Luca Gentile, J Stem Cell Res Ther 2017, 7:8(Suppl)
DOI: 10.4172/2157-7633-C1-026

The Heartpatch, an alginate-based scaffold system for cardiac tissue engineering

Luca Gentile
Fraunhofer Institute, Germany

Over the last 60 years, 14% of all drugs were withdrawn post-marketing owing to their cardiotoxic effects. Cardiovascular diseases are responsible for nearly half of all deaths in Europe. This is largely due to the poor regeneration capability of the human heart, which culminates in scar tissue formation and reduced function. Although advanced medical procedures increased the survival rate, cell-based therapies fall short in delivering a functional engraftment, and many patients progress towards end-stage heart failure. We used 3D printing and ultra-high viscosity alginate to produce a hydrogel scaffold called the Heart-patch, which could sustain cardiac muscle identity as a functional unit over long time in culture. Human induced pluripotent stem cell-derived cardiomyocytes cultured on the Heartpatch are closer to adult CMs that those cultured on traditional plastic, making the Heartpatch a physiologically relevant model of the heart. Biocompatible UHV alginate is 3D printed using a novel, viscosity-independent, printing method. It allows both patterning the scaffold's surface and tuning its stiffness. Additionally, surface modifications can be applied with click-it chemistry, allowing a specific ECM protein composition that mimics the cardiac niche. Cardiomyocytes on the Heartpatch can be cultured for longer periods (3-4 months) than their counterparts on cell culture plastic, exhibiting self-sustained macro contractions visible to the naked eye. Gene expression profiling and immunocytochemistry analysis indicate increased cardiomyocyte maturation, enhanced cell-cell interactions and a high degree of both electrophysiological coupling and cytoskeletal maturation. As a result, force transduction resembles more closely the *in vivo* situation, as also supported by a novel optical-based analysis of the self sustained depolarization. On the Heart-patch, hiPSC-CMs acquire an additional degree of freedom. As an individual working unit, the Heartpatch is an enhanced cardiac muscle model that enables disease modeling and high-throughput compound screening, with potential future applications in regenerative medicine.

Biography

Luca Gentile graduated in Developmental Biology in 2000 and received his PhD in Bioengineering and Bioinformatics at the University of Pavia (ITA). In 2003, he was invited to the Center for Animal Transgenesis and Germ Cell Research (Kenneth Square, PA, USA) for studying reprogramming in single reconstructed mouse embryos. In 2004, he joined the Max Planck Institute for Molecular Biomedicine (Münster, GER), working on the onset of cellular reprogramming. In 2010, he was appointed Head of the Planarian Stem Cell Laboratory (Münster, GER), working on the conserved mechanisms of pluripotency. In the same year, he organized the first International Meeting on Planarian Biology, which in 2018 reaches its 4th edition (Madison, WI, USA). Since March 2015, he leads the Pluripotency & Regeneration Group at the Fraunhofer Institute for Biomedical Engineering (Sulzbach, GER). His subjects of investigation are the derivation of human cardiac organoids and the functional characterization of stem cell subpopulations in planarian S. mediterranea.

luca.gentile@ibmt.fraunhofer.de

Notes: