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Artificial Arteries

Electrospinning Technology

In the past 20 years there have been many attempts to create a small-caliber arterial substitute for bypass surgery. Up until now the only option was using donor arteries, but finding compatible arteries is not always easy. Studies are now under way to create vascular grafts with similar composition, geometry, and mechanics as nature vessels using electrospinning.

Electrospinning (ES) is a process in which a polymer is placed in a volatile solvent. An electromagnetic field is then created using a high voltage source. This field then causes the polymers to elongate and spread out into small fibers. The fibers are then drawn to a grounded surface or adhere to a surface placed in between the solution and ground. This technique has been used to form nerve conduits, bone scaffolds, wound dressings, and drug and DNA delivery agents. The study at Wake Forest University set out to create the first trials in creating a vascular scaffold and perform tests on its mechanical, biocompatibility, and in vivo properties.

When creating the scaffolds the research group used type I collagen from calfskin, elastin from bovine neck ligament, and PLGA. The PLGA was added to increase mechanical strength as well as improve viscosity and spinning characteristics of the solution. After being placed in a certain ratio the solution it then went of the process of ES.

After producing the vascular scaffolding the material distribution, biomechanical properties, and in vitro and in vivo biocompatibility was measured to determine the feasibility of using them as graft material. In terms of both collagen and elastin, tests showed that there was uniform distribution. This showed that the content and the distribution of the scaffolds can be controlled depending on the situation requires. One of the most important tests though was biocompatibility, which shows whether the implantation of the electrospun vascular grafts is safe or not. In all cases it was found that in the in vitro case it was completely safe and actually promoted cellular growth. In the in vivo cases the fabricated scaffolds were implanted in mice. In all cases there were no effects whatsoever.

In conclusion, this study has shown that fabricated vascular scaffolds could be controlled to produce vascular grafts, which share structural characteristics to normal vessels. By controlling the ratio of collagen, elastin, and PLGA, there are improved ES characteristics and strength of scaffolds (they resist bursting at about 12 times normal systolic pressure). This study shoes the potential of a new source of functional vascular grafts. The next step for researchers is to demonstrate the ability of these new scaffolds as a vascular bypass graft in sheep.

Works Cited

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