Production and characterisation of a bioartificial and functionalised cardiac patch prototype

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Introduction The main purpose of cardiac tissue engineering is to develop new biomaterials able to induce myocardium regeneration after infarction. A micro-structured PLGA/gelatine patch showed to have suitable physico-chemical and mechanical properties as well as to promote adhesion and an early myocardial commitment of human mesenchymal stem cells (Patent WO2014108814A1). In this study, the first steps towards a technological transfer of the cardiac patch have been taken.

Experimental methods The effects of sterilisation on the PDMS moulds (ThunderNIL srl) were evaluated. Maintenance of the micropatterning was assessed by optical microscopy and SEM. The effect on mechanical properties was studied using tensile tests. Rheological studies were performed to optimise the preparation of the bioartificial blend. The patches obtained at several production steps were characterised by means of mechanical tests, SEM, HPLC, GPC, FT-IR Chemical Imaging and mass loss. Drug release from patches was quantified by HPLC. Biological tests were performed using H9C2 cardiomyoblasts.

Results and discussion Sterilisation of the moulds was effective in removing bacteria without damaging the geometry. Production of the matrix was optimised, with a reduction of production time and a better reproducibility of the matrices. Mechanical anisotropy, typical of cardiac ECM, was confirmed in the prototype samples. Biological studies proved the cytocompatibility of the patches and their capability to favour cell adhesion and elongation. The kinetics of patch degradation products was evaluated. The micropatterning improved drug release due to an increased surface area in contact with the medium.

Conclusion This study represents an important starting point of a cardiac patch translational path that will require further scientific studies and fruitful interaction with biomedical companies.

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