Journal of Advanced Chemical Engineering
ISSN: 2090-4568
OPEN ACCESS Freely available online
Commentary

Chemical Engineering Approach to Regenerative Therapy in Development of Human Tissues

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INTRODUCTION

Regenerative medicine follows the process of replace, engineer and regeneration of human or animal cells, tissues and organs. This developed therapy was motivated from organ and tissue loss through injury or disease. Regenerative medicine is an interdisciplinary field which applies engineering and life science principles that holds the potential to engineer the damaged tissues and organs. It stimulates the natural repair mechanism of the body to heal previously irreparable organs and tissues. There is a possibility of regenerating tissues or organs within laboratories and implant them when the body failed to heal itself. Use of stem cells is one of the main biomedical approaches in the field of regenerative medicine. Regenerative medicine could potentially alleviate the problem of non-availability of organ or tissue for transplantation. It is hard to meet the demand of every requirement for transplantation which leads to the long waiting list of people for the donation of the tissues or organs. This approach could circumvent the challenge of organ transplant rejection due to immunological mismatch or shortage of donors as the regeneration of organ is sourced from patients own tissues or cells. For a successful strategy of regenerative medicine, the materials used, mostly the combinations of scaffolds, stem cells and growth factors must be proficient enough to replace the damaged tissues and also to function as the original tissue or possibly stimulate the regeneration of the original tissue. In tissue engineering and regenerative medicine, the cells used can either be autologous, where the cells are collected from the same patient or allogeneic, where the cells are collected from another individual. Xenogeneic cells, those which are obtained from animals can also be endorsed in regenerative medicine strategy. To the present day, stem cells, fibroblasts, chondrocytes, and keratinocytes are the cells used in tissue engineering. Regenerative medicine utilizes and accelerates the body's own healing process, depending on the age of the patient.

The aim of regenerative medicine is to change the tissue environment by introducing the exogenous material and biological factors with solitary purpose of accelerating and enhancing the body's natural healing process. For several years to now, materials and biomimetics of the extracellular matrix are used and they can not only stimulate own regeneration but also are used to present biomolecules like growth factors that promote cell growth. The biomaterial or the scaffold was now found to be able to assimilate the biological signals to promote the regeneration and function of the tissue, which was primarily thought, was only necessary for physical support to cells. Different tissues have different regeneration capacities, while some tissues do not necessarily require cells but just the biomaterials and biologics alone, other kind of tissues with sparse capacity to regenerate, require biomaterials, biomolecules along with cells to stimulate regeneration. The organs or tissues with poor or no regenerative capacity include cartilage and cornea whilst the organs with high regeneration capacity are the liver and the lungs. Materials that are bind to the biomolecules and growth factors can yield sustained stimuli to enhance and promote cellular differentiation and regenerate the damaged tissue. The bone morphogenic proteins (BMP) are growth factors used in one of the regenerative medicine strategies to promote bone formation and platelet derived growth factor for wound healing.

Over the last decade, the Food and Drug Administration (FDA) and European Medicines Agency (EMA) have approved several stem cell therapies and 3D bio-printed constructs. The possibility of complications, post the transplantation of material arises with using of certain materials that lack the growth factor release control. The FDA approved products showed better results than pre-existing products, although the efficiency may vary.

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Received: August 06, 2021; **Accepted:** August 23, 2021; **Published:** August 30, 2021

Citation: Thierry BAA (2021) Chemical Engineering Approach to Regenerative Therapy in Development of Human Tissues, J Adv Chem Eng, 11:4: 203

ACKNOWLEDGMENTS

The authors are grateful to the journal editor and the anonymous reviewers for their helpful comments and suggestions.

DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interest for the research, authorship, and/or publication of this article.