Data-driven optimization of bioengineered vascular scaffolds for small-diameter blood vessel replacement

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Abstract: Despite enormous potential, the impact of advanced biomaterials on tissue engineering and regenerative medicine have been somewhat limited by a lack of systematic, data-driven optimization of these materials for specific engineering applications. This is particularly evident in the vascular field where a large number of vascular replacement or repair surgeries are performed annually, and there is a critical lack of replacement materials. Development of optimized “off-the-shelf” materials that can be efficiently and effectively used for replacement of small diameter blood vessels would be a substantial advancement within this field. Decellularized extracellular matrix scaffolds have increasingly gained popularity as advanced platforms for tissue engineering purposes due to their enhanced biomechanical properties and diminished immunogenicity following engraftment. However, hurdles still remain in the development of decellularized scaffolds that are optimized specifically for small diameter vascular replacement. A team of investigators has been assembled whose specific expertise and experiences will be combined towards the development of an idealized small diameter vessel replacement scaffold. Experiments are being carried out to systematically apply selected decellularization protocols to the porcine internal thoracic artery and evaluate the resulting scaffold for cellularity, mechanical properties, extracellular matrix composition, thrombogenesis, toxicity, immunogenenicity and repopulation potential. Quantitative data from these initial experiments will provide input for computational modeling that will allow more effective predictions regarding the resultant mechanical and biological properties of scaffolds based on modulation of select decellularization parameters. *This work is being funded by support from the South Carolina EPSCoR Stimulus Research Program.*