

Mesenchymal stem cells for the treatment of various diseases

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The reports regarding the potential of bone marrow to generate bone date back to 19th century [1-2]. The finding that a distinct cell is present in bone marrow that forms a distinct colony, rapidly adheres to tissue culture vessels, has a fibroblast-like morphology and can generate bone, cartilage, adipose and fibrous tissues was reported in 70s and 80s by Friedenstein et al. [3-6]. Caplan is the first author to use the term "mesenchymal stem cell" [7]. Mesenchymal stem cells (MSCs) exist in and can be isolated from many tissues (bone marrow, the umbilical cord, fetal liver, adipose tissue, muscle, placenta and lung) [3,8-13]. Nowadays there are many studies regarding the treatment of various diseases by means of intravenous (IV) infusion or intramural injection of mesenchymal stem cells. Some of the diseases, in treatment trials of which mesenchymal stem cells are used, are listed and summarized below.

Cardiovascular diseases: Various types (drug induced [14], ischemic [15]) of cardiomyopathy, chronic heart failure [16], myocardial infarction [17] and atherosclerotic plaque [18]. Ammar et al. [14] compared bone marrow-derived (BM-MSCs) and adipose-derived (AT-MSCs) MSCs for the treatment of doxorubicin induced cardiac dysfunction in diabetic rats and concluded that the two MSC types are equally effective in alleviating cardiac dysfunction by reducing immune cell infiltration, promoting angiogenesis and decreasing collagen deposition. Kawamura et al. [15] tried human MSCs on porcine ischemic cardiomyopathy model and reported improvement in cardiac function and attenuation in left ventricle remodelling. Velloso de Morais et al. [16] intravenously injected MSCs in a rat model of chronic heart failure and reported a decrease in the area of myocardial infarction (MI) and myocardial interstitial fibrosis, and improvement in baroreflex sensitivity and heart rate variability. Roura et al. [17] tried human umbilical cord blood-derived mesenchymal stem cells (UCBMSCs) in the treatment of a mouse model of MI and reported an attenuation in infarct-derived cardiac dysfunction. Wang et al. [18] examined the effects of IV MSC infusion on a vulnerable plaque model of rabbit and reported that MSC transplantation can effectively stabilize vulnerable plaques.

Neurological diseases: Hypoxic-ischemic brain lesions [19], Parkinson's disease [20], stroke [21] and Alzheimer's disease [22]. Okazaki et al. [19] tried bone marrow stromal cells on focal cerebral ischemia model of rat and concluded that transplantation of these cells prevents apoptosis and cell death in the ischemic brain and causes recovery in motor and sensory function. Venkataramana et al. [20] transplanted BM-MSCs into the sublateral ventricular zones of seven Parkinson's disease patients and reported encouraging results. Honmou et al. [21] infused autologous human MSCs to stroke patients and reported more than 20% decrease in mean lesion volume one week after infusion. Liu et al. [22] transplanted mouse bone marrow MSCs

into mouse model of Alzheimer's disease and reported a decrease in amyloid beta deposition, an increase in BDNF levels and improvements in social recognition test and Plus-Maze Discriminative Avoidance Task.

Orthopedic diseases: Osteochondral defects [23] and osteoarthritis [24]. Harada et al. [23] intraarticularly injected BM-MSCs for treatment of osteochondral defects in medial femoral condyle of rabbit knees and reported early cartilage repair. Orozco et al. [24] intraarticularly injected autologous BM-MSCs into the knees of osteoarthritis patients and concluded that this simple procedure provides pain relief and significantly improves cartilage quality.

Rheumatologic diseases: Rheumatoid arthritis [25], ankylosing spondylitis [26], systemic sclerosis [27], lupus erythematosus [28], polymyositis and dermatomyositis [29] and Sjögren's syndrome [30]. In these diseases MSCs are tried and provided encouraging results with their immunosuppressive effects.

Endocrine diseases: Type 1 diabetes mellitus [31]. Kerby et al. [31] showed that MSCs improve the outcome of islet grafts.

In the light of the published studies and ongoing trials, some of which can be found in ClinicalTrials.gov, it can be foreseen that many patients will be benefiting from mesenchymal stem cells in near future.

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