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EDITORIAL OPEN ACCESS

Effects of traditional Chinese medicine on self-renew, migration and differentiation of neural stem cells *in vivo* and *in vitro*

Yin-chu Si, Feng Wan, Yi-lun Song, Xin Niu

INTRODUCTION OF NEURAL STEM CELLS

Neural stem cells (NSCs) are those stem cells that can proliferate, self-renew and multi-differentiate into neurons, astrocytes and oligodendrocytes [1]. NSCs mainly exist in subependymal ventricular zone (SVZ) and subgranular zone (SGZ) of hippocampal dentate gyrus in the adult mammalian brain, and some self-replicating neural stem cells also exist in other parts of the mammalian brain, such as the cortex and striatum [2]. NSCs in healthy adult mammalian brains divide to maintain the number of the general stem cells, or become progenitor cells, which migrate within the brain and function primarily to maintain the neuron population for olfaction [3].

In the case of stroke or traumatic brain injury, which leads to the death of brain cells, characterized by a loss of neurons and glial cells in the brain, NSCs can proliferate and migrate into the injured section of the brain, and then, they differentiate into the corresponding nerve cells to take part in the formation of neural circuits, promoting structural and functional repair of the injured brain [4, 5]. NSCs may also play a role in the treatment of brain degeneration related to some diseases, such as Parkinson's disease and Alzheimer's disease [6–8].

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INTERVENTION OF TRADITIONAL CHINESE MEDICINE ON NEURAL STEM CELLS

Traditional Chinese medicine (TCM) has a history of about five thousand years, and its unique diagnostic methods and various drug therapies and non-drug therapies have been recognized worldwide. Modern medical researchers have found that TCM can play a positive role in the intervention on some diseases related to the central nervous system. Through many *in vitro* and *in vivo* experiments, including the screening of Chinese herbs and puncturing of acupoints, researchers have found that many Chinese herbs and acupoints have definite effects on NSCs in many aspects [9–12].

EFFECT OF CHINESE HERBS AND THEIR ACTIVE COMPONENTS ON NEURAL STEM CELLS

Many Chinese herbs, such as *Angelica* (danggui) [13], *Acanthopanax* (ciwujia) [14], tortoise plastron (guiban) [15–16] can significantly increase the number of nestin positive cells in ischemic area of the brain after focal cerebral ischemia in rats, and promote NSCs to differentiate into neurons and glial cells. The Chinese herb *Ganoderma lucidum* (lingzhi) can raise the number of Brdu positive cells in the ependymal area of the spinal cord after spinal cord injury in rats, and meanwhile, increase the co-expression of Brdu and Nestin in the white matter of the spinal cord [17]. Radix Polygalae (yuanzhi) can raise the number of Brdu positive cells in dentate gyrus of the hippocampus in AD rats, and at different dose of Radix Polygalae, the spatial memory ability is proportional to number of Brdu positive cells in the dentate gyrus [18]. Gardenia (zhizi) and Radix *Scutellariae* (huangqin) can induce the ability of NSCs to differentiate into neuron progenitors, and in combination with saponins from *Panax notoginseng* (sanqi) can

promote the differentiation of NSCs into mature neurons [19].

Active components from Chinese herbs, such as baicalin, geniposide [20], ginkgolide B [21], protocatechuic acid [22], ginsenoside Rg1 [23], astragaloside [24], *Panax notoginsengsaponins* [25], catalpol [26], angelica lactone [27], Ligustrazine [28], scutellariabaicalin and plain [29], can promote the proliferation of NSCs in SVZ, SGZ and ischemic focus in the brain after cerebral ischemia in rats, and also help the differentiation of NSC into neurons and glial cells. Salidroside [30], pilose antler polypeptides [31], soybean saponins [32] and gypenosides [9] can induce the directed-differentiation of NSCs into neurons in a dose-effect manner, while tanshinol and salvianolic acid can promote the migration of NSCs into the ischemic area of the brain in fetal rats [33].

EFFECT OF ACUPUNCTURE ON NEURAL STEM CELLS

According to the TCM theory, the brain is located at the intersection of Du meridian and Ren meridian, so the encephalopathic diseases can be treated by acupuncture with the acupoints on the head. Accordingly, puncturing of some head acupoints has certain effects on NSCs existing in the brain. For example, puncture of "baihui" and "dazhui" acupoints can raise the number of Nestin positive cells in hippocampal CA1 region in the brain after ischemia by hypoxia in rats [10], and electroacupuncture of "baihui" and "fengfu" acupoints can increase the number of Brdu/NSE and Brdu/GFAP significantly in the brain after cerebral ischemia in rats [11]. Another example is that puncture of "hegu" and "taichong" acupoints can increase the number of nestin positive cells in pars compacta of substantia nigra in mice with Parkinson's disease [12].

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Author Contributions

Yin-chu Si – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Feng Wan – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Yi-lun Song – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

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Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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