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Progress of Research on the Relationship between Basic Theories of Chinese Medicine and Stem Cells

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Abstract: Modern research shows that stem cells can differentiate into different cell types and have the ability to repair various tissues and organs, and gradually move from basic research to clinical treatment, which brings revolutionary progress to modern human medicine. The basic theory of TCM is the foundation of the whole modern discipline group of TCM, with its unique research ideas and methods to summarize the basic conceptual laws of TCM. Based on the analysis and summarization of related literature, the article summarizes the understanding of stem cells by some scholars from the basic theory of TCM and reviews the relationship between stem cells and the doctrines of yin and yang, five elements, Zang Xiang and meridians in TCM, which can provide a theoretical basis for future clinical research and application.

Stem cells (SC) are a class of cells with the potential for self-renewal and self-differentiation. Under certain conditions, they can generate more stem cells through mitosis and can differentiate into a specific cell type.[1] It can also differentiate into a specific cell type. In recent years, with the rise of stem cell therapy, the research of Chinese medicine involved in stem cells has also been gradually promoted, giving full play to the advantages of interdisciplinary disciplines and carrying out discussions about their characteristics. This article reviews the understanding of some scholars on the relationship between stem cells and basic theories of TCM.

1. Classification and Function of Stem Cells

Stem cells can be classified into two types according to their developmental origin: embryonic stem cells and adult stem cells, and also into totipotent, multipotent, and unipotent stem cells according to their differentiation potential.[2] . Pluripotent stem cells can differentiate into any type of cells and have the potential to form complete individuals; pluripotent stem cells[3] are capable of differentiating into all cell types within a specific lineage, but cannot develop a complete individual; and unipotent stem cells can only differentiate in a single direction, producing one type of cell. Recent studies have found that the functions and applications of stem cells are focused on five main areas[4] (1) replacement and repair; (2) activation of dormant and inhibited cells; (3) paracrine effects; (4) immune regulation; and (5) restoration of cell signaling. It has broad application

prospects in the treatment of various autoimmune diseases, neurological diseases, circulatory system diseases, and reproductive system diseases.

2. Stem Cells and the Basic Theory of Chinese Medicine

2.1 Stem Cells and the Doctrine of Yin and Yang

The doctrine of yin and yang is the philosophical basis of the basic theory of Chinese medicine, and the material world is constantly changing under the interaction of yin and yang. The life activity of stem cells in the human body conforms to the law of yin and yang, which is mainly reflected in their constant number and their ability to differentiate into other cells under certain conditions.[5] . At present, stem cells can be directed to produce osteoblasts, chondrocytes, adipocytes, nerve cells, etc.[6] . When the bone metabolism of the body is in balance, the activities of the body are orderly and coordinated, showing a state of "yin and yang balance", and when the balance between bone tissue and bone marrow adipose tissue is broken, the potential stem cells are activated to repair bone tissue.[7] When the balance between bone tissue and bone marrow adipose tissue is broken, potential stem cells are activated to repair bone tissue. Wang Bo et al.[8] The ability of Yin and Yang to coordinate themselves in the physiological state and restore the balance in the pathological state reflects the regenerative repair function of the human body, i.e. the repairing and replacing the function of stem cells.

2.2 Stem Cells and the Five Elements Theory

Stem cells reside in the body and their vital activities exhibit innate essence properties that are closely related to the five elements, and Li Hongmei et al.[4] suggest that the proliferation and differentiation of stem cells can reflect the relationship between the five elements at the microscopic level. Under certain conditions, stem cells of the mother generation will be continuously lysed and induced to form daughter stem cells, which will have different degrees of somatization, but all of them have the characteristics of innate essence. When the metabolism is completed, the process of somatic cells toward aging and apoptosis is also similar to the relationship between the five elements[9] The five elements are complementary to each other in terms of the relationship between the five elements. The life activity of stem cells is inseparable from the energy reserve, and the circulation and metabolism of energy are also dependent on the biological function of cells. The replacement and repair of stem cells also reflect the relationship between the five elements: the self-growth and renewal of cells in the physiological state and the differentiation and repair and regeneration in the pathological state both reflect the relationship between the two elements, while when the cells grow and differentiate to a certain degree, they need to regulate the constraints to maintain internal stability, which reflects the relationship between the two elements.

