Event Abstract

Hydrogen membrane transport activity coupled with changing deuterium/hydrogen ratio may be a key proliferation signal for the cells

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Background and aim: The deuterium/hydrogen (D/H) mass ratio is the largest among stable isotopes of the same element, causing differences in the chemical behavior between the two hydrogen isotopes. Although the concentration of D is more than 10 mM (150 ppm) in living organisms, the potential role of D was not investigated for six decades after its discovery. In order to reveal the possible role of naturally occurring D in living organisms, the consequence of the shortage of D was investigated in different biological systems such as cell cultures, animal studies and human clinical trials.
Materials and Methods: In order to reduce the D-concentration in different biological systems below the natural level, we used deuterium-depleted water (DDW) in a range of 25 ppm and 135 ppm D. DDW was produced by fractional distillation. A microelectronic cell sensor method (xCELLigence RTCA SP) was used to follow the cell growth of cancer cells in real-time.
Results: The experiments with DDW revealed that due to D-depletion (135-40 ppm) the cell growth of various cell lines (HT199 melanoma, A549 lung and MCF7 breast cancer) was inhibited in vitro. Even 1 ppm decrease in D-concentration of the media in every 8 hours was associated with a lower growth rate. The results also revealed that increasing the D-concentration over the natural level (200--800 ppm) stimulated cell growth. Simultaneous DDW administration enhanced the growth-controlling effect of anticancer drugs. Deuterium depletion (DD) decreased the rate of recovery of the cytoplasmic pH of the cells (an IL-3-dependent murine haemopoietic cell line FDCP-Mix cloneA4) from acid load, an indicator of the activity of the Na.+/H.+ antiport. In the same cells DD increased the rate of apoptosis induced by IL-3 deprivation. DD also inhibited the expression of genes (c-myc, H-Ras, Bcl-2, K-Ras, COX-2) having key role in tumor development or restored the expression of genes having key role in aging (DAF-16, SOD, Akt). Replacing the normal daily water intake with DDW (25 ppm D), it induced complete or partial tumor regression in dogs and cats. In human clinical studies the integration of DDW (25-105 ppm) into conventional therapies resulted a 2-3 fold increase in median survival time of patients with prostate, breast and lung cancer.
Conclusions: It is suggested that cells are readily able to regulate their D/H ratios, while these changes trigger distinct molecular processes. One possibility to modify intracellular D/H ratios is the activation of the H+-transport system, which preferentially eliminates H+, resulting an increased D/H ratio within the cells. Altered D/H ratios strongly regulate the expression of distinct genes and the activity of enzymes having key role in cell cycle regulation and also control various molecular mechanisms. We contemplate that naturally occurring D is a key element of a still obscure sub-molecular regulatory system (SMRS). Deuterium depletion opens new perspectives in cancer treatment and prevention offering a completely safe and non-invasive treatment modality.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

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Keywords: deuterium depletion, anticancer drug, deuterium depleted water, DDW, somlyai

Conference: 4th Annual Meeting of the International Society of Proton Dynamics in Cancer. Garching, Germany, 10 Oct - 12 Oct, 2013.

Presentation Type: Abstract

Topic: 9. Acidity as a target for antitumor therapy

Citation: Somlyai G, Nagy L, Puskás L, Fábián G, Gyöngyi Z, Krempels K, Somlyai I, Laskay G, Jancsó G, Jákli G, Kovács A, Guller I, Ávila DS and Aschner M. Hydrogen membrane transport activity coupled with changing deuterium/hydrogen ratio
may be a key proliferation signal for the cells. *Front. Pharmacol. Conference Abstract: 4th Annual Meeting of the International Society of Proton Dynamics in Cancer*.

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