Biomimetic Polymers for Cardiac Tissue Engineering

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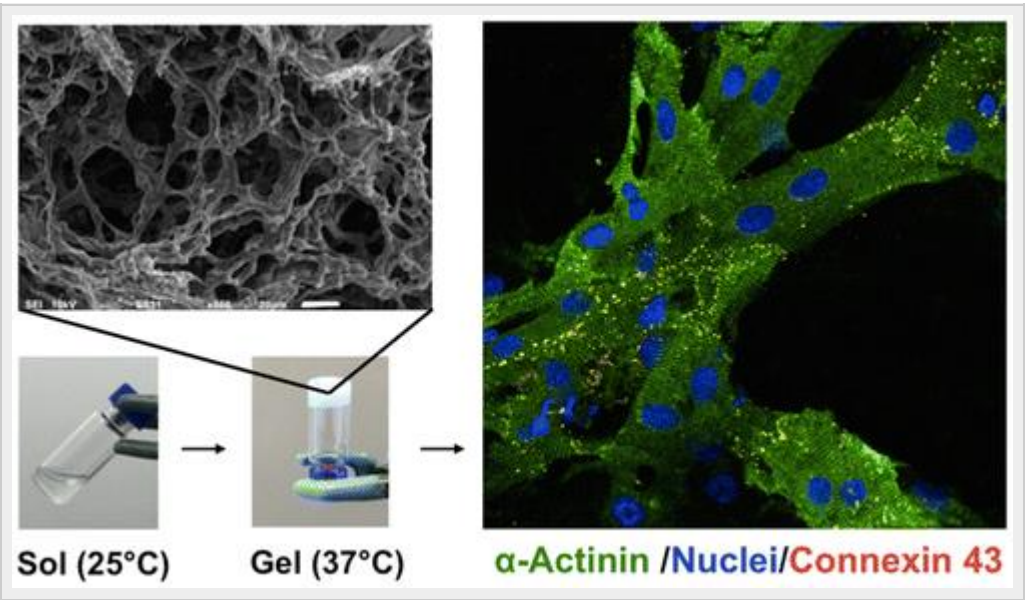
Abstract



Heart failure is a morbid disorder characterized by progressive cardiomyocyte (CM) dysfunction and death. Interest in cell-based therapies is growing, but sustainability of injected CMs remains a challenge. To mitigate this, we developed an injectable biomimetic Reverse Thermal Gel (RTG) specifically engineered to support long-term CM survival. This RTG biopolymer provided a solution-based delivery vehicle of CMs, which transitioned to a gel-based matrix shortly after reaching body temperature. In this study we tested the suitability of this biopolymer to sustain CM viability. The RTG was biomolecule-functionalized with poly-L-lysine or laminin. Neonatal rat ventricular myocytes

(NRVM) and adult rat ventricular myocytes (ARVM) were cultured in plain-RTG and biomolecule-functionalized-RTG both under 3-dimensional (3D) conditions. Traditional 2D biomolecule-coated dishes were used as controls. We found that the RTG-lysine stimulated NRVM to spread and form heart-like functional syncytia. Regarding cell contraction, in both RTG and RTG-lysine, beating cells were recorded after 21 days. Additionally, more than 50% (p value < 0.05; n = 5) viable ARVMs, characterized by a well-defined cardiac phenotype represented by sarcomeric cross-striations, were found in the RTG-laminin after 8 days. These results exhibit the tremendous potential of a minimally invasive CM transplantation through our designed RTG-cell therapy platform.