



STEM CELLS: REVOLUTIONIZING MEDICINE FOR COPD!

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ABSTRACT Chronic obstructive pulmonary disease is a respiratory disease that has a major impact worldwide. The currently-available drugs mainly focus on relieving the symptoms of COPD patients. Novel regenerative therapeutic approaches have been investigated with the aim of repairing or replacing the injured functional structures of the respiratory system. This review article summarises about stem cell therapy and the progress of implementation it in a cure for COPD.

KEYWORDS : COPD, Stem cells, mesenchymal stem cells MSCs, GOLD.

INTRODUCTION

Stem cell therapies have emerged as a ground breaking approach in medicine, harnessing the power of human stem cells, including human embryonic stem cells and umbilical cord tissue stem cells, to treat various diseases and conditions. These versatile cells can differentiate into numerous cell types such as blood cells, muscle cells, nerve cells, and brain cells, offering immense potential for regenerative medicine¹.

Stem Cells

Stem cells are specialized, undifferentiated cells with the unique ability to self-renew and differentiate into various cell types in the body. They play a crucial role in growth, development, and tissue repair².

Stem Cells In COPD

Stem cells have the unique ability to change into any cell in the body, called differentiation. They can be administered intravenously and find damaged tissues around organs. When used in regards to COPD patients, stem cells can repair damaged lung tissue to combat emphysema or chronic bronchitis. Stem cells have natural anti-inflammatory properties, which can clear airways for those with chronic bronchitis³.

Need to have a look into what are these stem cells⁷....

Types of Stem Cells**a. Embryonic Stem Cells (Pluripotent)**

Embryonic stem cells originate from early-stage embryos at the blastocyst stage. They are pluripotent - meaning they can differentiate into any cell type within the body - making them highly versatile tools for medical research.

b. Adult Stem Cells (Somatic)

Somatic or adult stem cells are undifferentiated cells found throughout the body after development. They have a limited range of differentiation possibilities compared to embryonic stem cells but play an essential role in maintaining and repairing the body's tissues.

c. Induced Pluripotent Stem Cells (iPSCs)

Induced pluripotent stem cells (iPSCs) are created by reprogramming specialized adult cells back into an embryonic-like state using specific genetic factors. This process allows them to possess similar characteristics to embryonic stem cells without the ethical concerns surrounding embryo-derived stem

Applications of Stem Cells

Stem cells have the potential to revolutionize several areas of medicine, including⁷:

- Regenerative Medicine:** By differentiating stem cells into specific cell types, researchers can use them to replace damaged or lost tissue in patients with various diseases or injuries, such as Parkinson's disease, spinal cord injuries, or heart disease.
- Drug Development:** Stem cells provide an accurate model for studying how specific cell types react to drugs, enabling researchers to evaluate the safety and efficacy of new treatments.
- Disease Modelling:** By generating stem cells from patients with specific genetic disorders, scientists can create personalized cell models of the disease, furthering our understanding of the disorder and facilitating the development of potential treatments.

New Frontier in Medical Treatment

Stem cell-based therapies are emerging as a promising approach to treating various diseases and conditions by using stem cells to repair or replace damaged or diseased cells, tissues, or organs within the body. The goal of stem cell therapy is to regenerate lost or damaged cells, restoring normal function and improving patients' overall well-being³.

Types of Stem Cell Treatments

- Hematopoietic Stem Cell Transplantation** – This treatment uses bone marrow or blood-derived stem cells to treat blood disorders such as leukaemia and lymphoma.
- Mesenchymal Stem Cell Therapy** – Sourced from umbilical cord tissue, bone marrow or adipose tissue, these stem cells can potentially treat conditions like osteoarthritis and tendon injuries, Multiple Sclerosis, ALS as well as heart disease.
- Embryonic Stem Cell Therapy** – Using embryonic stem cells for treating a variety of conditions, although ethical concerns limit its widespread use.
- Induced Pluripotent Stem Cell (iPSC) Therapy** – This innovative approach involves reprogramming adult cells into an embryonic-like state to treat various diseases⁵.

Regenerative Approach In COPD

- The regenerative approaches have included extrinsic cell therapy (embryonic stem cells (ESCs), induced pluripotent stem (iPS) cells, mesenchymal stem cells (MSCs), and lung stem cells (LSCs) such as the infusion of exogenous stem cells to repair the damaged structure of the respiratory system and intrinsic cell therapy such as the administration of small molecules to stimulate the endogenous lung stem/progenitor cells for regeneration and replacement of the damaged structures⁷
- Mesenchymal stem cells could help patients with COPD. When administered intravenously, stem cells have the ability to promote healing and regeneration by secreting messenger cells called "cytokines"⁸
- Stem cells have the unique ability to become any cell in the body, called differentiation. They can be given intravenously and are found in damaged tissue around organs. When used in COPD patients, stem cells can repair damaged lung tissue to fight emphysema or chronic bronchitis. Stem cells have natural anti-inflammatory properties that can clear the airways for people with chronic bronchitis⁴
- Completed studies have demonstrated the ability to quantify the effects of stem cell therapy. According to a report done by the Lung Institute called Autologous Stem Cell Therapy and Its Impact on COPD, more than 82 percent of patients who tried stem cell therapy experienced a significant improvement in their quality of life after treatment. Many of these patients reported increases in lung capacity and walking ability after blood transfusions. These reports position stem cells as one of the best available options for current COPD patients.⁵

Current Treatments For COPD

Medications: Bronchodilators, corticosteroids, and other medications can help open the airways and reduce inflammation, making it easier to breathe.