2.3 Stem Cells and the Tibetan Elephant Theory

The five viscera are the core of the doctrine of "Tibetan Elephants", and they store essence without diarrhea. The survival, growth, differentiation, and other vital activities of stem cells cannot be achieved without the assistance of the five viscera to produce essence. Some scholars believe that there are many connections between "Tibet" and stem cells: in terms of location, both are hidden inside the body; in terms of physiological functions, the five organs store and store the essence inside and spread it around the body, while stem cells transform into different functional cells of the body to maintain the internal stability of the living body.[10] In terms of physiological functions, the five internal organs produce and store essence in the body, and circulate the body.

2.3.1 Stem Cells and the Heart

The heart is the master of the mind and the blood vessels. Stem cells are distributed throughout the body, and by obtaining energy from the vascular tract, they promote cell proliferation and chemotaxis, thus participating in the body's repair. Ischemic heart disease can be classified as "chest paralysis" and "true heart pain" in Chinese medicine, and the deficiency of both qi and blood is one of the basic pathological mechanisms leading to the loss of nourishment of the heart vessels. If the heart qi is deficient, the vasculature is not well regulated and the vasculature is not well nourished, which affects the survival and development of stem cells and is not conducive to damage repair.

Ischemic heart disease is caused by the reduction of myocardial cells and myocardial scar formation due to myocardial cell ischemia, and such patients are prone to heart failure and even death. Therefore, promoting the regeneration of myocardial cells and fibroblasts and inhibiting ventricular remodeling can improve cardiac function to a certain extent and suppress the adverse effects of myocardial infarction.[11] Therefore, promoting the regeneration of cardiac myocytes and fibroblasts and inhibiting ventricular remodeling can improve cardiac function to some extent and suppress the adverse effects of myocardial infarction. Human umbilical cord MSCs have a high potential for self-differentiation and can promote tissue repair and improve cardiac function by secreting a large number of bioactive factors to reduce myocardial fibrosis, regulate immune function, and promote neovascularization.[12, 13] The potential of human umbilical cord MSCs to self-differentiate is shown in the following table. Jing Yucheng et al.[14] Randomly divided eight patients with ischemic heart disease into stem cell transplantation group and control group, and treated the transplantation group with isolated and extracted human umbilical cord MSCs, and the results showed that human umbilical cord MSCs could improve the cardiac function of patients with ischemic heart disease to some extent.

According to Chinese medicine, the heart and dementia are closely related. Insufficient heart blood, loss of nourishment for the marrow, and loss of use of the divine apparatus lead to dementia. He Jia [15] It was found that the therapy of mesenchymal stem cell (MSC) transplantation can inhibit apoptosis of brain tissue in animal models of dementia, promote brain angiogenesis and neural regeneration, and improve brain cognition.

2.3.2 Stem Cells and Lung

The lung is the master of the whole body's qi. Through the two-way movement of upward and outward ascending and decreasing and downward and converging, the lung qi enables the inhaled qi to reach the whole body and promotes the normal circulation of qi, blood, and fluid around the body. MSCs are the most abundant storage cells among bone marrow mobilized cells, and MSCs in the lung has the function of promoting cell renewal, guiding the repair of diseased tissues, and activating the self-healing potential of lung tissues.[16] Niu Hui et al.[17] Summarized the basic and clinical studies of MSC treatment for lung diseases showed that MSC can regulate the inflammatory response through immunomodulation while promoting lung injury repair with certain safety and efficacy.

