

March 26-28, 2018
Vienna, Austria

Polym Sci, Volume 4
DOI: 10.4172/2471-9935-C1-009

NATURAL POLYMERS AS A MATRIX FOR CELLULARISED SCAFFOLDS FOR 3D REGENERATIVE MEDICINE

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Over the last 50 years, biomaterials, prostheses and implants saved and prolonged the life of millions of humans around the globe. Today, nano-biotechnology, nanomaterials and surface modifications provide a new insight to the current problem of biomaterial complications, and even allows us to envisage strategies for the organ shortage. In this talk, creative strategies for mixing vascular cells and collagen-based materials will be targeted with the overall aim to envisage today how far innovation can bring tomorrow solutions for regenerative medicine. Collagen gel is a commonly used scaffold in vascular tissue engineering due to its biological properties including a high potential for supporting and guiding vascular cells in the regeneration process. With the aim to regenerate the vascular wall, the approach we deployed consists in first reproducing the media, which provide the high elastic properties of the vessel wall, thus making it an essential and effective component for blood and nutrients transportation. Starting from an original method aimed to process collagen and smooth muscle cells (SMCs), we developed an endothelialised two layers collagen cell-based tubular scaffold. The external layer was composed of fibroblasts (FBs) and SMCs

seeded within collagen. The middle layer was composed of SMCs seeded within collagen, and endothelial cells (ECs) were culture on the lumen of the construct. The construct was expected to provide vascular tissue remodeling due to cells/cells and cells/matrix interactions and to produce an engineered tissue with hierarchical structure close to that of blood vessel walls. It was also expected to provide a valid *in vitro* model for further studies of vascular patho-physiology. The middle and external layer were mold around a mandrel, directly in the bioreactor chamber. Then, the mandrel was removed, and a ECs solution was perfused inside the lumen. The interaction between cells enhanced the matrix remodeling and the properties of the arterial construct resulted strongly improved. This shows that vascular cells tri-culture using collagen gel scaffold is a valid strategy for the regeneration of the vascular tissue. The overall take home message of this talk is aimed to show how 3D pluri-culture of appropriate material/cell/environment represent the today bottleneck in regenerative medicine and which are few of the strategies that must be investigated to push forward innovation in the field.

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