

Editorial

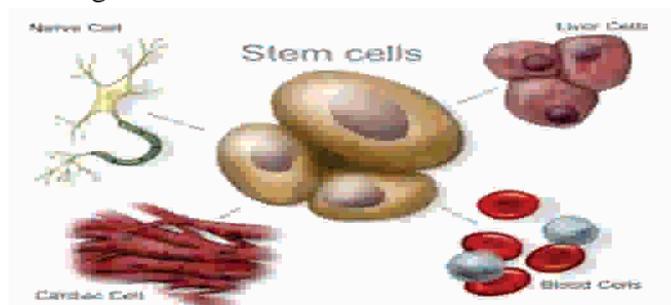
Current and Future Prospects of Mesenchymal Stem Cells in Regenerative Medicine

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Introduction

As stem cells have revolutionized all the fields of medicine in the present era so is the field of regenerative medicine which is the most recent and emerging branch of medical science and in which stem cells may prove to be a new armamentarium in treating different chronic and disabling diseases.

The self-renewal potential and the stem cells ability to differentiate into different other type of specialized cells under appropriate conditions make them important in regenerative medicine. Stem cell research has shown that the diseases which could not be cured by conventional medicines can be treated by cell based therapies. Stem cells based therapies are newer, very promising and are gaining exceptional attention for treating different diseases.



Human Stem Cells Applications

There are many tissues from which mesenchymal stem cells (MSCs) can be obtained like skin, placenta, endometrium, peripheral blood, dental pulp, dermis, adipose tissue, amniotic fluid, umbilical cord blood as well as from tumors.¹ Cardiovascular, musculoskeletal, neurological, dermatological and many other diseases that have a limited capacity for repair can get benefit from stem cells therapy. Stem cells therapy has brought hope to the those who are suffering from

distressing pathologies which involve different systems and organs of the body. Embryonic, mesenchymal stem cells and pluripotent cells which are induced are the predominant types of stem cells and currently only mesenchymal stem cells seems to be safe and are advised for different human pathologies involving different systems of the body.

MSCs can differentiate into cells of mesodermal origin such as chondrocytes, muscle cells, osteocytes, adipocytes, into cells of ectodermal origin such as melanocytes and also into cells of endodermal origin such as liver cells so that they can be widely used for successful cellular therapy in different diseases.²⁻⁴ They secrete multiple growth factors like neural growth factors, vascular endothelial growth factors (VEGF), insulin like growth factors (IGF-1), brain derived neurotrophic factors (BDNF) etc, so these can target the affected cells and play a major role in regenerative process as well as in degenerative diseases.⁵⁻⁷ MSCs play a significant role in certain neurodegenerative diseases. They have successfully been used in rat models of parkinson's disease, diabetic foot neuropathy, amyotrophic lateral sclerosis etc.⁸

MSCs can regenerate liver tissue so they can play an important role in liver cirrhosis management.⁹ Either stem cells can be directly transplanted or they can be first differentiated and then they are transplanted. Osteogenic, chondrogenic and adipogenic potential of MSCs can be used as a therapeutic option in various orthopaedic injuries and diseases.¹⁰ For periodontal disease and different tooth injuries MSCs have been proved to play a role as a regenerative therapeutic option.¹¹ Various autoimmune diseases also respond to MSCs like systemic lupus erythema-

tosus, generalized systemic sclerosis, chronic graft versus host disease with cutaneous manifestations etc.¹²⁻¹⁴ Vitiligo which is an autoimmune disease can also be treated by using MSCs. Melanocytes stem cells (McSCs) or hair follicle stem cells (HFSCs) are present in the hair follicle outer root sheath (ORS). These HFSCs have a vast potential in the treatment of vitiligo as initial re-pigmentation often occurs around the hair follicles.

One of the application of MSCs in regenerative medicine is its use in different infectious diseases as the immune responses can be modulated by inflammatory cytokines which are secreted from the immune cells of the host, they attract MSCs to the site of inflammation. When inflammation occurs, MSCs migrate towards the site of injury, differentiate into specialized cells mainly fibroblasts and release certain cytokines, growth factors and chemokines that can help in regeneration of injured tissue, so MSCs can support repair of damaged tissues. Also MSCs can modify healing of injured tissues through anti-fibrotic, pro-angiogenic and anti-apoptotic pathways.¹²

Melanocyte stem cells (McSCs) are involved in melanoma as melanoma can descend in extrafollicular stem cells which are harmed by UVA and UVB.¹⁵ Different studies are being performed to find mechanisms which can cause damage to the stem cells DNA.^b

MSCs have also been used for the treatment of androgenetic alopecia and for other types of alopecia as well as for rejuvenation of aging skin. Different factors play their role in aging process and cause structural and functional damage with impaired signalling. Stem cells of the aged people do not function normally. Various mechanisms are involved in impaired function of stem cells in aged people such as defaults in DNA repair, accumulation of reactive oxygen species, epigenetic alterations and mitochondrial dysfunctions. All the above mechanisms are responsible for impaired function of stem cells in aged people.¹⁷ Rejuvenation and preservation of niches of stem cells can reverse aging manifestations.¹⁸

No considerable side effects have been reported as far as safety profile is concerned in mesenchymal stem cells based therapies. So this therapy seems to be safe

and effective for the management of severe and refractory immune-mediated diseases. Patients suffering from various chronic diseases in which first line medications do not work can also get benefit from mesenchymal stem cells therapy.¹⁶

Studies on mesenchymal stem cells based therapies for different diseases are continuously increasing and applications of these therapies for treating various diseases is also exponentially increasing. But for the treatment of certain inherited and acquired disorders using stem cells based therapies, further research is required to observe their safety and efficacy.

Different studies are being carried out throughout the world also in Pakistan and it is thought to be a new armamentarium in the field of regenerative medicine. Regenerative medicine using stem cells has opened new avenues for different therapeutic strategies which are aimed at cell replacement as well as protection in various ischemic, traumatic and degenerative diseases. The ultimate aim should be to bring or translate stem cell based therapy to clinics thereby benefitting patients by curing their debilitating illnesses.

Stem cells based research represents great hope regarding regenerative therapeutic potential of stem cells in different fields of medicine. Although the existing therapeutic advancements of stem cells are more interventional, experimental and high in cost so due to this reason the application of stem cells based therapies may not be feasible under current circumstances but due to advancements in the medical science, in the near future stem cells may be used to treat autoimmune diseases, muscle damage, neurological disorders, genetic skin diseases, cancer etc. For the progression and advancement of certain translational applications of stem cells, there is indeed a dire need of various clinical trials in future. Funding from both public as well as private organizations may be required to accomplish this.

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