Short Communication

Journal of Veterinary Health Science

Benefits of drinking dissolved oxygenated water for older dogs

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Submitted: 29 Sep 2021; **Accepted**: 05 Oct 2021; **Published**: 08 Oct 2021

Citation: *Mitsuhiro Isaka and Yutaro Suzuki. (2021). Benefits of drinking dissolved oxygenated water for older dogs. J Vet Heal Sci, 2(1), 19-21.*

Abstract

Objective: *Oxygen is an essential factor in the body. As dissolved oxygen is primarily absorbed through the gastrointestinal tract, this study aimed to investigate whether oxygenated water (commercial: water 0) reduced serum lactate levels in old dogs under conditions of rest and exercise.*

Materials and Methods: *Beagle dogs (n = 8), unneutered males (n = 4), and unspayed females (n = 4), aged 8.1 ± 1.3 years and weighing 12.2 ± 1.2 kg, considered healthy by physical examination and blood tests, were included in the study.*

Results: *Oxygenated water (5 ml; Water 0, Inc.) was fed per 1 kg of body weight. The blood lactate level was significantly decreased in the group fed with O2 supplementation in the usual environment without exercise than in the control group (1.97 ± 0.19 vs. 2.63 ± 0.3 mmol/L). In addition, the blood lactate level after 30 min of walking was markedly decreased in the oxygen supplemented water-fed group than in the control group (2.46 ± 0.38 in the control group vs. 1.66 ± 0.21 mmol/L in the oxygen supplemented water-fed group).*

Conclusion: *In this study, the efficacy and benefits of dissolved oxygen feeding were demonstrated in old dogs both at rest and after exercise.*

Keywords: Dissolved Oxygen, Dogs, Lactate, Old, Serum

Introduction

Oxygen is essential for adenosine triphosphate production by oxidative phosphorylation; therefore, must be reliably supplied to all metabolically active cells in the body [1, 2]. Hemoglobin is the primary carrier of oxygen in mammals. Approximately 98 % of oxygen transport in the blood is hemoglobin-bound (bound oxygen), and only 2 % is directly dissolved in plasma (dissolved oxygen) [3]. Coupled oxygen is primarily inoculated by pulmonary respiration and is thought to have a large molecular weight, preventing sufficient oxygen from reaching the capillaries [4, 5]. In contrast, dissolved oxygen is mainly absorbed through the gastrointestinal tract, and since it is in a gaseous state, its molecular weight is small and it can reach every corner of the capillaries (microcirculation) [6, 7].

Owing to the importance of oxygen supply, artificial oxygen carriers and other devices have also been studied in various pathological conditions; however, their clinical application is still lacking [8, 9].

In general, oxygen taken by breathing under atmospheric pressure cannot carry more than a certain amount of oxygen to the body, and in hyperbaric environments using Henry's law, oxygen dissolves in the blood in proportion to the atmospheric pressure, allowing it to spread to every corner of the cell [10]. Local oxygen concentration is important, as it promotes metabolism, improves physical functions, activates the brain, promotes blood circulation (improves microcirculation), and prevents aging [11]. In the veterinary medical field, hyperbaric oxygen therapy has been reported for the treatment of bone fractures; however, there have

been few reports in dogs and cats as it is difficult to use for general purposes because of the cost and other factors. Moreover, it is not indicated in cases of underlying diseases, such as those of the heart [12].

Hypoxia and old age are closely related, and blood lactate rises in hypoxia, which has been reported as a prognostic factor for various diseases [11, 13]. However, there are no reports on the effects of dissolved oxygen supply in healthy old dogs. In recent times, high-performance liposome technology has enabled the dissolution and stabilization of oxygen in water so that oxygen can be absorbed from the gastrointestinal tract, allowing efficient delivery of oxygen to the terminal cellular level [14]. This study aimed to investigate whether or not oxygenated water (commercial: Water O, Inc, Tokyo, Japan) reduced serum lactate levels in old dogs.

Materials and Methods

Animals

Beagle dogs (n = 8), unneutered males (n = 4), and unspayed females (n = 4), aged 8.1 ± 1.3 years and weighing 12.2 ± 1.2 kg, which were considered healthy by physical examination and blood tests (complete blood count and blood biochemical tests), were included in the study. The study protocol was as follows: 5 ml of oxygenated water was fed per 1 kg of body weight, and after a 15-min break (PRE), a 30-min walk was conducted. The blood lactate level was measured immediately (POST) after the walk as post 10 min (POST 10 min) and post 30 min (POST 30 min). This study was approved by the Rakuno Gakuen University, School of Veterinary Medicine Institutional Animal Care and Use Committee (approval no. VH19A10).

