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STEM CELL THERAPY- RECENT ADVANCES

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ABSTRACTS

Various studies and trials are going on stem cell therapy for treatment of wide varieties of disorders. Uncertainty of many diseases in modern medical field has been promised to be sort out with help of stem cell treatment alone or in association with gene therapy. Many more positive results are energizing the researchers to explore field of stem cells as much can be done. Maybe congenital or acquired, many diseases have been shown to be responsive more or less to stem cell therapy. Here in this review some lights have been focused on current progress in this field of cell therapy.

KEYWORDS: Stem cell therapy, gene therapy, genetic disorder, clinical trial.

INTRODUCTION

Stem cell therapy is going to be more inclusive in our day to day medical fraternity, whatever maybe its current scenario. Various studies and trials have shown the golden era to be evolved in near future. Uncertainty of many diseases in modern medical field has been promised to be sort out with help of stem cell treatment alone or in association with gene therapy. Hopefully in near future stem cell therapy will be feasibly available for various diseases.

Here, in this review, are given some lights on recent advances in stem cell therapy in multidisciplinary faculties. Bone marrow transplant is the best known stem cell therapy to treat leukemia and other blood cancers.[1]

Current progress in Stem Cell Therapy: Wyse et al reviewed about the use of genetically modified mesenchymal stem cells for neurodegenerative disorders like Parkinson's and Alzheimer's diseases. Glial cell-derived neurotrophic factor (GDNF), nerve growth factor (NGF), and brain derived neurotrophic factor (BDNF) have been identified as therapeutic trophic factors for Parkinson's, Alzheimer's and Huntington's diseases, respectively.[2]

Many studies have been able of targeting cancer stem cells rather than just cancer cells. There is proven existence of heterogeneity in these stem cell populations. This leads to target the different subclonal populations in tumours and resulting in complete eradication. This is a recent concept of identifying and characterizing circulating tumour cells (CTC).[3]

Treatment with intensive immunosuppressive therapy followed by autologous hematopoietic stem cell transplantation (HSCT) has been used since long time for the management of severe forms of Multiple Sclerosis (MS) with superior results. But still it is not established as method of MS treatment owing to methodological difficulties and less numbers of patient recruitment. And also it is associated with transplant-associated toxicity and an approximately 3% risk of mortality. An alternative interesting approach to HSCT i.e. the transplantation of Mesenchymal stem cells (MSCs) has been explored in a limited number of phase I/II studies with promising results awaiting confirmation on clinical trials of larger scale.[4]

MSCs administration is a promising approach to treat articular cartilage lesions (focal defects and osteoarthritis) in patients as a means to enhance the poor intrinsic capabilities of this specialized tissue for self-repair. However, with the availability of optimized gene transfer systems, gene therapy offers powerful tools to stimulate the chondrogenic process in MSCs via the effective, safe, and durable delivery of candidate sequences chondroprotective and/or chondroregenerative properties, both in vitro and in experimental models of cartilage lesions in vivo.[5]

Current development in stem cell manipulation and humanized mouse models are helping in rapid developments of gene therapy for HIV treatment. The trials are going on to generate immune systems resistant to HIV infection to enhance anti-HIV immunity and to eliminate HIV infected cells.[6]

As the dental tissues are one of the storehouses for stem cells and many health issues can be sorted out by the therapeutic application of stem cells, the emphasis and significance of understanding this vital subject is gaining vast importance.[7]

There are various laboratory experiments and trials suggesting improvement of cardiac function and regeneration with help of bone marrow derived and other progenitor cells. Recently, indicating that heart is no more terminally differentiated organ, resident cardiac stem cells have been found to differentiate into multiple cell types of the heart, including cardiac myocytes. These findings have raised the ray of hope for possibility of prevention and reversion of heart failure in near future.[8]

The experience of pre-implantation genetic diagnosis (PGD) for HLA typing of about one thousand cases has shown PGD providing the at risk couples of importance to avoid an inherited risk of producing the offspring with congenital disease and also to establish an unaffected pregnancy, which may benefit the affected member of the family with hemoglobinopathies, immunodeficiencies and other congenital or acquired bone marrow failures.[9]

Mammalian target of rapamycin (mTORC1) mainly regulates umbilical cord blood (UCB)-derived human mesenchymal stem cell (hMSC) proliferation and migration under hypoxic conditions via control of cell cycle and F-actin organization modulating factors. This is thought to be due to lipid metabolism alteration via hypoxia.[10]

The application of stem cell therapy to patients with congenital heart disease (CHD) could potentially offer a new treatment paradigm. The Transcoronary Infusion of Cardiac Progenitor Cells in Patients with Single Ventricle Physiology (TICAP) trial is an effort in the direction of stem cell therapy for patients with CHD.[11]

Iinsulin-like growth factor binding protein 5 (IGFBP5) is highly expressed in dental tissue-derived MSCs compared with in non-dental tissue-derived MSCs. IGFBP5 has been found to enhance MSC-mediated periodontal tissue regeneration and alleviate local inflammation in a swine model of periodontitis.[12]

Partial bladder recovery including improvement of voiding pressure, non-voiding contraction (NVC), and residual urine has been shown after stem cell-based cell therapy in spinal cord injury (SCI).[13]

Synthemax II-SC is a novel, synthetic animal-derived component-free, RGD peptide-containing copolymer compliant with good manufacturing practices designed for xeno-free stem cell culture. Human embryonic stem cells (hESCs) and hESC derived retinal pigment epithelium (RPE) has been found to be maintained normal karyotypes after long-term culture on Synthemax II-SC.[14]

Autoimmune Diseases (ADs) have aberrant reactions of adaptive or innate immune systems. Stem cell transplantation has shown promising improvement of the functions of immune systems with a valuable strategy for the treatment of various Ads.[15]

