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Mesenchymal Stem Cells Benefit Diabetes and Alzheimer's Disease

Editorial

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Type 2 diabetes mellitus (T2DM) is characterized by chronic hyperglycemia, which induces neuron, kidney and eye dysfunction. Hyperglycemia is also a risk factor for dementia. T2DM also causes brain insulin resistance, oxidative stress and cognitive impairment. Futhermore, oxidative stress causes a complex dysregulation of cell metabolism resulting in insulin resistance and beta cell dysfunction [1]. Alzheimer's Disease (AD) is the most common form of dementia among older people worldwide, and oxidative stress is an important pathogenic factor in AD. Oxygen metabolism generates free radicals such as hydroxylradical, superoxide radical, and reactive nitrogen species, inducing ROS [2]. An imbalance between oxidant and antioxidant agents could generate oxidative stress, which damages macromolecules and disrupts the reduction/oxidation (redox) signaling [3]. Mitochondria contain many redox enzymes, and generate ROS when there are inefficiencies in oxidative phosphorylation. Mitochondrial dysfunction occurs early and has a primary role in the pathogenesis of AD [4]. T2DM patients show increased incidence of AD, and one report has shown the role of insulin in that it links T2DM with AD through mitochondrial alterations, oxidative stress and glucose metabolism [5]. The insulin effect not only impacts glucose metabolism, but also has neuroprotective and neuromodulatory effects [6].

Mesenchymal stem cells (MSCs) can be isolated from bone marrow, adipose tissue, umbilical cord blood, and other tissues. MSCs have been reported to secrete factors that decrease inflammatory and immune reactions [7,8]. Human bone marrow-derived MSCs have been shown to protect human islets from pro-inflammatory cytokines [9], and to enable MSCs to differentiate into insulin-producing cells in *vitro*. These cells have been shown to improve hyperglycemia when transplanted into diabetic mice [10]. Human adipose tissue-derived MSCs also differentiate into glucose-sensitive insulin-producing cells, which help improve glucose levels and decrease levels of inflammatory cytokines and free fatty acids in T2DM mice [11,12]. Similarly, MSCs secrete neurotrophic factors to modulate neuroplasticity and neurogenesis [13,14]. Bone marrow-derived-MSCs were able to home in on the injured brains and increased the number of positive cells for choline acetyltransferase [15]. Autologous bone marrow- derived-MSCs have been used to transfuse into ischemic brain in clinical application [16]. In contrast, human adipose-derived MSCs have been shown to benefit neural differentiation and to help with functional improvement. When MSCs were transplanted into brains, Ach levels improved, cognitive and locomotor functions were improved in aged mice [17].

Aging associated with immune dysfunction is a risk factor for both T2DM and AD. MSC therapy has the ability to modulate the immune system and replace damaged cells, and may thus be effective in both diseases.

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