Effect of electrical field stimulation on intracellular sodium concentration in human iPS cardiomyocytes

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Human-induced pluripotent stem cell-derived cardiomyocytes (hiPS-CMs) are significantly immature compared with adult cardiomyocytes and exhibit a fetal-like phenotype. Although efficient propagation of electrical signals in the heart is crucial for natural development program and functionality, maturation of hiPS-CMs causes hyperpolarization of resting membrane potentials and a loss of automaticity *in vitro*. We therefore investigated whether artificial electrical field stimulations mature physiological properties of hiPS-CMs, especially on intracellular sodium concentrations ($[Na^+]_i$). We cultured hiPS-CMs for a week under electrical field stimulations (3 V/cm, 1 ms, 1 Hz), and quantified $[Na^+]_i$ with a Na^+ indicator. Basal intracellular sodium concentration without stimuli was 4.7 mM (n = 17) which is much lower than that in normal excitable cells (10-15 mM). The intracellular sodium concentration with the electrical stimuli (5.7 mM, n = 23) was significantly greater than $[Na^+]_i$ without stimuli. These results suggest that artificial electrical stimulations enable us to obtain more mature hiPS-CMs *in vitro*.