Docket #: S20-273

Expansion of Human iPSC-derived Cardiomyocytes In Vitro Through Small Molecule Inhibition of Cell-Cell Contact

Stanford inventors have identified a treatment regimen that allows expansion of cardiomyocytes (CMs) derived from human induced pluripotent stem cells *in vitro*. Human iPSC-derived cardioymyocytes (hiPSC-CMs) are a tool used frequently in the study of cardiac biology and disease recently shown to have therapeutic potential. Cell-based therapeutic approaches using hiPSC-CMs, such as the injection of these cells or the transplantation of engineered cardiac tissue, show promise in repairing damage and improving cardiac function characteristic of many heart diseases. These approaches are limited because they require billions of CMs, a process that is technically challenging and incredibly resource intensive. To overcome this limitation, researchers in the Wu lab developed pharmacological interventions that block inhibition of proliferation consequent from cell-cell contact. Co-treatment with a small molecule mitogen combined with the pharmacological inhibition of cell-cell contact restores the regenerative capacity of hiPSC-CMs while maintaining the functional integrity of CMs. In addition to overcoming a technical barrier for therapeutic development, the ability to massively expand CMs *in vitro* enables researchers to address previously unanswered questions in regenerative biology, cardiac disease, and drug discovery using a highly pure and patient specific model.

Stage of Development
Research - *in vitro*

Applications

- Cell therapy for cardiomyopathy or congenital heart defects

- Cardiac regeneration therapy or transplantation
- *In vitro* disease modeling
- High throughput drug toxicity and efficacy screening
- Patient-specific engineered heart tissue
- 3D tissue generation

Advantages

- Targeted expansion of CMs generates large numbers of pure CMs previously unobtainable *in vitro*
- Bypasses need to start differentiation process with large amounts of iPSCs
- CMs retain contractile, electrophysiological, and cellular characteristics
- Robust protocol works across multiple cell lines with no observable differences from genetic background showing potential for patient-specific CM expansion
- Can be expanded right away or following cryopreservation
- Proliferating cells can be rapidly matured
- Decreased labor and time

Publications

- Maas, R. G., Lee, S., et al. (2021).Massive expansion and cryopreservation of functional human induced pluripotent stem cell-derived cardiomyocytes. STAR protocols, 2(1),100334.
- Buikema, J. W., Lee, S., et al. (2020). Wnt Activation and Reduced Cell-Cell Contact Synergistically Induce Massive Expansion of Functional Human iPSC-Derived Cardiomyocytes. Cell stem cell, 27(1), 50–63.e5.

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