Effect of Moderate Treadmill Exercise on Some Physiological Parameters in Untrained Beagle Dogs

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Abstract: The aim of the present study was to evaluate the modifications of some physiological parameters during moderate treadmill exercise in seven healthy Beagle dogs. All animals were submitted to treadmill exercise consisting of walking (15 min), trotting (20 min) and walking (10 min). At every step, rectal temperature (RT) was measured, and the mean heart rate (HR) was assessed. Venous blood samples were collected immediately before starting the treadmill exercise session (at rest), after the end of walking (15 min), trotting (20 min) and walking (10 min), and after 30 min of passive recovery. For immediate assessment of lactate and glucose concentration, blood was analyzed with portable blood lactate and blood glucose analyzers, respectively. Blood was also transferred into sterile glass tubes containing K3-ethylenediaminetetraacetic acid (K3-EDTA) for evaluation of red blood cells (RBC), white blood cells (WBC), platelets (PLT), hemoglobin (Hb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). One-way repeated measures analysis of variance (ANOVA) showed a significant effect of treadmill exercise (P<0.05) on RT, HR, lactate, glucose, RBC and Hct. Considering these significant variations, the knowledge of RT, HR, glucose and lactate concentrations, RBC, and Hct, the most suitable and sensitive indicators of response to treadmill exercise in untrained dogs, is essential in order to evidence the individual levels of exercise tolerance, to investigate exercise-related problems and to design specific and individual treadmill protocols.

Key words: dog, exercise, hematological parameters, heart rate, rectal temperature

Introduction

It has been accepted that physical exercise induces a series of changes in humans [9, 24] and animals [1, 3, 4] organism. Above all, in the recent years, the dog has been an important research model because it has greater aerobic capacities and oxidative enzyme activities [8]. The popularity of canine sports has led to an increased number of scientific reports addressing the systemic changes that happen during exercise, as well as the time needed to achieve resting values after exercise [2, 21].

Additionally, it has been demonstrated that in the dog, exercise induces a variety of physiological and blood changes depending on the duration and intensity of exercise and on the fitness and training level of the athlete [21]. Several studies have been conducted in order to assess these modifications associated with exercise in racing Greyhounds [12], Sled dogs [10], Labrador dogs during retrieving exercises [6, 23] and in dogs of different breeds during agility competitions [19, 20]. The authors have demonstrated that training and racing cause physical and mental stress as in human athletes [15].
evaluation of these variations it is of the utmost importance to understand which metabolic pathways are involved, and which physiological adaptations are induced by different types of exercise [1]. But although it is important to understand all modifications because they reflect changes in the functions of different systems and in the type of energy utilized [13], few authors have studied the responses during a specific aerobic test [2, 5, 22]. Recently, the effect of a treadmill exercise program on plasma cortisol hormone level and some physiological and hematological parameters have been evaluated in German shepherd dogs [16, 17]. On the other hand, in Beagle dogs, the studies have been limited to evaluation of daily rhythmicity of these parameters [14, 18] without considering the response that occurs during exercise. In fact, to the best of our knowledge, there are no available data that originate from standardized studies in Beagles. For this purpose, the modifications of rectal temperature (RT), heart rate (HR), blood lactate and glucose concentration, and hematological parameters (red blood cells, white blood cells, platelets, hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration) were evaluated in untrained dogs after moderate treadmill exercise.

### Materials and Methods

The study involved a laboratory component and a veterinary clinic component, both conducted at the University of Messina’s School of Veterinary Medicine. The protocols of animal husbandry and experimentation were reviewed and approved in accordance with the standards recommended by the US National Research Council’s *Guide for the Care and Use of Laboratory Animals* and European Union’s Directive 86/609 CEE.

Seven healthy male Beagle dogs participated in the present study. A full clinical history, including dietary regimens and average daily exercise, was obtained from every dog. All dogs underwent a full physical examination to rule out possible clinical abnormalities. The details and weights of all the dogs were recorded at the beginning of the study. The dogs were 4–6 years of age and weighed 15–18 kg. They were housed in individual pens (140 × 200 cm) lined with wood shavings under a natural photoperiod with 12 h of light and 12 h of darkness each day. Food (Eukanuba, Procter & Gamble, Cincinnati, OH, USA) was provided once a day. Water was available *ad libitum*. During the experiment, the dogs were not fed 12 h prior to exercise to ensure that they were in a postabsorptive state.

The dogs were not pre-trained to run on a treadmill and were not familiar with the equipment. They underwent an exercise test on a motorized treadmill (professional canine treadmill, © Grillo, Modena, Italy) for 45 min. The technical characteristics of the treadmill are given in Table 1. The treadmill exercise consisting of walking (15 min), trotting (20 min) and walking (10 min) at the following speeds respectively: 3.8, 7.2, and 3.8 km/h.

Environmental conditions were controlled by air conditioning: the temperature was maintained at 21°C, and relative humidity was kept in the range of 50–60%.

Rectal temperature was measured at rest, immediately after each exercise stage, and at the end of the recovery period using a digital thermometer (HI92704, Hanna Instruments, Bedfordshire, UK). Moreover, each dog was equipped with a heart rate monitor (Polar S610i, Polar Electro Inc., Kempele, Finland) to assess the mean heart rate value at every step.

