Bulk heating induces neuronal behaviour modification in an in vitro model of dorsal root ganglion neurons

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Heating represents a promising approach to induce neurite outgrowth and recovery from neuronal injures. Protocols with different heating temperatures (from 38°C to 50°C) and duration (from milliseconds to several days) have shown changes in cell membrane[1,2], but the underlying process remains so far unknown. In order to elucidate the mechanisms of bulk heating we performed experiments on the model of dorsal root ganglion neurons we have established in our laboratory[3]. Cells in serum-deprived medium were seeded on day 1 and maintained at 37°C (control) and 41.5°C (bulk heating exposure) for 10 minutes per sample on days 2 and 3, and functional and morphological analysis were carried out from day 4 to day 8. Results obtained by analysing morphological properties showed a significant difference in neurite elongation in samples incubated at 41.5°C versus 37°C. Moreover, cells maintained at 41.5°C showed a tendency to reduce their growth compared to control. Functional analysis using the Patch-Clamp technique confirmed changes in the behaviour of cells incubated at 41.5°C, which consisted in a significantly higher sodium current density and a more hyperpolarized membrane potential. In addition, 41.5°C samples showed a significantly higher action potential firing frequency compared to control samples. These results suggest that heating is an effective approach to induce cell differentiation and support its application as a new strategy to modify neuronal behaviour.

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