Cardiomyocytes in Voltage Clamp and Current Clamp by Automated Patch Clamp

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Abstract

In recent years, human stem cell-derived cardiomyocytes have proven to recapitulate key features of human cardiac electrophysiology in vitro. Furthermore, it has become apparent that the intact ensemble of cardiac ion channels is necessary to capture physiopathologic effects ideally. Hence, due to their increasing availability, stem cell-derived cardiomyocytes have become the preferred choice of cardiac cells.

The poster summarizes the promises and challenges of combining iPSC-derived cardiac myocytes with automated patch clamp. Features like high throughput, temperature control, easy internal solution exchange and full automation make planar patch clamp a desired method for characterizing iPSC-derived cardiomyocytes.

One of the biggest challenges of patch-potential clamp in this context is the fact that individual cells cannot be chosen, but cells will be selected randomly. In addition, cells have to be harvested before the application to the patch clamp chip and cannot be positioned as adherent cells.

With this poster, we show our progress on these challenges. Two automated patch clamp platforms, the Patchliner, as a medium throughput, and the SyncroPatch 384/PE, as a high throughput device, were used for this study.

Pharmacological measurements in voltage clamp as well as current clamp will be shown also under physiological temperatures and perfused patch.

Methods

The experiments presented on this poster were performed on the Patchliner or SyncroPatch 384/768PE as indicated. Experiments were all performed in regular electrophysiological cell culture. Both systems have the option of temperature control and the former amplifies the option of current clamp (Patchliner, HDRA10P1, 5’384’PE Tecan).

Pharmacology on human stem cell-derived cardiomyocytes (voltage clamp) Cardiomyocytes

NPD and lidocaine Raw currents and IVs conducted from minimum (NM) and maximum (KM) current, from human iPSC-derived cardiomyocytes.

Calcium

Sodium and Potassium Raw currents and IVs conducted from minimum (NM) and maximum (KM) current, from human iPSC-derived cardiomyocytes.

Calcium

Sodium Raw current traces as response to an IV protocol and average IV curves (VH) of cardiomyocytes and in the presence of 10 mM nifedipine.

Calcium

Sodium Raw current traces as response to an IV protocol and average IV curves (VH) of cardiomyocytes and in the presence of 10 mM nifedipine.

Htg Pharmacology

Nanion’s Patchliner and SyncroPatch 384/768PE are both planar patch clamp platforms with reliable high throughput and high throughput options high for high throughput. These platforms can be configured in any of the following 3 configurations:

1) enabling temperature controlled experiments.

2) being suitable for high throughput experiments with stem cell-derived cardiomyocytes.

3) having a current clamp amplifier.

They combine the necessary features for successful drug discovery.

High Throughput Automated Patch Clamping: Voltage and Current Clamp

The SyncroPatch 384/PE is a patch clamp module that can be used in a state-of-the-art pipetting robot, e.g. Biomek FX Beckman Coulter. Figure 1 illustrates three different currents recorded simultaneously on the SyncroPatch 384/PE. Screenshot shows data acquisition and analysis software performing recordings from iPS cells expressing HERG channels and recorded on the SyncroPatch 384/PE.

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