User Manual:
2D Human Induced Pluripotent Stem Cell-derived Cardiomyocyte Cardiac Contractility Modulation Tool: 2D hiPSC-CM CCM Tool

Tool Reference

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For technical details regarding cell culture (monoculture), electrical apparatus, and stimulation:

Feaster, T. K., Casciola, M., Narkar, A., Blinova, K. (2022). Evaluation of Cardiac Contractility Modulation Therapy in 2D Human Stem Cell-Derived Cardiomyocytes. J. Vis. Exp. (190), e64848, doi:10.3791/64848

This publication describes the experimental details for maintenance and culture of 2D hiPSC-CMs monolayers as well as the application of nonexcitatory electrical stimulation (i.e., CCM). Step-by-step video and instructional protocol are provided. Likewise, the extension of CCM stimulation to a patient-specific disease model of Dilated Cardiomyopathy (DCM) is demonstrated.

For technical details regarding cell culture (co-culture), electrical apparatus, and stimulation:

Narkar, A., Feaster, T. K., Casciola, M., & Blinova, K. (2022). Human in vitro neurocardiac coculture (ivNCC) assay development for evaluating cardiac contractility modulation. Physiological Reports, 10, e15498. doi:10.14814/phy2.15498

This publication describes the experimental details for maintenance and culture of 2D hiPSC-CM (cardiomyocyte) and hiPSC-MN (Motor Neuron) monolayers (i.e., ivNCC, in vitro neurocardiac co-culture). Contractile response to nonexcitatory electrical stimulation (i.e., CCM) is described to elucidate cardiac-neuronal interplay and peripheral nervous system contribution. Detailed description of the electrical set up and pulse parameters are provided. Demonstration of pharmacological characterization is presented with, muscarinic agonist and β-adrenergic antagonist, to demonstrate functional coupling and elucidate potential mechanisms, respectively.

For technical details regarding cell culture (monoculture), electrical apparatus, and stimulation:

Feaster, T. K., Casciola, M., Narkar, A., and Blinova, K. (2021). Acute effects of cardiac contractility modulation on human induced pluripotent stem cell-derived cardiomyocytes. Physiol. Rep. 9, e15085. doi:10.14814/phy2.15085

This publication describes the experimental details for maintenance and culture of 2D hiPSC-CMs monolayers including the experimental conditions necessary to elucidate nonexcitatory electrical stimulation (i.e., CCM) response under these conditions (i.e., flexible substrate and submaximal extracellular calcium). Moreover, the methodology to evaluate contractile properties is described as well as additional cardiac excitation- contraction coupling readouts including electrophysiology (i.e., action potential) and intracellular calcium handling. Demonstration of pharmacological characterization is presented with β-adrenergic antagonist and extracellular calcium challenge to evaluate potential mechanisms. Detailed description of the electrical set up, pulse parameters and numerical electric field modeling are provided.