Acta Scientiae Veterinariae, 2014. 42: 1171.

RESEARCH ARTICLE
Pub. 1171

ISSN 1679-9216

Haematological Changes Following Reining Trials in Quarter Horses

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ABSTRACT

***Background*:** It is well known that exercise induce physiological stress on horse's body system, causing significant changes in blood components. Haematological changes associated with exercise have been widely analyzed to provide information about health status and athletic performance in horses. Numerous studies have been performed to investigate the response of haematological parameters to various types of exercise. However, only few studies dealt with reining horses. Reining is a typical Western discipline characterised by manoeuvres requiring fast and powerful muscle contractions and motor skills. The aim of this study was to assess the effect of a reining training session on some haematological parameters.
***Material, Methods & Results*:** In the present study, eight Quarter Horses aged 5-15 years (three stallions and five mares; mean body weight 480 ± 60 kg) were used to establish physiologic responses to a reining training session. All subjects were housed at the same horse training centre in Sicily, Italy. All horses were subjected to the reining pattern 5 of National Reining Horse Association (NRHA), consisting of 2 large circle gallop (G1; G2), 1 small circle lope (L1), 1 stop (STOP), 4 spins (S1), 2 large circle gallop (G3; G4), 1 small circle lope (L2), 1 stop (STOP), 4 spins (S2), 1 large circle gallop (G5), lead change (LC1), 1 small circle lope (L3), 1 large circle gallop (G6), lead change (LC2), 1 large circle gallop (G7), lead change (LC3), 2 rollbacks (RB1, RB2), 1 stop (STOP) and backing (B). Blood samples were collected from each animal before (T0) and immediately after completion of the pattern (T1). Further samples were collected after 1 h (T2), 2 h (T3) and 24 h (T4) after exercise, during the recovery period. Blood was analysed for haematological parameters using an automatic analyser. One way repeated measure analysis of variance (ANOVA) showed a statistical significant effect of time on the following parameters: red blood cell ($P < 0.0001$), haemoglobin concentration ($P < 0.0001$), haematocrit ($P < 0.0001$) and white blood cell ($P < 0.05$). The application of Bonferroni's post-hoc comparison showed a statistical significant increase in red blood cell, haemoglobin and haematocrit values at T1 compared to T0, T2, T3 and T4. White blood cell count increased at T1 and T4 compared to T0.
***Discussion*:** Exercise has variable effects on hematological parameters. These differences might depend on both intensity and duration of physical effort. The increase in erythrocyte numbers together with the increase in Hb concentrations after exercise is probably a sequela of splenic contraction and subsequent release of erythrocytes with altered erythrocytic indices. High red blood cell counts and haemoglobin concentrations allow to increase oxygen transportation capacity to body tissues. In association with the increase in red blood cell and haemoglobin concentrations an increase in haematocrit. This might be due to exercise-induced fluid shifts as well as to splenic contraction. The spleen releases not only the stored erythrocytes but also the leukocytes into the peripheral circulation. These changes are likely secondary to catecholamine release and splenic contraction. The results of this study showed that a reining training session induces an increase in red blood cell, haemoglobin concentration, haematocrit and white blood cell concentrations, immediately after completion of the pattern, returning to basal values 1 h after exercise.

Keywords: haematological parameters, reining, physical exercise, quarter horses.

Received: 15 September 2013 Accepted: 28 December 2013 Published: 10 January 2014

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INTRODUCTION

Reining is a western equestrian sport in which the horse performs a set pattern of movements requiring fast and powerful muscle contractions and motor skills. During competition, the reining horse performs one of 11 predetermined patterns having approximately 10 manoeuvres in common [7]. The pattern includes small circles at slow lope, large circles at fast lope, straight runs to sliding stops, spins and rollbacks in both directions, and backing up [2]. Quarter Horse is the most common breed used in reining competitions. Specialized equine reining events are largely regulated by the National Reining Horse Association (NRHA) and represent a significant business venture, offering high monetary awards. In recent years, the interest in reining competitions has greatly increased and expanded worldwide.

The relatively short duration of the reining pattern and the intermittent bursts of moderate to high intensity exercise, suggest that a combination of aerobic and anaerobic metabolism are involved for energy production [2]. Therefore, Quarter Horses undergoing this discipline have high energy needs during both training and competition sessions [14].

Haematological changes associated with exercise have been widely analyzed to provide information about welfare, performance and health status in several sport horses such as standardbred [9,10], thoroughbred [16], endurance [12], and jumpers horses [11]. However, only few studies dealt with reining horses during competition [5,13].

The objective of this study was to evaluate haematological responses in Quarter Horses during a reining trial.