It has been shown that after severe lung injury, stem cell division is accelerated to promote wound healing and tissue repair[18]. The novel coronavirus pneumonia has become a global pandemic, and there is no specific treatment. A foreign research team treated 24 patients with severe COVID-19 with exosomes injected intravenously into bone marrow mesenchymal stem cells (BMSCs) and evaluated the safety and efficacy of exosomes 1 to 14 days after treatment. The clinical status and oxygenation index of the patients were improved, with the ability to down-regulate cytokine storm and rebuild immunity, which proves that BMSCs exosome therapy has the potential to treat moderate to severe COVID-19 patients.[19] Most severe patients with

COVID-19 have symptoms such as immune imbalance, pulmonary inflammatory lesions, and tissue fibrosis. Stem cell therapy can play an immunomodulatory and anti-inflammatory role, promote tissue repair and accelerate the recovery of the organism.[20]

2.3.3 Stem Cells and Spleen

The spleen is the master of transportation and facilitates the digestion and absorption of food intake by the stomach and intestines, converting water and grain essence into basic nutrients to be dispersed throughout the body, fundamentally providing the body with the nutrients and energy it needs. Modern medicine believes that mitochondria can integrate energy metabolism and material metabolism, and the ATP produced is the source of cellular power and energy, which is very similar to the function of the spleen in Chinese medicine[21] It is very similar to the function of the spleen in Chinese medicine. Peng Yan et al.[22] After establishing a model of spleen deficiency in rats, their intracellular ATP production was impaired, and treatment with the formula of strengthening the spleen and benefiting qi could effectively promote ATP production, indicating that spleen deficiency could lead to the decrease of intracellular mitochondrial function, and stem cells as one of the somatic cells, spleen deficiency would directly affect the vital activities of stem cells.

Ulcerative colitis is classified as a spleen and stomach disease in Chinese medicine, and the key to clinical treatment is to strengthen the spleen and consolidate the root, Zhu Lei[23] Through experimental studies, it was proved that the formula for strengthening the spleen and tonifying the kidney could promote the homing of BMSCs, repair the inflammation-damaged tissues, and repair the intestinal mucosa for therapeutic effects. Myogenic stem cells (MDSCs) are a type of adult stem cells from human limb muscles, and MDSCs correspond to the spleen's main limb muscles.[24] Therefore, the growth, proliferation, and differentiation process of MDSCs are closely related to the spleen in Chinese medicine.

2.3.4 Stem Cells and the Liver

The liver stores blood and the kidney stores essence, and both essence and blood have the same origin and are nourished by water and grain essence nutrients. Stem cells exist in the body, and their growth and survival depend on the essence and micro substances from the essence and blood.[25] summarized the recent therapeutic initiatives of Chinese medicine combined with stem cells against liver fibrosis, and pointed out that the growth and proliferation of stem cells can be promoted by "benefiting marrow and filling essence", and improving the internal environment of the liver by "nourishing liver yin and nourishing liver blood", which is conducive to the orientation and differentiation of stem cells and repair of damaged liver tissues. differentiation and repair of damaged liver tissues.

The liver is the only organ in the adult body that has a significant ability to repair itself. Hepatocytes and intra- and extra-hepatic stem cells are involved in and contribute to the repair of the liver autologously, and the alternative repair effect of stem cells helps to stimulate the self-repair potential of hepatocytes for the ultimate purpose of treating liver diseases[26] The replacement repair effect of stem cells helps to stimulate the self-healing potential of hepatocytes for the ultimate purpose of treating liver diseases. Some experimental studies have demonstrated that transplantation of BMSCs into hepatic fibrosis animals after hepatic induction of differentiation can effectively improve liver function, reduce tissue fibrosis, and increase the survival rate in rats.[27] Liu Junzhi[28] Exploring the molecular mechanism of BMSCs exosomes for the treatment of liver fibrosis, we found that BMSCs exosomes can inhibit inflammation, promote hepatocyte regeneration and contribute to the recovery of liver function, which can provide a new therapeutic strategy for the treatment of clinical liver fibrosis.

