CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

S0516

Project Title

The Future of Tissue Engineering: A Novel Perfusion-Based Protocol for Decellularizing Adipose Tissue on a Bioreactor

Abstract

Objectives/Goals

Every year, almost 7000 of the 110,000 organ transplant candidates in the U.S. die while on a waiting list. Tissue engineering has great potential to satisfy the need for replacement organs and to be applied in other clinical venues, such as wound repair, organ regeneration, and military and cosmetic surgery. Decellularization is a critical step in the tissue engineering process because it removes cells and cellular antigens that may cause transplant rejection while maintaining an intact extracellular matrix (ECM) and vasculature as a location for stem cell seeding and growth. The use of adipose (fat) tissue is advantageous in that its high degree of vascularization enables long-term tissue viability. None of the existing protocols for adipose tissue decellularization employ perfusion-based methods, which would result in a more thorough decellularization. The purpose of this study was to develop a novel perfusion protocol to decellularize adipose tissue on a bioreactor, a perfusion apparatus that maintains physiological conditions ex vivo.

Methods/Materials

Peracetic acid was determined to be ideal for removing cells while maintaining an intact ECM and vasculature. Thus, a novel protocol that employed perfusion of 0.1% peracetic acid in PBS pH 7.4 was designed for decellularizing adipose tissue on the bioreactor. In repeated trials (n=3), the decellularization efficacy of this protocol was compared with that of two existing detergent-based protocols using four methods of data analysis: a perfusion test, two histological stainings (H & E, Masson#s Trichrome), and a computer program developed by the researcher for quantitative image analysis.

Results

The results indicated that the novel perfusion-based protocol using peracetic acid was the most effective with respect to both ECM and vasculature preservation and uniform and consistent cell removal (mean=73%, range=8%). However, the two existing protocols attained lower levels of decellularization that was concentrated only to surface regions of tissue

Conclusions/Discussion

The researcher developed a novel perfusion-based approach to adipose tissue decellularization employing peracetic acid, which holds great potential for successful stem cell seeding, viable organ growth, and ultimately, transplantation. This protocol is currently being applied by the Pediatric Regenerative Medicine Lab at Stanford University.

Summary Statement

Through this study, the researcher has developed the first perfusion-based protocol to successfully decellularize adipose tissue; this protocol has a multitude of applications to tissue engineering and emerging clinical medicine

Help Received

Used lab equipment and conducted experiments at Stanford University under the supervision of Dr.Michael Sorkin