Tissue Engineering

Morgan Hammick, *Biomedical Engineering, University of Rhode Island*
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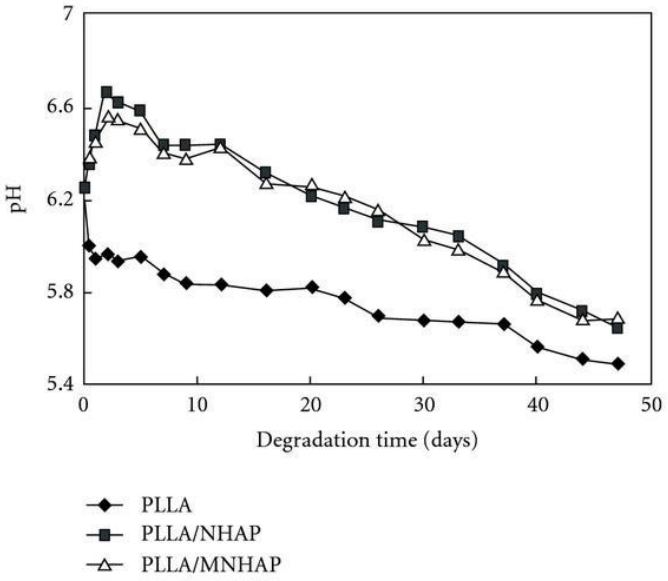
I. Introduction

In recent years, lack of donor organs has caused many to consider tissue engineering methods as means to replace diseased or damaged organs. This newly emerging field uses tissue-specific cells in a three dimensional organization, provided by a scaffolding material, to return functionality of the organ.

II. Materials

There are many different materials being considered for scaffold formation. The materials showing the most promise are poly (glycolic acid) (PGA), poly (L-lactic acid) (PLLA) and their copolymer, poly (DL-lactic-co-glycolic acid) (PLGA). These polymers are preferred over other materials because they offer distinct advantages. Their relative biocompatibility and ability to be sterilized have been well documented. Also, their degradation rates can be tailored to match that of new tissue formation. Since PLLA is more hydrophobic than PGA and degrades at a slower rate the degradation rate of the unstructured copolymer can thus be easily controlled by changing the ratio of PLLA to PGA



III. Scaffolds

Creating sustainable scaffolds is a huge priority for tissue engineering. They are tricky to make because they must be biocompatible with the intended patient. Also, they must have a large surface area to allow cell attachment and promote tissue growth, which is usually done by creating highly porous polymer foam. There are many methods used today to create these scaffolds. One such method is called Fiber Bonding. In which PLLA or PLGA is dissolved in chloroform and sprayed onto the PGA fibers. The solvent is then evaporated, leaving the fibers glued with PLLA or PLGA. When tubes made in this manner were implanted in rats for 17 days, fibrous tissue in growth was observed, indicating that constructs with these physical properties could encourage neo tissue formation. The main problem with this method is that the toxic solvents would be harmful to cells if not completely removed. Other scaffolding methods include Solvent Casting/ Particulate Leaching and Gas Foaming. Gas Foaming is a preferred method because it doesn't use harsh chemicals, but it is limited because it results in pores that are largely unconnected and the high temperature used in the process prohibits the integration of cells or bioactive molecules. One last method is Phase Separation/ Emulsification. Emulsification involves freeze drying, and Liquid-liquid phase separation involves the use of harsh chemicals. However, in Liquid-Liquid phase separation, the pores sizes can be manipulated for specific applications, which is obviously very advantageous.

IV. Discussion

Recently tissue engineering has been applied to research in fixing problems throughout the body, such as the heart, the brain, bones, and skin. For example, cardiac tissue engineering is now being investigated as an approach to support cell-based therapies for myocardial infarction, heart failure, and congenital heart diseases. Tissue engineering is a rapidly expanding field, but, like any developing field, issues arise. For example, a substrate material must be inserted to aid in organization of the cells in three dimensions for the cells to maintain their tissue-specific functions once implanted. The substrate material must demonstrate good biocompatibility (it cannot obtain an unresolved inflammatory response nor cause an extreme immune response or be poisonous to living cells). Also, the mechanical properties of the scaffold must be sufficient so that it does not collapse during the patient's normal activities. Once these issues are resolved, the future of tissue engineering looks extremely promising and will immeasurably improve the quality of human health care.

References

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