2.3.5 Stem Cells and the Kidney

The kidney is the master of bone and marrow, the source of yin and yang in the internal organs, and the source of life. The kidney is the main reservoir of sperm, including the "acquired sperm", which is derived from the essence of water and grain, and the "innate sperm", which is endowed by the parents. The innate essence is the original material of life, forming the embryo and hidden in the kidney.[29] The embryonic stem cells are derived from the embryonic stem cells. The embryonic stem cells are the inner cell mass from the blastocyst stage of the fertilized egg, which is the innate sperm produced by the parents. Embryonic stem cells can be called totipotent stem cells, which have developmental totipotency and can differentiate all tissues and organs of the body. Thus, the innate sperm contains all the genetic material including all-powerful stem cells and is closely related to the growth and development of the human body[4].

Life science researchers found that increasing the number of stem cells and stimulating stem cell activity, can accelerate self-renewal and promote differentiation ability, thus delaying aging, while Chinese medicine believes that kidney essence is the driving force of life, and the amount of kidney essence has a direct relationship with the speed of aging and the length of life, so it is proposed to supplement kidney and fill essence to fight to age and prevent aging. Chen Fangmin et al.[30] selected a kidney tonic compound composed of Shu Di, Cistanches, and He Shou Wu to explore its regulatory effect on the expression of the senescent cell cycle, and the study showed that the kidney tonic formula could increase the number of senescent cell passages and promote the senescent cell cycle, indicating that a strong kidney essence helps to improve the aging state.

Chinese medicine considers the occurrence of premature ovarian failure to be closely related to the kidney. Chen Hong et al.[31] found that kidney tonic prescriptions are quite effective in inducing and promoting the proliferation and differentiation of BMSCs, which can play a role in repairing damaged tissues by inducing the proliferation and differentiation of BMSCs to the corresponding cells through in vitro transplantation or culture. Liu JB et al.[32] found that BMSCs could inhibit the apoptosis of ovarian granulosa cells, promote follicle growth, improve ovarian function, and play a role in the treatment of premature ovarian failure.

2.4 Stem Cells and Meridian Theory

Meridians are special network systems that sense and transmit information and regulate the body's functions. The theory of qi-blood meridians has many correlations with the mobilization, nesting, proliferation, and differentiation of stem cells, and meridians include not only the regulatory network of the nervous system but also the circulation network of blood vessels and lymph, as well as the information regulation mechanism of endocrine and cytokines, which is a kind of complex and systemic regulator. A series of physiological activities of stem cells are signaled through this signaling network.

Yuan Hongdou et al.[33] Studied the microenvironment of stem cell life activities and concluded that meridians are closely related to the differentiation, proliferation, and migration patterns of stem cells in the body, and act as the main signaling network of the body to realize signal delivery and participate in the whole process of stem cell mobilization, homing, migration, and transformation. Yang Jun et al.[34] explored the relationship between the microenvironment of cardiac transplantation of BMSCs and meridian qi and blood, and found that the improvement of the microenvironment became the key to improving the efficacy of stem cell transplantation, and the essence and function of meridian qi and blood were closely related to the transplantation microenvironment of stem cells, which had a positive effect on the myocardial repair of BMSCs.

It has been suggested that the meridian system is composed of stem cells distributed in different tissues and their surrounding microenvironment in an orderly manner and that the acupoints are the

enrichment points of stem cells and their surrounding microenvironment at specific locations, i.e. the nests of stem cells.[35] The acupuncture points are the enrichment points of stem cells and their surrounding microenvironment, i.e. the nests of stem cells. Therefore, stimulation of acupoints by acupuncture and moxibustion can induce local stem cells to differentiate towards specific tissues to treat related diseases.

3. Conclusions

With the gradual development of modern medicine, stem cells have become the frontier engineering and hot engineering of life science research today. As multipotential cells, stem cells have strong growth and differentiation ability, and they belong to the multifaceted and multilevel system of kidney essence in the basic theory of Chinese medicine. With the deepening research on the relationship between TCM and modern medicine, the organic combination of stem cells and traditional TCM, taking advantage of cross-discipline, is expected to solve many difficult problems in the process of disease research. In recent years, a large number of basic studies have proved the scientific validity and reliability of stem cell therapy in Chinese medicine, which has a broad clinical application prospect. As the research continues to deepen, it will help to promote innovative breakthroughs in life sciences in China and provide new ideas for the prevention and treatment of major diseases.

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