INFLUENCE OF ZINC IONS AND EXTRACELLULAR pH ON THE ACTIVITY OF VOLTAGE-GATED POTASSIUM CHANNELS IN CULTURED RAT HIPPOCAMPAL NEURONS

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Using the whole-cell patch-clamp technique we invesitgated the influence of zinc ions (Zn^{2+}) and extracellular pH (pH_o) on the activity of voltage-gated potassium currents in cultured rat hippocampal neurons. First we estimated the contribution of Kv1.3 currents to the currents recorded in examined cells. Then, the influence of both factors on the activity of other voltage-gated potassium currents was examined. During experiments, both the total current and the "delayed rectifier" component were recorded. Results obtained for both components were not significantly different from each other. The obtained data provide evidence that Kv1.3 current did not contribute significantly to the currents. Nevertheless, application of Zn^{2+} at concentrations from 100 µM to 5 mM reversibly modulated the currents. The activation midpoint (V_n) was shifted by about 40 mV towards positive membrane potentials and activation kinetics were slowed down 2–3 times in relation to control conditions. The inactivation midpoint (V_i) was also shifted towards positive membrane potentials upon Zn^{2+} application, but significantly less than the V_n (about 14 mV). The current amplitude was reduced in a dose-dependent manner to about a half of the control value. The modulatory effects of Zn^{2+} were saturated at a 1 mM concentration. Lowering pH_o from 7.35 to 6.4 did not affect significantly the currents. Altogether, the obtained data provide evidence that Zn^{2+} modulates the activity of voltage-gated potassium currents in rat hippocampal neurons. This effect may be related to modulation of electrical activity of these neurons by Zn^{2+}.