MATERIALS AND METHODS

Animals and housing

Eight Quarter Horses (5-15 years; 3 male, 5 female, mean body weight 480 ± 60 kg) were used in the present study. All subjects were housed at the same horse training centre in Sicily, Italy (latitude 38° 10' 35"N; longitude 13° 18' 14"E). All animals were clinically healthy and free from internal and external parasites. Their health status was evaluated based on through a clinical exam. The horses were kept, under natural photoperiod and ambient temperature, in individual stall with free access to water and were fed four times a day with commercial feed and alfalfa hay. All horses performed the reining pattern 5 [7] consisting of 2 large circle gallop (G1; G2), 1 small circle lope (L1), 1 stop (STOP), 4 spins (S1), 2 large circle gallop (G3; G4), 1 small circle lope (L2), 1 stop (STOP), 4 spins (S2), 1 large circle gallop (G5), lead change (LC1), 1 small circle lope (L3), 1 large circle gallop (G6), lead change (LC2), 1 large circle gallop (G7), lead change (LC3), 2 rollbacks (RB 1, RB2), 1 stop (STOP) and backing (B). On the day of the training session the mean environmental temperature and relative humidity were 23.4°C and 64%, respectively.

Blood sampling and analysis

Blood was collected by jugular venipuncture into vacuum tubes containing ethylenediaminetetraacetic acid (EDTA)[1]. Whole blood was sampled at 5 time points: T0 (before exercise), T1 (immediately after completion of the pattern), and during the recovery period at T2 (1 h after exercise), T3 (2 h after exercise) and T4 (24 h after exercise).

EDTA blood samples were refrigerated and analysed for complete blood count within 6 h. From the collection ,blood analysis was performed using the HeCo Vet C blood cell counter[2]. All samples were tested for red blood cell (RBC), haemoglobin concentration (Hb), haematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentrations (MCHC), platelet (Plt) and white blood cell (WBC).

Statistical analysis

One-way repeated measures analysis of variance (ANOVA) was applied to determine significant effects of time on haematological parameters studied. P value < 0.05 was considered statistically significant. Data were analyzed using statistical software Prism v. 4.00 (Graphpad Software Ldt., USA, 2003).

RESULTS

All results are expressed as means ± standard deviation (SD) in table 1. One-way ANOVA showed a statistical significant effect of time on following parameters: red blood cell ($P < 0.0001$), haemoglobin concentration ($P < 0.0001$), haematocrit ($P < 0.0001$) and white blood cell ($P < 0.05$). The application of Bonferroni's post-hoc comparison showed a statistical significant increase in RBC, Hb and Htc values at T1 compared to T0, T2, T3 and T4, whereas WBC were increased at T1 and T4 compared to T0 (Figure 1).

Table 1. Haematological parameters (mean ± standard deviation) observed before (T0) and immediately after completion of the pattern (T1), and after 1 h (T2), 2 h (T3) and 24 h (T4) of recovery period.

Parameters	Experimental Periods				
	T0	T1	T2	T3	T4
RBC(10^6/μL)	6.69 ± 0.76	8.20 ± 0.93	7.08 ± 0.64	7.33 ± 0.51	7.25 ± 0.82
Hb (g/dL)	10.58 ± 0.84	12.91 ± 0.92	11.20 ± 0.86	11.60±1.05	11.51 ± 0.97
Hct (%)	26.13 ± 2.26	31.64 ± 2.13	27.33 ± 2.17	28.46±2.70	27.75 ± 2.30
MCV (fl)	38.80 ± 1.50	38.79 ± 1.66	38.66 ± 1.85	38.79±1.85	38.45 ± 1.94
MCH (pg)	15.85 ± 0.78	15.81 ± 0.76	15.88 ± 0.72	15.80±0.71	15.95 ± 0.72
MCHC (g/dL)	40.53 ± 0.45	40.78 ± 0.72	41.01 ± 0.25	40.76±0.34	41.08 ± 0.35
PLT (10^3/μL)	160.01 ± 32.21	171.41 ± 15.86	157.64 ± 16.98	151.51 ± 23.82	166.00 ± 10.50
WBC (10^3/μL)	6.13 ± 0.93	7.37 ± 0.71	6.89±0.62	7.04 ± 1.40	7.36 ± 0.66