Measurement

Approximately 0.1 ml of whole blood was drawn from the saphenous vein, and blood lactate level was measured immediately using Lactate Pro 2 (manufacture number: LT1730).

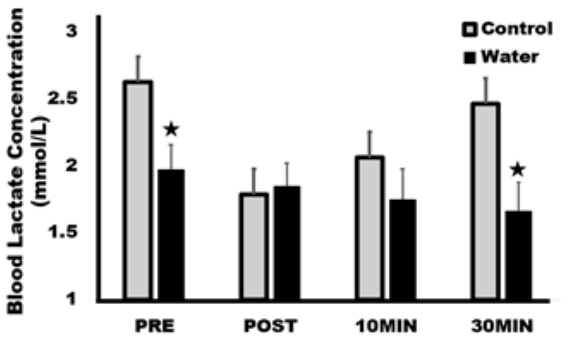
Statistical Analysis

Wilcoxon signed-rank test was used to test for significant differences between two groups.

Results and Discussion

As shown in Figure 1, the blood lactate level was significantly decreased in the group fed with O2 supplementation in the general environment without exercise than in the control group (1.97 ± 0.19 vs. 2.6 3± 0.3 mmol/L). In the control group, the blood lactate level showed a gradual upward trend than that of the control group immediately after walking; however, this trend was not observed in the oxygen supplemented water-fed group. There was no significant difference between the two groups in the blood lactate immediately after the walk (1.79 ± 0.18 in the control group vs. 1.85 ± 0.17 mmol/L in the oxygen supplemented group) and after 10 min (2.06 ± 0.12 in the control group vs. 1.75 ± 0.23 mmol/L in the oxygen supplemented group); however, there was significant difference in the blood lactate 30 min after the walk. The blood lactate level after 30 min of walking was significantly decreased in the oxygen supplemented water-fed group than in the control group (2.46 ± 0.38 in the control group vs. 1.66 ± 0.21 mmol/L in the oxygen supplemented water-fed group).

Figure 1



	PRE	POST	10MIN	30MIN
Control	2.63 ± 0.3	1.79 ± 0.18	2.06 ± 0.12	2.46 ± 0.38
Water	1.97 ± 0.19	1.85 ± 0.17	1.75 ± 0.23	1.66 ± 0.21

Figure 1: Change in blood lactate concentrations
*shows $p<0.05$ by Wilcoxon signed-rank test

In this study, the efficacy and benefits of dissolved oxygen feeding were demonstrated in old dogs both at rest and after exercise. Lactate, an end product of anaerobic metabolism, is considered a biomarker in veterinary medicine for the diagnosis and prognosis of shock, detection of hypoperfusion (hypoxia), and other conditions [15]. It has also been suggested that lactate levels are elevated in old age and that this may be related to aging [16]. In the present study, resting blood lactate levels were significantly decreased by dissolved oxygenated water in old dogs, suggesting that old dogs may have been hypoperfused. However, oxygen toxicity has been reported in normal and hypoxic dogs [17, 18]. In the present study, 5 ml of oxygenated water per body weight was effective for older dogs; however, the water supply may need to be adjusted for younger dogs or under morbid conditions, suggesting the need to study the appropriate amount for various ages, breeds, and diseases.

Thirty minutes of exercise for healthy dogs is moderate exercise, and it has been reported that there is no significant increase in blood glucose concentration, hemoglobin concentration, or red blood cell count, although there is a significant increase in heart rate, blood lactate, and rectal temperature [19]. However, in the present study, feeding water before moderate exercise resulted in a decrease in blood lactate levels during the recovery period after exercise, suggesting that the oxygenated water used in this study was effective not only for old dogs, but also for sporting dogs since it showed efficacy even when fed before the start of exercise.

Nevertheless, this study does not have results for younger dogs, and further research is needed on 1) the amount of supplemental water applied, and 2) the effective duration.

Conclusion

The dissolved oxygenated water was found effective for healthy old dogs at rest and during exercise.

Acknowledgment

We would like to thank Editage (www.editage.com) for English language editing.

Conflict of interests

None of the authors have any financial or personal relationships that could inappropriately influence or bias the content of this paper.

Author's contribution

Mitsuhiro Isaka: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation, Visualization, Investigation, Validation, Writing- Reviewing and Editing
Yutaro Suzuki: Supervision

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