Venous blood samples were obtained from the cephalic vein immediately before starting the treadmill exercise session (at rest), during the treadmill exercise within the first 3 min finishing each exercise stage, walking (15 min), trotting (20 min) and walking (10 min), and at 30 min of a passive recovery. For immediate assessment of blood lactate and glucose concentration, blood was analyzed with a portable blood lactate analyser (Accusport, Bohering, Mannheim, Germany) and portable blood glucose analyzer (ACCU-Chex Active, Roche Diagnostics GmbH, Mannheim, Germany), respectively. Blood was also transferred into sterile glass tubes containing K₃-ethylenediaminetetraacetic acid (K₃-EDTA). The following hematological parameters were determined using the EDTA-blood and an automatic hematology analyzer (HecoVet C, SEAC, Florence, Italy): red blood cells (RBC), white blood cells (WBC), platelets (PLT), hemoglobin (Hb), hematocrit

<table>
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<tr>
<th>Table 1. Technical characteristics of the treadmill</th>
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<tr>
<td><strong>Treadmill model</strong></td>
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<tr>
<td>Length 2.40 m – running surface 2.50 m</td>
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<tr>
<td>Width 0.640 m – running surface 0.410 m</td>
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<tr>
<td>Height 0.600 m</td>
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<tr>
<td>Total weight 120 kg</td>
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<td>Speed 2.5–14 km/h</td>
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(Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC).

The statistical elaboration of the data for each parameter was based on the average values obtained. Data are presented as means ± standard deviation (SD). All data were normally distributed (P < 0.05, Kolmogorov-Smirnov’s test). One-way repeated measures analysis of variance (ANOVA) was used to determine the effect of sampling time. Statistical significance was set at P < 0.05. Bonferroni’s multiple comparison test was applied for post hoc comparison. Statistical analysis was performed using the Statistica software package (Statistica for Windows, v. 8.0; StatSoft Inc., Vigonza, Italy).

Results

Table 2 shows the average values of all studied parameters, expressed in conventional units of measurement with standard deviations (SD), measured during the experimental trial in the dogs.

One-way ANOVA showed a significant effect of sampling time on following parameters: HR [F(4,24)=31.94, P<0.0001], RT [F(4,24)=145.80, P<0.0001], lactate [F(4,24)=14.98, P<0.0001], glucose [F(4,24)=2.92, P=0.04], RBC [F(4,24)=4.66, P<0.006], and Hct [F(4,24)=4.51, P<0.007]. No statistically significant effect of sampling time was observed on WBC, Hb, MCV, MCH and MCHC is considered not significant.

Figure 1 shows the patterns (Mean ± SD) of HR and RT, lactate and glucose concentrations, and RBC and Hct, expressed in their conventional units of measurement together statistical significances, obtained in the dogs at rest, during exercise and 30 min after the end of exercise.

Discussion

The present study has focused on clear modifications in hematological parameters, together with hematoclinical and physiological parameters, that occurred in untrained Beagle dogs during a specific treadmill exercise protocol. The results confirmed that physical exercise causes significant responses in RT, HR, RBC and Hct values and in the blood lactate and glucose concentrations.

The rectal temperature values increased during the experiment because as often happens during exercise, the heat produced exceeds the ability of the dog to dissipate it, causing the body temperature to increase [25]. During the trial, the dogs’ heart rates also significantly increased, and as HR is the main determinant of cardiac output and oxygen uptake, its increase during treadmill exercise is an index of cardiovascular workload in untrained dogs [21]. Although some authors have shown consistently lower values of heart rate during exercise [22], our results are in agreement with other studies in which HR increased gradually but significantly at each stage of exercise, suggesting enhanced oxygen requirements [17, 21]. Recently, a statistically significant increase in HR was observed in Beagles subjected to submaximal moderate exercise in which the velocity was
constant and the slope of the treadmill was increased during the exercise period [2]. In contrast, in the present study, the slope of the treadmill was constant, and the velocity was changed during the moderate treadmill exercise, but the HR data were similar. So, ATP is catabolized to adenosine diphosphate and further to adenosine monophosphate and inosine phosphate in the muscle fibres. This process is accompanied by glycogen consumption and increasing glucose-3-phosphate, glycerol, and lactate concentrations [7]. In fact, the lactate concentration significantly increased and the glucose concentration significantly decreased after trotting. Accumulation of lactate within the body causes modifications in acid-base status with acidosis of metabolic origin and respiratory compensation with hyperventilation. Glucose values generally decrease significantly with all forms of exercise because of stimulation of hepatic glycogenolysis. However, with prolonged exercise, glucose concentrations will increase as a result of liver glycogenolysis. Additionally, the mean Hct was higher during treadmill exercise versus at rest and after passive recovery. This modification is attributed to an increase in RBC due to splenic contraction in exercising dogs. While most of the hematocrit increase is related to splenic erythrocyte release, there are also substantial fluid shifts out of the plasma during exercise, and therefore, some of the increase in hematocrit is due to fluid movement [1, 20].

Considering that evaluation of sporting dogs requires control values for each type of exercise because response varies with the type, duration and intensity of the performed exercise, our findings are useful as evidence of the individual levels of exercise tolerance and for investigation of exercise-related problems. Particularly, the knowledge relating to RT, HR, glucose and lactate concentrations, RBC, and Hct, the most suitable and sensitive indicators of response to treadmill exercise in untrained dogs, is essential in order to design specific and individual treadmill protocols.

**References**


TREADMILL AND HEMATOLOGICAL PROFILE IN DOG


