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Application Report

Recordings of hiPSC-derived neurons on QPatch Compact

Ligand-gated, voltage-gated and current clamp recordings of BrainXell hiPSC-derived neurons

Summary

Using BrainXell hiPSC-derived neurons (either cortical glutamatergic or spinal motor neurons), we demonstrate that it is possible to record ligand- and voltage-gated currents, as well as action potentials, from hiPSC-derived neurons using QPatch Compact (hereafter QPC) with whole-cell success rates of up to 60%.

Results and Discussion

Representative single-cell Na_V, K_V and AMPA currents as well as action potentials are displayed in Figure 1-4.

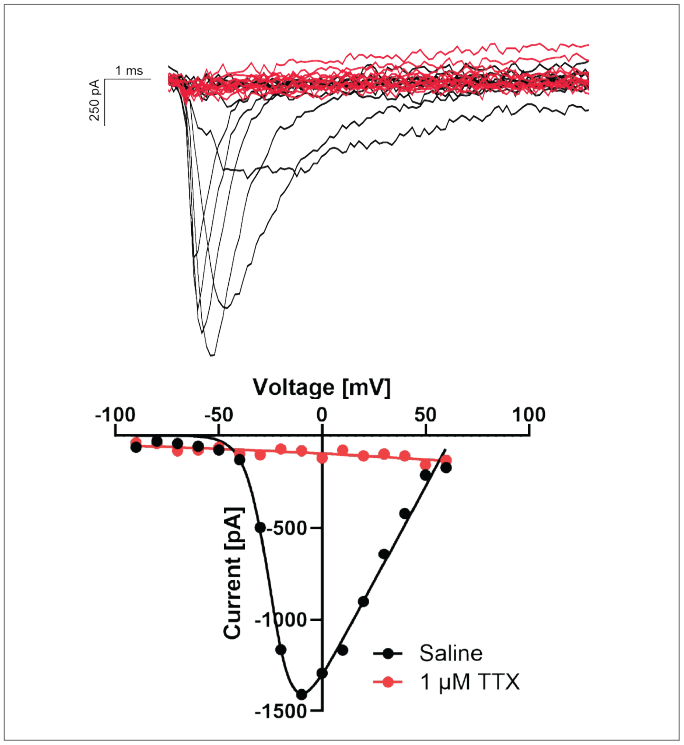

Fig. 1: Representative Na_V current (top) and current-voltage relationship (bottom) before (black) and after (red) addition of 1 µM TTX.

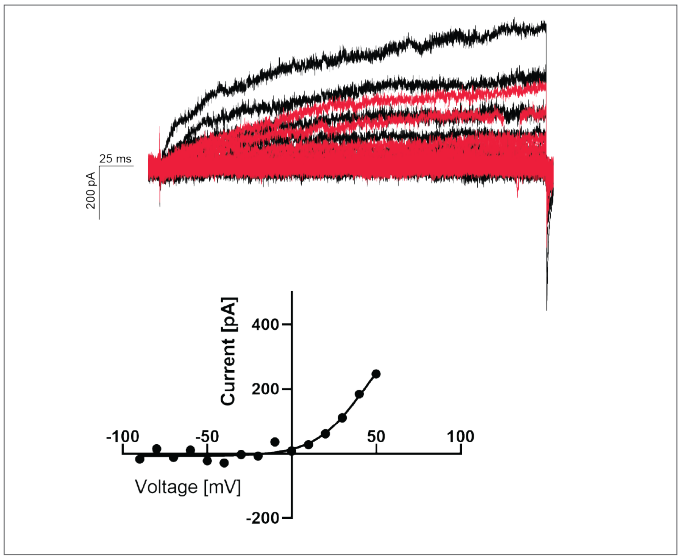

Fig. 2: Representative K_V current (top) before (black) and after (red) addition of 30 µM TEA and 4 mM 4-AP. Subtracting the blocked current (red) from the initial current (black), allows us to plot the sensitive and outwardly rectifying current-voltage relationship (bottom).

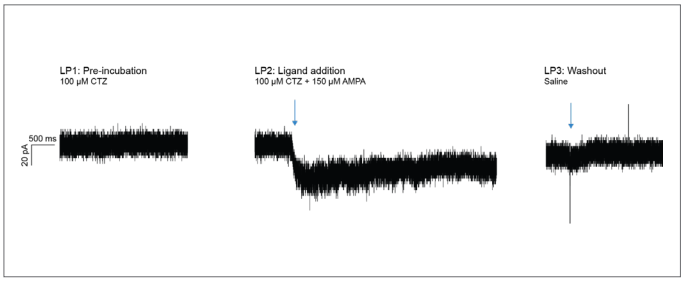

Fig. 3: Representative AMPA receptor current induced by addition of 150 µM AMPA (agonist) in the presence of 100 µM CTZ (potentiator). First, the cell was pre-incubated with the potentiator (LP1, left), then the receptor was activated by addition of agonist (LP2, middle), followed by washout with saline (LP3, right).

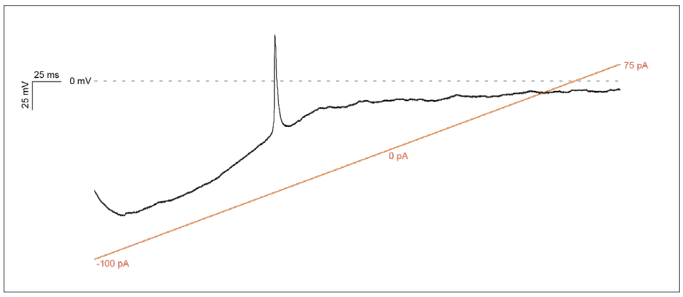

Fig. 4: The membrane voltage response to a current clamp ramp (from -100 pA to +75 pA), showing a single action potential as the membrane voltage crosses the firing threshold.

As expected, the Na_V current was completely blocked by 1 µM tetrodotoksin (TTX) (Figure 1). The K_V current was partially blocked by the addition of 30 mM tetraethylammonium (TEA) + 4 mM 4-aminopyridine (4-AP), with the remaining current likely being caused by leak or currents mediated by other anions (e.g. F^- or Cl^-) (Figure 2, top). Subtracting the blocked current (red) from the original current (black) allow us to plot the sensitive and outwardly rectifying current versus voltage relationship (figure 2, bottom). The AMPA receptor was activated by the addition of agonist, 150 µM AMPA, in the presence of potentiator, 100 µM cyclothiazide (CTZ), followed by washout with saline (Figure 3). Finally, we were able to record a single action potential from a neuron in response to a current clamp ramp (from -100 pA to +75 pA). The neuron fired as the membrane potential reached the threshold potential of approximately -50 mV (Figure 4).

To perform QPC experiments with hiPSC-derived neurons, it is essential to dissociate the neuronal network into a pure, viable single-cell suspension. For more information on this process contact us to get access to comprehensive guides, operating procedures QPC assays, contact us at info@sophion.com.

For more advanced applications of APC and hiPSC neurons, including test of disease phenotypes and action potential measurements, see application reports:

- Using Automated Patch Clamp for recordings of neuronal action potentials, 2025
- Evaluation of disease phenotypes in hiPSC-derived excitatory neurons using Automated Patch Clamp, 2024
- Electrophysiological characterization of human iPSC-derived motor neurons using Qube 384 and QPatch, 2019

Methods

- hiPSC-derived spinal motor neurons and hiPSC-derived cortical glutamatergic neurons were kindly provided by BrainXell, and cultured according to manufacturer protocols until the day of experiment (day 7-10 post thawing).
- For information on dissociation procedures and solutions contact us at info@sophion.com.

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