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Mesenchymal Stem Cells in Regenerative Medicine

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ABSTRACT: Regenerative medicine's key tool is mesenchymal stem cells. Multipurpose mesenchymal stromal cells, multipotent stromal cells, medicinal signalling cells, and MSCs are various names for mesenchymal stem cells. The first isolation of human ESC (Embryonic Stem Cells) was reported in 1998. The osteogenic population of cells with fibroblast-like appearance that were isolated from bone marrow in 1968 is the first recorded evidence of adult multipotent cells, or MSC. The primary sources of MSCs are classified as adult, fetal, and embryonic cell types. MScs can be delivered intra-arterially, intra-lesionally, via multi-focal lesions, intravenous catheterization, and regional perfusion. MSCs can be clinically utilized in veterinary regenerative medicine to treat clinical conditions mostly associated with autoimmune, degenerative, and inflammatory diseases.

Keywords: Mesenchymal stem cells, Regenerative Medicine, tissue repair mechanism, multipotent cells, Intra-arterial delivery, multi-focal lesions.

INTRODUCTION

Mesenchymal stem cells, additionally referred to as multipotent mesenchymal stromal cells, multipotent stromal cells, medicinal signalling cells, or MSCs, are a key component of regenerative medicine. MSCs are characterized as plastic adherent cells that lack the expression of surface molecules specific to other cell types, such as CD105, CD73, and CD90, and that can differentiate into osteoblasts, adipocytes, and chondroblasts in vitro (Dominici *et al*., 2006).

MILESTONES OF DEVELOPMENT IN MSCS ISOLATION

1998 witnessed the first report of human ESC (embryonic stem cell) isolation. Because human embryos are destroyed during the harvesting process, the broad-spectrum therapeutic potential of human ESC has clashed with moral, ethical, and cultural quandaries (Thomson *et al*., 1998). A viable substitute was created by Takahashi and Yamanaka (2006), which converted adult mouse fibroblasts into pluripotent stem cells. These cells, known as IPSCs, shared characteristics with ESCs in terms of morphology, growth, and the expression of ESC marker genes (Takahashi and Yamanaka 2006).

The stem cells found in adult organisms offer an additional substitute for embryonic stem cells. Hematopoietic stem cells (HSCs) and non-hematopoietic or mesenchymal stem cells (MSCs), which are also found in many other tissues, are present in bone marrow and umbilical cord blood. Due to their ability to differentiate into distinct body cell types, these cells are multipotent. MSCs can differentiate into cells of bone, cartilage, ligaments, tendons, fat, skin, muscle, and connective tissue, while HSCs can differentiate into various immune system cells, erythrocytes, and platelets. When it becomes necessary to replace damaged, diseased, or dead tissue cells, MSCs are naturally activated (Caplan, 1991).

In 1968, an osteogenic population of cells exhibiting fibroblast-like morphology was extracted from bone marrow, marking the first documented instance of adult multipotent cells, or MSC. MSCs' immune-modulatory and tissue-repair mechanisms are the main sources of their capacity for regeneration. MSC's perivascular localization in diverse tissues is thought to be crucial for their ability to recognize and respond to nearby or distant tissue damage, which involves guided migration to the site of injury and involvement in the healing process (Niess *et al*., 2016).

MSC Sources: The sources of MSCs can be identified as adult, fetal, and embryonic cell types.

Embryonic stem cells (ESCs):

- Blastocyst embryonic node, blastomere-containing embryo, and blastocyst germ cells (ICM).

Fetal stem cells (FSCs):

- Amniotic cells, fetal tissues, umbilical cord blood, and umbilical cord tissues (such as Wharton's jelly).

Adult stem cells (ASCs):

- Mammary gland (BM-MSCs), fat tissue (AD-MSCs), peripheral blood (PB-MSCs), placental tissue (P-MSCs), umbilical cord (UC-MSCs), and umbilical cord blood (UCB-MSCs) (Prządka *et al.,* 2021).

Other Sources:

- MSCs have been extracted from bone marrow, adipose tissue, and the most common companion veterinary patients-dogs, horses, and cats. The following are the components of peripheral blood: muscle and periosteum, gingiva and periodontal ligament, endometrium, placenta, infrapatellar fat pad, synovium, synovial fluid, and synovial membrane (Voga *et al*., 2020).

ROUTES FOR MSC ADMINISTRATION

Multiple focal lesions, intra-arterial delivery, intra-lesional direct administration, and regional perfusion using an intravenous catheter. MSCs can be used clinically in veterinary regenerative medicine to treat conditions primarily associated with inflammatory, autoimmune, and degenerative diseases, such as osteoarthritis/DJD, tendon and ligament damage, bone damage, laminitis, muscular dystrophy, liver injury, CKD, diabetes, wound healing, cardiac disorders, and corneal affections.

CONCLUSIONS

Regenerative Medicine is still in budding stage. Still preclinical trials are ongoing in the field so to gain the knowledge of regenerative medicine it is important to know the source, differentiating ability, routes of administration and clinical areas of MSCs.

Conflict of Interest. None.

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