Exploring stem cell-derived cardiomyocytes with automated patch clamp techniques

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Abstract

There is a growing interest for cardiomyocytes from induced pluripotent stem cells as in vitro models. Recent advances in stem cell technology have permitted the generation of human cardiomyocytes from induced pluripotent stem cells (iPSCs), which offer several advantages compared to conventional cardiomyocytes derived from embryonic stem cells. These iPSC-derived cardiomyocytes have demonstrated features such as arrhythmogenic potential and a more robust response to pharmacological agents. In this study, we characterized the electrophysiological properties of cryopreserved human induced pluripotent stem (iPS) cell-derived cardiomyocytes, iCells, using the QPatch Assay Software. Action potential recordings were obtained after giga seal and whole cell formation. Data were analyzed using the single-hole and multi-hole technology. Small volumes of 50-100 µl cell suspension were applied to the QPatch. Cell positioning, giga sealing, and suction protocol. Currents were recorded using either the single-hole or multi-hole technology. Data were fitted to the Hill equation and the IC50 values determined for known blockers (TTX, nifedipine and cisapride) for single-hole and multi-hole experiments. We showed that iCells from the QPatch platform have the potential for automated patch-clamping and facilitate their use in drug screening. We tested the cells using the single-hole and multi-hole technique. The properties of stem cell-derived cardiomyocytes have been characterized from single-hole recordings with differential properties being observed for different methods. The present investigation is the first to describe the electrophysiological properties of cryopreserved human induced pluripotent stem (iPS) cell-derived cardiomyocytes using multi-hole recordings with automated patch clamp techniques.

Material and Methods

Ringer solutions, voltage clamp experiments, and current clamp recordings. From our exploration of different stem cell-derived cardiomyocytes our data have shown that these cells are candidates for in vitro preclinical drug safety testing. Stem cell-derived cardiomyocytes have the potential for such a model.

References:


Conclusions

The study of ion channels in tissue sample using automated patch-clamp has historically been performed by oocytes. The cells have not been available in sufficient numbers and the cell association has shown an inherent homogeneity. With the recent advances in stem cell technology, this technique has been adapted to human cardiomyocytes and is now a feasible option for preclinical drug safety testing. The data from this study suggest that stem cell-derived cardiomyocytes have the potential for automated patch clamp systems.