Approaches in Heart Valve Tissue Engineering

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Abstract:

As the application of biomechanical stimuli to developing tissue has shown to be beneficial in terms of overall tissue properties, custom-built devices, termed bioreactors are designed so that they can provide appropriate mechanical conditioning to the engineered tissue. In heart valve tissue engineering applications, a bioreactor was successfully designed and used by Engelmayr et al [1]. This bioreactor subjected engineered tissue samples to flexure, flow and stretch modes of mechanical stimui [2]. In this project, we focus on this bioreactor design and proceed with relevant cell/tissue culture followed by engineered valvular tissue development. As a clinically viable cell source, we made use of ovine bone marrow mesenchymal stem cells. These cells were used to seed strips of nonwoven 50:50 blend poly(glycolic acid) (PGA) and poly(l-lactic acid) (PLLA) scaffolds. Seeded scaffolds that underwent mechanical conditioning were compared to static controls. Relevant assays to measure cell extracellular matrix production and density were performed. These results are their interpretation are discussed.

[1] Engelmayr Jr George C., Sales Virna L., Mayer Jr John E., Sacks Michael S. Cyclic flexure and laminar flow synergistically accelerate mesenchymal stem cell-mediated engineered tissue formation: Implications for engineered heart valve tissues. Biomaterials 27 (2006): 6083–6095.

[2] Engelmayr Jr George C. , Soletti Lorenzo, Vigmostad Sarah, Budilarto Stephanus, Federspiel William, Chandran Krishnan, Vorp David, Sacks Michael. Design and Qualification of a Novel Flex-Stretch-Flow Bioreactor for Engineering Heart Valve Tissues, Society of Heart Valve Disease, 4th Biennials meeting, June 15th-18th, New York, NY.