A Small Diameter Elastic Blood Vessel Wall Prepared under Pulsatile Conditions from Polyglycolic Acid Mesh and Smooth Muscle Cells Differentiated from Adipose-Derived Stem Cells

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Introduction

Smooth muscle layer plays an important role in maintaining homeostasis of blood vessels, thus generating a functional smooth muscle layer is a prerequisite for successful construction of blood vessels via tissue engineering approach. In this study, we investigated the feasibility of constructing an elastic vessel wall in small diameter (less than 6mm) using smooth muscle cells (SMCs) differentiated from human adipose derived stem cells (hASCs) under pulsatile stimulation in a bioreactor.

Materials and Methods

The isolation and culture of human adipose-derived stem cells (hASCs) in vitro, then the differentiated hASCs were detected by immunofluorescent staining and collagen gel lattice contraction assay. Histological staining, Western blot analysis, collagen quantification and biomechanical assessment were performed to evaluate the constructed vessels. A paired t-test (Student’s t-test) was performed and p<0.05 was considered statistically significant.

Results

With the induction of TGF-β1 and BMP4 in combination for 7 days, hASCs were found to acquire a SMC phenotype characterized by the expression of SMC-related markers including α-SMA, calponin, and SM-MHC. The differentiated hASCs with dynamic loading were found to maintain their SMC phenotype within 3-dimensional PGA scaffold with a high level of collagen deposition close to that of native ones. More importantly, the engineered vessel under pulsatile stimulation exhibited significant improvement in biomechanical properties over that generated from static conditions.

Discussion and Conclusions

An elastic small diameter vessel wall (4 mm in diameter) with improved biomechanical strength could be engineered by in vitro culture of SMC-differentiated hASCs on the PGA scaffold in a blood vessel bioreactor.

References


Acknowledgments

This work was financially supported by Doctoral Degree Foundation of China (Grant No: 200802480072) and National “973” Project Foundation (Grant No: 2005CB522700).

Disclosures

Authors have nothing to disclose.