

Stem cells: Modeling, regeneration, and therapy.

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Introduction

This review explores the significant progress of human induced pluripotent stem cells (hiPSCs) in modeling neurodegenerative diseases like Alzheimer's and Parkinson's, and their potential for therapeutic applications. It also addresses the current hurdles, such as scalability and immunogenicity, pointing towards future strategies for clinical translation[1].

This article highlights the therapeutic potential of Mesenchymal Stem Cells (MSCs) across various regenerative medicine applications, including tissue repair and immune modulation. It discusses their biological characteristics, mechanisms of action, and current clinical trial landscape, emphasizing their versatility and safety profiles[2].

This review provides an overview of recent advancements in hematopoietic stem cell transplantation (HSCT), discussing improvements in conditioning regimens, donor selection, and supportive care. It also touches upon novel strategies like gene therapy and immune cellular therapies that are enhancing HSCT's efficacy and expanding its applications for various hematological and non-hematological disorders[3].

This article details how CRISPR-Cas9 technology is revolutionizing stem cell research, particularly in human pluripotent stem cells (hPSCs), for creating precise disease models and developing therapeutic strategies. It discusses the methodologies, challenges, and ethical considerations associated with gene editing in stem cells for treating genetic disorders[4].

This review examines the growing field of organoids derived from stem cells, highlighting their utility as in vitro models for studying organ development, disease pathogenesis, and drug discovery. It covers various organoid types and their applications, emphasizing their capacity to mimic physiological conditions more accurately than traditional 2D cultures[5].

This article reviews the advancements in using cardiac stem cells for repairing and regenerating damaged heart tissue, especially after myocardial infarction. It delves into the different types of cardiac stem cells, their regenerative mechanisms, and the challenges

faced in clinical translation, offering insights into future therapeutic strategies[6].

This paper explores the intricate relationship between stem cells and the aging process, examining how stem cell dysfunction contributes to age-related decline in tissue regeneration and organ function. It discusses potential interventions targeting stem cell rejuvenation to combat aging and age-related diseases[7].

This review focuses on the therapeutic potential of exosomes derived from various stem cell types in regenerative medicine. It details their roles as mediators of intercellular communication, their immunomodulatory and regenerative properties, and the challenges in their large-scale production and clinical application[8].

This article explores the critical role of cancer stem cells (CSCs) in conferring drug resistance in various malignancies, making them a significant barrier to effective cancer therapy. It discusses the mechanisms by which CSCs evade conventional treatments and highlights novel strategies aimed at targeting CSCs to overcome resistance[9].

This review summarizes recent advances in protocols for directing the differentiation of pluripotent stem cells (PSCs) into specific cell types, crucial for regenerative medicine applications. It highlights improved efficiency, purity, and functionality of differentiated cells, paving the way for better cell-based therapies and disease modeling[10].

Conclusion

Stem cell research continues to advance rapidly, offering profound insights and therapeutic potential across various medical fields. Human induced Pluripotent Stem Cells (hiPSCs) show great promise in modeling neurodegenerative diseases like Alzheimer's and Parkinson's, and for therapeutic applications, though challenges like scalability and immunogenicity require attention. Mesenchymal Stem Cells (MSCs) are recognized for their versatility in regenerative medicine, contributing to tissue repair and immune modulation, with a strong safety profile. Similarly, Hematopoietic Stem Cell Transplantation (HSCT) has seen improvements in conditioning

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regimens and donor selection, with gene therapy and immune cellular therapies further enhancing its efficacy for hematological disorders.

CRISPR-Cas9 technology is revolutionizing how we create precise disease models and therapeutic strategies using human Pluripotent Stem Cells (hPSCs), though ethical considerations remain important. Organoids, derived from stem cells, serve as valuable in vitro models for studying organ development, disease, and drug discovery, offering a more accurate physiological representation than traditional cultures. Cardiac stem cells are being investigated for repairing and regenerating damaged heart tissue post-myocardial infarction, despite clinical translation hurdles.

Further, the intricate relationship between stem cells and aging is explored, with a focus on how stem cell dysfunction impacts tissue regeneration and potential interventions for rejuvenation. Exosomes from various stem cell types are emerging as key mediators in regenerative medicine, exhibiting immunomodulatory and regenerative properties, though large-scale production is a challenge. Crucially, Cancer Stem Cells (CSCs) are identified as a major factor in drug resistance in malignancies, driving research into targeted therapies to overcome this barrier. Advances in directed differentiation of Pluripotent Stem Cells (PSCs) are improving the efficiency and purity of specific cell types, paving the way for better cell-based therapies and disease modeling.

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