Oxygen Therapy: For people with severe COPD, oxygen therapy may be necessary to provide enough oxygen to the body. This may involve using an oxygen tank or portable oxygen concentrator.

Pulmonary Rehabilitation: This program of exercise and education can help improve physical conditioning and quality of life for people with COPD.

Surgery: In some cases, surgery may be necessary to remove damaged lung tissue or to repair a damaged airway.

Stem Cell Therapy: There is some evidence that stem cell therapy for lungs may be effective in improving lung function and reducing inflammation in people with COPD. However, the effectiveness of stem cell therapy for COPD is still being studied, and more research is needed to determine its long-term effectiveness.⁶

Clinical Trial Of Stem Cells In COPD

A recent study conducted by Phuong Le et al. has shown that allogeneic umbilical cord-derived mesenchymal stem cell transplantation is both a safe and effective treatment option for both moderate to severe COPD (Chronic Obstructive Pulmonary Disease) patients. Twenty patients were enrolled in the study, patients were infused with expanded allogeneic umbilical cord tissue derived mesenchymal stem cells (MSCs). All patients were followed for 6 months after the first infusion. The treatment end-point included a comprehensive safety evaluation, pulmonary function testing (PFT), and quality-of-life indicators including questionnaires, the 6-min walk test (6MWT), and systemic inflammation assessments. All patients completed the full infusion and 6-month follow-up.¹⁰

The study concluded that MSC treatment was safe. There were no infusion-related toxicities, deaths, or severe adverse events occurred that were deemed related to UC-MSC administration. The UC-MSC-transplanted patients showed a significantly reduced Modified Medical Research Council score, COPD assessment test, and number of exacerbations. This study showed that allogeneic non-HLA-matched UC-MSC transplantation is a safe treatment that improved the quality of life of COPD patients. This clinical study was the first to use allogeneic MSCs from umbilical cord tissue to treat COPD.³

Data show that UC-MSCs can help improve the symptoms of bronchopulmonary dysplasia and have fewer adverse reactions. In addition, the administration of UC-MSCs to low-birth-weight premature infants can effectively reduce the risk of bronchopulmonary dysplasia.⁴

According to the World Health Organization, there are more than 650,000 COPD (chronic obstructive pulmonary disease) patients worldwide. The goal of mesenchymal stem cells in the treatment of COPD is to promote the regeneration of lung parenchymal cells and alveolar structures and the recovery of lung function. So far, five clinical trials have used BM-MSCs as the main stem cells for the treatment of COPD, but the therapeutic effect needs to be confirmed in larger clinical trials. Although the standard pharmacological therapies, including bronchodilators, inhaled corticosteroids and the phosphodiesterase 4 inhibitor, roflumilast, showed modest efficacy in improving pulmonary function, to date, no conclusive clinical evidence was found to show that any existing medications for COPD could modify the long-term decline in pulmonary function as well as the mortality. Therefore, the development of novel effective treatments to reverse the decline in pulmonary function and reduce the clinical symptoms of the COPD patients is urgently needed. Stem cells are a class of cells with the ability to self-renew repeatedly, and produce at least one type of highly differentiated progeny. The most important function of stem cells is to maintain cell regeneration⁵

Of course, many latest findings of stem cells research have also provided new insights into the potential of stem cells to treat a variety of lung diseases, and the stem cell therapy for COPD has gradually become a hot spot. In recent years, the therapeutic effect of stem cells in animal models of COPD has been demonstrated by many preclinical studies, which mainly focus on BM-MSCs, AD-MSCs, and UC-MSCs. The purpose of these studies was to evaluate the safety of infusion procedure in patients with advanced COPD (GOLD stage IV). Later stage intratracheal/intra bronchial administration of BM-MSCs was done and found more effective than intravenous infusions. All the studies concluded administration of MSCs in severe COPD patients was relatively safe and was able to reduce systemic inflammation by reducing the level of CRP and to improve life quality of COPD patients.¹⁰

Challenges And Limitations In Stem Cell Therapy

1. **Standardization And Regulation** – Inconsistency in protocols across research labs may lead to ineffective treatments.
2. **Cultivating Stem Cells** – Difficulty in growing and maintaining large numbers of stem cells in the lab can limit treatment availability.
3. **Ethical Concerns** – The use of embryonic stem cells raises ethical questions, potentially limiting research funding.
4. **Safety Concerns** – The potential for stem cells to form tumours or migrate to incorrect locations within the body poses safety risks (embryonic stem cells).
5. **High Costs** – The expenses associated with stem cell therapy may limit access for many patients.⁶

CONCLUSION

While stem cell treatment has not shown the ability to cure COPD, its ability to repair damaged tissue and relatively invasive nature makes it an attractive alternative to patients. This path becomes even more desirable when considering the current treatment protocols requiring the use of ventilators or even total lung transplants, which are rare and extremely expensive.

It is believed that stem cell therapy may play a revolutionary role in the treatment of COPD and other respiratory diseases in the near future. As of today, there is no proven cure for COPD; however, modern advances in stem cell therapy have yielded promising results. Regenerative therapies can improve functionality by repairing or replacing the damaged structures.

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