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Tuning Hierarchical Architectures of 3D Polymeric Scaffolds for Cardiac Tissue Engineering

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Abstract – This talk will present work undertaken to setup strategies to integrate stem cells and tailored scaffolds, as a tool to control cardiac tissue regeneration. Phase separation and electrospinning were selected as low-cost and user-friendly technologies to fabricate tuneable, hierarchically porous matrices that mimic aspects of the cell native surroundings.

The aging of population is one of the problems to be considered for sustainable development. Elder people needs healthcare treatments to improve their quality of life. The approach of regenerative medicine is of paramount importance for the rescue of patients with severe cardiac diseases, which can be treated only with transplants, since the number of donors is very limited.

The challenge for successful exploitation of cardiac regenerative medicine is to identify the suitable combination between the best cell source for cardiac repair and the design of the optimal scaffold as a template for tissue replacement. Adult stem cells have the potential to improve regenerative medicine with their peculiar feature to self-renew and differentiate into various phenotypes. Insights into the stem cell field lead to the identification of the suitable scaffold features that enhance the ex vivo proliferation and differentiation of stem cells.

Scaffolds composed of natural and/or synthetic polymers can organize stem cells into complex architectures that mimic native tissues. To achieve this, a proper design of the chemical, mechanical, and morphological characteristics of the scaffold at different length scales is needed to reproduce the tissue complexity at the cell-scaffold interface [1]. Hierarchical porosities are needed in a single construct, at the millimetre scale to help nutrition and vascularization, at the micrometer scale to accommodate cells, and at the nanometre scale to favour the expression of extra-cellular matrix components [2].

This talk will present work undertaken to setup strategies to integrate stem cells and tailored scaffolds, as a tool to control cardiac tissue regeneration. Phase separation and electrospinning were selected as low-cost and user-friendly technologies to fabricate tuneable, hierarchically porous matrices that mimic aspects of the cell native surroundings. The biological validation of these scaffolds was performed by implanting adult stem cells.

References

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