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Mesenchymal Stem Cells Therapy for Muscular Atrophy and Sarcopenia

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Review Article

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Abstract

Sarcopenia is characterized by a loss of skeletal muscle mass, strength and function, and badly influence health and quality of the patients, the prevalence of sarcopenia is increasing particularly in the people aged 65 years or above, and the phenomena of chronic-inflammation and inflamm-aging is a major reason to multitude of geriatric conditions including sarcopenia. With the rapid development of regenerative medicine, Mesenchymal stem cells therapy showed a potential possibility to treat or alleviate the symptoms of muscular atrophy and sarcopenia. Here, we will summarize the recent progress of Mesenchymal stem cells therapy on muscular Atrophy and sarcopenia, which may provide some ideas for aging-related or degenerative diseases treatment.

Keywords: Muscular Atrophy and Arcopenia; Regeneration; Treatment; MSCs

Abbreviations: MSCs: Mesenchymal Stem Cells; NK: Natural Killer Cells; DCs: Dendritic Cells.

Introduction

Sarcopenia is a progressive skeletal muscle disease which is correlated with increased the possible of adverse results containing fractures, physical disability and mortality [1]. This complex or multi-factorial disease happens acutely sometimes that following a period of enforced inactivity, or with age-related loss of muscle cell quality and mass. Over 10% elder people suffer this kind of disease [2]. The most important factor when diagnosis of sarcopenia is the mass and quality of muscle and this is the common diagnostic criteria. The clinical methods about sarcopenia treatment is increasing physical activity and support sufficient nutritional supplementation, it is reported that exercise and nutrition is useful for the effect of anti-inflammatory and anti-oxidative stress which slowed down muscle consuming [3]. However, these interventions should differ between individuals and will not effective for every sarcopenia patient and numerous older patients aged 65 years or above cannot do prescriptive exercise and intake nutrition because various geriatric complications exists.

Mesenchymal stem cells (MSCs) are a kind of cells with the ability of self- replication and multi-directional differentiation, they can renew themselves and differentiate into one or more kinds of body cells under specific conditions. It has been reported that MSCs could be able to treat or alleviate many types of diseases including Muscular atrophy and arcopenia. In this mini-review, we aim to review recent

progress on MSCs therapy approaches on Muscular atrophy and arcopenia. These new and innovative therapies may help to restore age-related declines in skeletal muscle mass and quality, thereby reducing the global burden of disability and dependency.

Muscular Atrophy and Sarcopenia

It was in 1989 that "sarcopenia" named by Rosenberg to describe flesh-loss in Greek [4]. Sarcopenia is characterized by a gradual loss of skeletal muscle mass at a rate of about 1% or 2% per year after the fifth decade of life [5]. The standard operating definition of sarcopenia still unclear, although the primary method of defining sarcopenia includes the presence of low muscle mass with the phenomenon of low muscle strength or decreased physical performance as the primary criteria. Skeletal muscle consists of multinucleated cells called fibers and composed of two main types: type 1 is responsible for oxidative metabolism, and type 2 for glycoglycolysis [6]. Various factors, for example, poor nutrition, sedentary behaviour, hormonal changes, altered metabolism, epigenetics are all thought to be the main determinants of sarcopenia. However, growing evidence showed that chronic inflammation in the elderly people is the most important contributor to sarcopenia [7].

Chronic inflammation influences the aging body with a variety of impairments, such as insulin, hormonal, epigenetic and microvascular changes [8]. Thus, realistically, these injuries may conspire to promote a loss of muscle strength, metabolism and energy regulation, manifested as sarcopenia. In addition, the dysfunction of immune homeostasis during chronic inflammatory states can directly lead to a loss of the regenerative ability of muscle stem cells (satellite cells), leading to sarcopenia cascade [9].

MSCs Therapy for Muscular Atrophy and Sarcopenia Treatment

Regenerative medicine is an emerging interdisciplinary field of research that focuses on the repair, replacement, or regeneration of cells, tissues, or organs to restore damaged function. Although preservation of homeostasis and tissue regeneration is the main role of adult stem cells, their functions are exceedingly decreased with age. This is associated with the activation of chronic inflammatory for it lead to affect immune function. MSCs are kind of pluripotent cells which could differentiate into muscle cells, bone cells and cartilage cells, it is reported that MSCs could reduce the inflammation response [10,11], transplanting satellite cells (a kind of muscle stem cells) into the damaged muscles could alleviate the inflammation and promote the regeneration of muscles in mice [10]. Generally, the Immunoregulatory mechanism of MSCs is primarily by pararine signalling [12].

MSCs profoundly influence the immune response by interacting with cellular components of the innate and adaptive immune system, such as natural killer cells (NK), dendritic cells (DCs), B lymphocytes, and T lymphocytes. Immune regulation of MSCs occurred through cell contact or secretion of multiple factors. MSCs can help maintain immune homeostasis by preventing inappropriate activation of T lymphocytes and creating a tolerant environment during wound repair or shutting down immune responses during healing [13]. The safety and efficacy of the regenerative strategy is not very clear, so each country has relevant legislative provisions to limit MSCs applications in clinic. With the continuous advancement of research, there are a lot of ongoing clinical trials in MSCs therapy for age-related chronic diseases. The results of these researches may improve our understanding about the safety and efficacy of MSCs therapy.

Conclusion

Sarcopenia is a kind of muscle diseases that is caused by disadvantageous muscle changes accumulated with aging. Different with current strategies of exercise and nutrition, regenerative therapies especially MSCs therapy should be a key research aspect in future work. With the ability of regulating chronic inflammatory activation in the muscle tissues, MSCs therapy may be a potential suitable regenerative therapy for sarocpenia. The great progress has made from past regenerative medicine studies, from animal to human clinical trials, and the effectiveness and safety of these studies should be verified urgently.

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