A NOVEL APPROACH FOR ASSESSMENT OF THE MECHANICAL PROPERTIES OF SYNTHETIC ARTERIAL GRAFTS

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Introduction

Simultaneous measurement of pressure and diameter of blood vessels and/or synthetic arterial grafts in cardiovascular simulators is of great importance in cardiovascular research. These studies allow the possibility of submitting the samples to controlled experimental conditions [Bia, 2009]. Knowledge of diameter changes in response to intravascular pressure waveforms determines the basis to estimate biomechanical properties of vessel's wall.

The success of a vascular graft lies, among other things, in manifesting values of internal diameter and mechanical behavior which are comparable to the native arteries. Electrospinning of polymeric solutions allows the production of biomimetic nanofibrous structures with extracellular matrix morphology concomitantly with the adjustment of the mentioned parameters. Its mechanical evaluation requires an *in vitro* approach, which allows a precise and adequate estimation of the diameter dynamics, without disturbing the vessel itself.

Methods

A cardiovascular simulator designed to measure instantaneous pressure and diameter values in blood vessels and scaffolds was utilized. The simulator consists basically on an artificial heart (model Jarvik 5, Kolff Medical, Salt Lake City, UT) composed by in/out valves and two chambers separated by a mobile diaphragm. A perfusion line made of polyethylene and silicone, an organ chamber, a resistant modulator, a reservoir and an electrically controlled pneumatic pump complete the hydraulic circuit. Characterized electrospun polymeric tubular structures were obtained with a small diameter roto-collector. The poly(l-lactic acid) grafts presented a random bead-free nanofibrous morphology. The mean fiber diameter was 526 ± 190 nm. A solid-state pressure sensor (Model 2.5; 1200 Hz frequency response, Königsberg Instruments, Inc., Pasadena, CA, USA) was positioned inside the graft, through a catheter. Sonomicrometry (Tryton Technology Inc., San Diego, CA, USA) was used to estimate the distance between two small ultrasound crystals implanted in the sample, based on the time-of-flight assessment of an ultrasound pulse [Armentano, 2007]. Subsequently, dynamics of vessel's diameters and wall thickness was evaluated using backscattering RF signals (A-Scans), which provide high resolution measurements [Sushila, 2001].

Conclusion

This approach combines a gold standard method such a complete characterization through diameter pressure relationships introducing the advantages of high-resolution ultrasound techniques.

References

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