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Failure of cell-hydration controlling signaling system is a gate for medical disorders

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Abstract

Cell hydration is a dynamic and extra sensitive fundamental cell parameter determining its functional activity. Recently we have hypothesized that Na^+/K^+ pump α_3 isoforms are responsible for cell hydration controlling system. A dysfunction of this system was suggested as a primary gate for generation of cell pathology. To test this hypothesis the dose-dependent ouabain effect on cell hydration, intracellular cyclic nucleotides content, $^{45}Ca^{2+}$ exchange, ^{3}H-timidine involvement in DNA (cell proliferation) in women healthy and cancer breast tissues, different tissues of healthy (HM) and sarcoma-180 tumor carrying mice (SC), as well as on Na/K pump current (I_p) in isolated neuron and rat brain total mRNA injected xenopus oocytes were studied. Tissue hydration of normal breast of breast cancer patient, and organs of SC was higher than that in healthy organisms, which was accompanied by depression of α_3 receptors' affinity, $^{45}Ca^{2+}$ efflux from the cells, capacity of intracellular Ca buffering systems and cGMP content, increase of cell proliferation. The reciprocal correlation between Na/K pump and Na/Ca exchange existing in healthy tissues is lost in cell pathology or by phospholipase A_2 treation. The I_p in neuron was depressed by nM ouabain which was accompanied by activation Na/Ca exchange in reverse mode, while in oocytes these effects appeared only after rat brain total mRNA injection. The disturbance of correlation between Na/K pump and Na/Ca exchange responsible for cell volume regulation is suggested as a primary mechanism for decontrolling cell hydration leading to medical disorders such as cancer, cardio-vascular and nerve disorders.

Biography

Sinerik Ayrapetyan has completed his Ph.D and postdoctoral studies from Ukraine Academy of Sciences. He is the president of Life Sciences International Postgraduate Educational Center and head of UNESCO Chair in Life Sciences. He is the author of 7 books and 185 papers in refereed journals, and is serving as a member of Editorial Board of ISRN Biophysics, the Board of Associate Editors for the "Electromagnetic Biology and Medicine" Journal, Associate Editor for Biomedical Research of "Journal of International Dental and Medical Research". Research area: the metabolic regulation of excitable cell membrane function.