells, and internal environment disturbance are the main pathological alterations of brain injury, with neuronal cell injury being the most important. So far, there seems to be no successful pharmacological treatment. Hyperbaric oxygen, non-invasive brain stimulation, task-oriented functional electrical stimulation, and behavioral therapy are currently the most common treatments [4].

Stem cell treatment has developed as a new way to treating TBI15 neuroinflammation in recent decades. Recent research has found that stem cells with immunomodulatory and regenerative capabilities increase functional recovery after TBI16. Numerous studies have shown that Neural Stem Cell (NSC) transplantation has remarkable neuroprotective effects that enhance functional recovery after severe TBI by reducing neuroinflammation and promoting regenerative processes (i.e., increasing neurogenesis, angiogenesis, and plasticity). NSCs are multipotent cells that can differentiate into neurons, astrocytes, and oligodendrocytes, among other neural lineages. Moreover, the short life expectancy of NSCs transplanted continues a challenge. One of the key factors affecting the survival rate of NSCs within the injury site is the inflammatory environment. As a result, manipulating the inflammatory environment is required to reduce the unfavourable effects of stem cells while maximizing their therapeutic effects. As a result, in terms of the impact of the inflammatory environment on NSC survival rates, stand-alone NSC transplantation may not be enough to heal correctly wounded tissue, and adjuvant immunomodulatory therapies may be required [5]. Furthermore, optimizing brain delivery and brain retention medicines should be mentioned [6]. Encapsulating medicines in nanoparticles (NPs) is one of the methods for improving site-specific delivery and bioavailability.

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