



ORIGINAL ARTICLE

The influence of oxygenated water on the immune status, liver enzymes, and the generation of oxygen radicals: a prospective, randomised, blinded clinical study

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Summary *Background & Aims:* Oxygenated water with an oxygen concentration of 30–120 mg/l water is believed to improve the immune status, without any toxicological effects. The purpose of this clinical study was to assess the effects of long-term drinking of oxygenated water on the immune status.

Methods: In this prospective, double-blinded, randomised study 24 volunteers of either sex (age 18–63 years) drank daily 3 times 500 ml either oxygenated (Verum-group: $n = 12$) or normal mineral water (Placebo-group: $n = 12$) for 28 days. On day 1 and day 28 standard laboratory tests, IgG, IgA and IgM, lymphocyte subpopulations and functional analysis of T-cells by flow cytometry, were done. Furthermore, the oxygen radicals were determined by the detection of the ascorbyl radicals.

Results: Drinking of normal or oxygenated water had no effect on whole blood count or the liver enzymes. Interestingly the volunteers in the Verum-group showed a significant increase in ascorbyl radicals after drinking oxygenated water for 14 and 21 days. CD4⁺ and CD4⁺CD45RA⁺ lymphocytes as well as lymphocyte activation marker (CD69) and soluble IL-2 receptor increased in both groups, in contrast T-helper2 cells and IgG decreased during the study. The only differences between the two groups were a significant decrease of NK-cells from $13.42\% \pm 5.04$ to $10.83\% \pm 4.82$ ($P < .002$) and an increase of the Th1/Th2-ratio from $2.77\% \pm 1.07$ to $6.68\% \pm 5.33$ ($P < .03$) in the Verum-group.

Conclusion: Long-term consumption of oxygenated water has no apparent harmful effect on the liver, blood and the immune system. Moreover it leads to a transient moderate increase of oxygen radicals in the blood. An interesting observation is the increase of the Th1/Th2-ratio in the Verum group, whereas in

Abbreviations: PHA, phythamagglutinin; PWM, pokeweed mitogen; CD, cluster of differentiation

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both groups T-cell activation after mitogen stimulation, the soluble IL-2 receptor, the CD4⁺ and the naïve CD4⁺CD45RA⁺ cells increased.

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Introduction

Since the early 1990s various companies, especially in Europe and the United States, produce drinking water in which the concentration of physically dissolved oxygen is increased, ranging from 30 to 120 mg/l water. Normal drinking water contains approx. 5–7 mg and fresh fountain water 10–12 mg of oxygen dissolved per litre. The companies argue that drinking oxygenated water improves the oxygen availability, thus the “overall metabolism and health as well as the resistance against pollutants and drugs” of the consumer. This notion, however, is based only on anecdotal reports and not on scientifically reasonable studies. In the 1970s various groups have studied the effects of insufflation of gaseous oxygen into the intestinal lumen. Thus, Gelman et al.^{1,2} could show, both clinically and experimentally, that application of oxygen into the intestinal lumen improved the hepatic circulation and the overall oxygen supply. These studies were not repeated with oxygenated water. Recently Forth and Adam could show that oxygenated water applied intragastrically in rabbits increased the oxygen content within the abdominal cavity and portal vein.³ Besides these experimental data, there are some clinical reports published in Russian journals which describe positive effects of oxygenated water for patients suffering from a large variety of diseases such as morbid obesity, cholecystitis and portal hypertension.^{4,5} These reports do not meet the criteria of good clinical studies, and their value is therefore questionable. In a clinical pilot study Eble et al.⁶ studied the oxygenation of lymph node metastases in patients suffering from head and neck carcinomas. After drinking oxygenated water (60 mg oxygen/l H₂O) the authors observed an increase in oxygen in the lymph node tissue. Due to the large variations of the results the authors did not continue this study. Recently it has been speculated whether consumption of oxygenated water could lead to the enhanced generation of oxygen radicals. Whereas low concentrations of radicals might be even beneficial, high concentrations could lead to cell damage. Our group performed therefore a series of four prospective, randomised, blinded, pilot studies with altogether 66 volunteers drinking oxygenated water (60 mg O₂/l H₂O). We could show that drinking oxygenated water, in fact, led to transient

and moderate increase of oxygen radicals as measured with ascorbyl radicals by the Electron Spin Resonance (ESR)-technique.⁷ Long-term consumption of oxygenated water attenuated this effect. These observations are based on small studies and therefore warrant further research. In all studies mentioned above, no adverse effects were observed after drinking oxygenated water in concentrations ranging from 30 to 120 mg/l. Scientific studies, however, concerning a possible toxicological effect of oxygenated water especially on the liver have not been performed yet. This is probably due to the fact, that oxygenated water is regarded as normal drinking water, therefore such studies were not considered necessary.

The purpose of this prospective randomised double-blinded clinical study was therefore to assess the effects of long-term drinking of oxygenated water on the immune status, the generation of oxygen radicals and liver integrity, as the primary site of possible toxicological alterations.

Patients and methods

Twenty-four volunteers of either sex (age 18–63 years) participated in this prospective, double-blinded, randomised study approved by the Ethical Committee, University of Munich, Germany (Project No.: 119/03). After written informed consent was obtained the volunteers underwent physical examination and had to fill in a questionnaire concerning health status, smoking, alcohol consumption, current medication, sports activity. Subjects were excluded from the study, if they suffered from acute or chronic inflammatory diseases, blood loss and/or had undergone surgical procedure recently. Thereafter altogether 30 ml of venous blood was collected from the antecubital vein for determinations of the immune status, ascorbyl radicals and basic laboratory data including liver enzymes (see below). All volunteers were then randomised by balanced randomisation in the Verum- ($n = 12$) and Placebo-group ($n = 12$). The mean age of the volunteers was similar in both groups (Verum-group: 51.7 ± 9.9 ; Placebo-group: 47.7 ± 9.2 years), their sex distribution identical (8 women and 4 men in both groups).

The volunteers were instructed to drink daily 3 times 500 ml of the water distributed to them. They

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