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Stem cells and its importance in Therapies

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INTRODUCTION

In current years, tissue engineering has plunged as a latent method for treating numerous diseases and regenerating damaged cells [1-5]. The arena of regenerative medicine is becoming a stimulating area in both human and veterinary medicine that may significantly influence our capability to treat patients [6-8]. In the mid 1800's cells were revealed to be the necessary ingredient of life. It was then later discovered that in addition to this simple role, some cells were found to have the ability to self-renew and proliferate [9-13].The hematopoietic stem cells (HSC) exist in in privileged sites in the bone marrow (BM) which are called the HSC niches (endosteal and vascular niches) [14-17]. Adult (non-embryonic, postnatal somatic) stem cell is an undistinguishable cell found among distinguished cells in a tissue or organ that has the ability to renew itself (Multipotency) [18-21]. A lot of indication has been produced to state that stem cells are not only an vital part of the embryo, but also, present in most organs of the mature adult body such as liver, intestine, bone marrow, eye, heart, kidney, skin and hair; to name a few of them. These organ-based stem cells, called adult stem cell (ASC) generate the progenitor cells for the periodic cell turnover of the organs' tissues. [22-26]

Mesenchymal Stem Cells (MSCs) are clonogenic cells capable of considerable expansion in culture and, under specific conditions, able to differentiate into the mesenchymal lineages, i.e. osteoblasts, adipocytes and chondrocytes [27-35]

Stem cell therapy can be an efficacious treatment option for bone fragility disorders including osteogenesis imperfecta (OI), disuse osteopenia, and osteoporosis, and successful cell therapy application may be dependent on optimal cell engraftment in target bones. [36-40]

Bone marrow (BM) contains two different types of stem cell populations, hematopoietic stem cells (HSC) and non-hematopoietic cells; among the latter, mesenchymal stem cells (MSC) provide an appropriate microenvironment to HSC. MSC are multipotent progenitors capable of differentiating into a number of cell lineages, including bone, cartilage, tendon, muscle or adipose tissue [41-46]. Given their multipotentiality, MSC may be considered a powerful resource for tissue repair and gene therapy [47-50].

Bone marrow-derived mesenchymal stem cells have the capacity to differentiate into several cell types . Fibroblasts are referred to as mature counterpart of MSCs, even though they can differentiate into follicular dendritic cells and myofibroblasts, the latter type of cells play an important role in wound healing. In addition, fibroblasts contribute to synthesis and remodeling of extracellular matrix (ECM) proteins and are able to respond to external stimuli by production of several cytokines, e.g. CCL2, IL6, and IL 8 [48-52]. Fibroblast-derived cytokines have an impact on the immune system in Graves' disease and tumor tissue [53-58]

Sources of Stem Cells

Currently, the main sources of hematopoietic stem cells used in transplantation are bone marrow (BM), peripheral blood (PB), and umbilical cord blood (UCB) [59-61]. After transplantation, these hematopoietic stem cells can repopulate the bone marrow of the patient, providing a source of blood cells [62-65].

UCB represents the blood remained in placenta and attached umbilical cord after delivery. It is collected at delivery time, after detaching the umbilical cord from the neonate [50-54]. Its collection does not damage the newborn, because it occurs post-natal from an organ that is not useful anymore either for baby or for mother, and that otherwise would be discarded together with the placenta. Once collected, the blood is tested, frozen and stored in banks for future use in transplantation therapy. It is called cord blood unit [66-75].

Recent developments in stem cell biology have elucidated a significant differentiation plasticity of both embryonic and adult stem cells in human tissue. These findings have ignited the hopes of achieving cell-based replacement therapy for cardiovascular disease [76-82]. Stem cells with potential applications in the treatment of cardiovascular disease can be obtained from a variety of sources including the blood, bone marrow, somatic cells, and within the heart itself [83-90].

Different types of Stem Cells

Based on their ability of differentiation, stem cells are classified into following types [91-95].

- Totipotent: Able to give rise all embryonic and extraembryonic cell types e.g. fertilised oocyte or zygote
- Pluripotent: Give rise to all cells of embryo proper e.g. embryonic stem cells [96-100].
- Multipotent: Give rise to subset of cell lineages e.g. adult somatic/tissue based stem cells
- Oligopotent: Give rise to a more restricted subset of cell lineages than multipotent stem cells e.g. mammalian ocular surface
- Unipotent: Contribute to only one mature cell type e.g. Type II pneumocyte [101-107]

Stem cells Therapy

Bone Marrow Transplantation (BMT) is becoming a powerful strategy for the treatment of hematologic disorders (leukemia, aplastic anemia, etc.), congenital immunodeficiencies, metabolic disorders [51], and also autoimmune diseases [107-119].

Stem cell therapy in liver diseases

Liver failure is a rising health problem and one of the main reasons of death worldwide. Hundreds of millions of patients worldwide are affected with liver pathologies [120-130]. Discovery of stem cells reveals that they are capable of differentiating into specialized cell types, including the hepatocytes, by utilizing these hepatocytes damaged liver can be regenerated [131-148]

Neurological diseases are produced by a loss of neurons and glial cells in the central nervous system (CNS) or peripheral nervous system. Effective treatment of these neurological diseases is currently impossible [149-151]. Stem cell therapy is a promising treatment option for these neurological diseases [151-155].

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