Application of optogenetics in cell therapy has been found to link transplantation, animal behavior and postmortem analysis to enable the identification of mechanisms that drive recovery in neurodegenerative diseases like Parkinson's disease.[16]

An electrical instability, as shown by a high number of ventricular premature contractions (VPCs) and a longer QTc time, has been induced by intramuscular injections of bone marrow stem cells (BMSCs), as compared with intramuscular injections of saline and with intravenous administration of BMSCs. The pro-arrhythmic status was found to be related to the needle injury during injections and to the electrical remodeling induced by BMSCs administration.[17]

SUMMARY

These and other recent studies have, thus, shown that how the forthcoming world can look like in prospect of stem cell therapy. Stem cell therapy is still out of reach for common clinical use like gene therapy. Still we have to wait for more larger scale experiments and trials on these types of treatments to be well established in near future. Even adverse effects of stem cell therapies have to be abolished or minimized to get more sophisticated and successful results. Along with gene therapy the efficacy of stem cell therapy is much higher. So much of patience is to be kept to see future medical field of full-fledged stem cell utilization.

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REFERENCES

1. Gangane SD. Human Genetics. 4th ed. New Delhi: Reed Elsevier India Private Limited; 2012.
2. Wyse RD1, Dunbar GL2, Rossignol J3. Use of genetically modified mesenchymal stem cells to treat neurodegenerative diseases. Int J Mol Sci. 2014 Jan 23; 15(2): 1719-45.
3. Potdar PD, Lotey NK. Stem Cells – A Promise to Elixir. Enliven:J Stem Cells Regen Med. 2014; 1(1): 003.
4. Kimiskidis VK, Fassas A. Stem Cell-based Therapies in Multiple Sclerosis. J Genet Syndr Gene There. 2013; S3: 006. doi:10.4172/2157-7412.S3-006
5. Frisch J, Venkatesan JK, Rey-Rico A, Madre H and Cucchiarini M. Current Progress in Stem Cell-Based Gene Therapy for Articular Cartilage Repair. Current Stem Cell Research & Therapy. 2015; 10(2): 121-131.
6. Zhen A and Kitchen S. Stem-Cell-Based Gene Therapy for HIV Infection. Viruses. 2013 Dec 24; 6(1): 1-12. doi: 10.3390/v6010001.
7. Saraswathi KG and Madhubala E. Stem cell and the regenerative dentist. Int J Contemp Dent Med Rev, Vol. 2015. Article ID: 060215, 2015. doi: 10.15713/ins.ijcdmr.60
8. Segers VFM & Lee RT. Review Article Stem-cell therapy for cardiac disease. Nature 451, 937-942 (21 February 2008) | doi: 10.1038/nature06800; Published online 20 February 2008.
9. Kuliev A, Verlinsly O and Rechitsky S. Preimplantation Hla Typing- Practical Tool for Stem Cell Transplantation Treatment of Congenital and Acquired Disorders. J Genet Syndr Gene There. 2013; 4: 195. doi:10.4172/2157-7412.1000195.
10. Lee HJ, Ryu JM, Jung YH, Oh SY, Lee SJ and Han HJ. Novel pathway for hypoxia-Induced proliferation and migration in human mesenchymal stem cells: Involvement of HIF-1α, FASN, and mTORC1. Stem Cells. 2015 Mar 31. doi: 10.1002/stem.2020
11. Wehman B and Kaushal S. Emergence of Stem Cell Therapy for Patients With Congenital Heart Disease. Circulation Research. 2015; 116: 566-569 doi: 10.1161/CIRCRESAHA.115.305821.
12. Liu D, Wang Y, Jia Z, Wang L, Wang J, Yang D et al. Demethylation of IGFBP5 by histone demethylase KDM6b promotes mesenchymal stem cell-mediated periodontal

tissue regeneration by enhancing osteogenic differentiation and anti-Inflammation potentials. Stem Cells. 2015 Apr 1. doi: 10.1002/stem.2018.

13. Kim JH, Shim SR, Doo SW, Yang WJ, Yoo BW, Kim JM et Al. Bladder recovery by stem cell based cell therapy in the bladder dysfunction induced by spinal cord injury: systematic review and meta-analysis. PLoS One. 2015 Mar 17; 10(3): e0113491. doi: 10.1371/journal.pone.0113491. eCollection 2015.
14. Pennington BO, Clegg DO, Melkoumian ZK, Hikita ST. Defined culture of human embryonic stem cells and xeno-free derivation of retinal pigmented epithelial cells on a novel, synthetic substrate. Stem Cells Transl Med. 2015 Feb; 4(2): 165-77. doi: 10.5966/sctm.2014-0179. Epub 2015 Jan 15.
15. Li M, Ikehara S. Autoimmune Disease Treatment with Stem Cell Transplantation. J Genet Syndr Gene There. 2013; 4: 174. doi:10.4172/2157-7412.1000174
16. Steinbeck JA, Choi SJ, Mrejeru A, Ganat Y, Deisseroth K, Sulzer D et al. Optogenetics enables functional analysis of human embryonic stem cell–derived grafts in a Parkinson's disease model. Nature Biotechnology, 2015; 33: 204–209 doi:10.1038/nbt.3124
17. Mattioli AV, Pennella S, Bonetti LR, Migaldi M, Farinetti A, et al. Stem Cells Transplantation in Myocardial Tissue Induces Proarrhythmic Effects and Promotes Reperfusion. Comparison between Intramyocardial and Intravenous Approach. J Genet Syndr Gene There. 2014; 5: 226. doi:10.4172/2157-7412.1000226