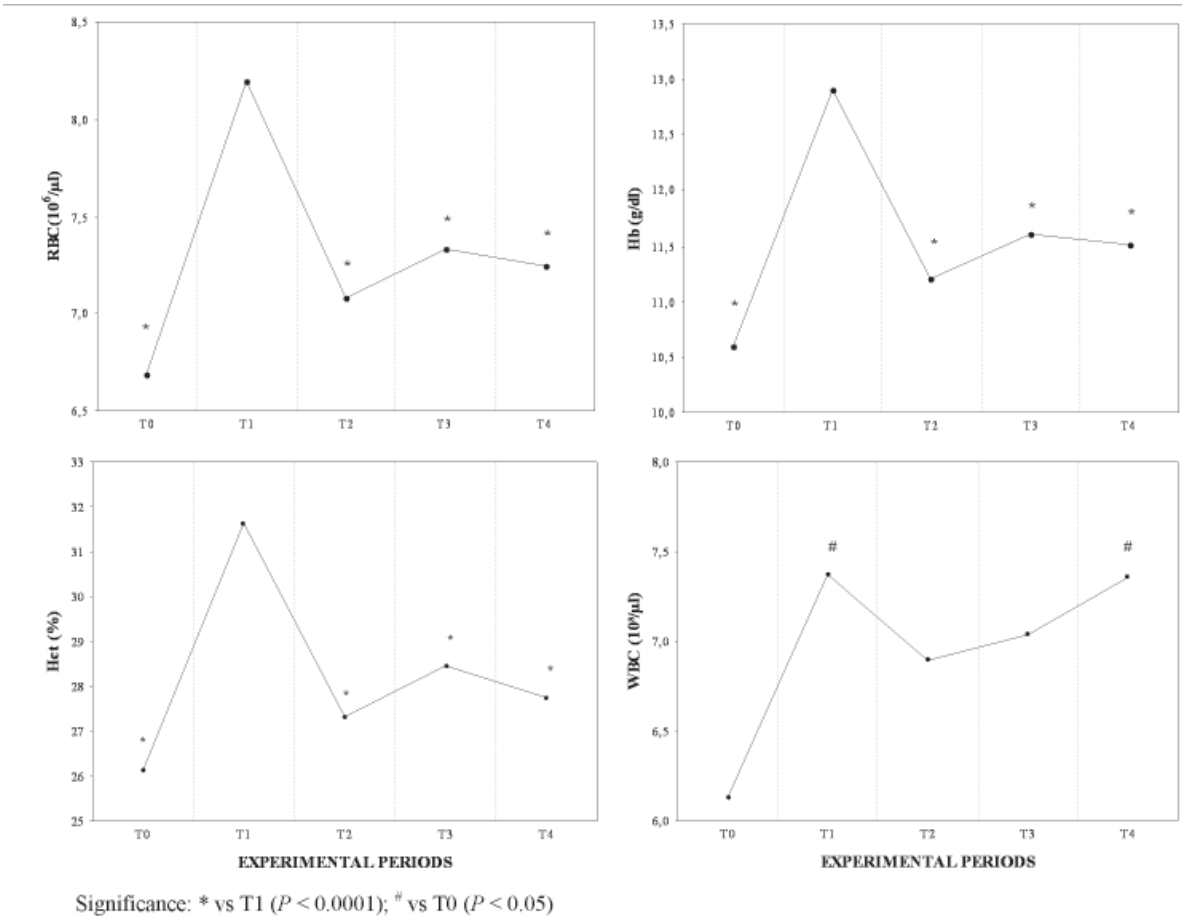

Figure 1. The pattern of mean values together with the relative statistical significance of RBC, Hb, Hct and WBC obtained at T0 (before exercise), T1 (immediately after completion of the pattern), and in recovery at T2 (1 h after exercise), T3 (2 h after exercise) and T4 (24 h after exercise).

DISCUSSION

In the present study significant changes occurred in RBC, Hb Htc and WBC values after reining trial in all horses. The RBC count showed a significant increase with concomitant significant changes in Hb and Hct after completion of the pattern (T1). These data confirm results obtained in a previous study on reining horses [5]. The RBC is under the direct influence of catecholamine concentrations, so exercise has a variable effect on red cell indices, depending on the speed and duration of the exercise [15]. The horses have the capability to naturally increase their RBC concentration due to an external excitation stimulus [8,17]. The increase in erythrocytes number together with the increase in Hb concentrations after exercise is probably a sequel of splenic contraction and subsequent release of erythrocytes with altered erythrocytic indices. The horse's spleen is responsible for storing one third to one half of the total number of RBC's within the horse [3]. Splenic erythrocyte release produces an increase in haematocrit. This might be due to exercise-induced fluid shifts of the plasma into the cells as well as to splenic contraction [11]. These adaptations induce a higher oxygen-carrying capacity of the blood to the active muscle and an increased aerobic capacity [6].

Moreover high intensity exercise induced a moderate leukocytosis [1,16]. As previously observed in endurance horses [4], our results showed a significant leukocytosis ($P < 0.05$) immediately after exercise (T1) and 24 h post exercise (T4). Although the WBC count increased, it remained within the reference range [5]. Following high intensity exercise, changes in leukocyte count are likely due to catecholamine release and splenic contraction [18]; in effect the spleen releases both erythrocytes and leukocytes into peripheral circulation. However changes in WBC count depend on the intensity and duration of exercise, as well as the degree of stress the horse is subjected to [16].

CONCLUSION

The study shows how reining exercise affects hematological parameters by increasing RBC, Hb, Hct and WBC levels immediately after completion of the trial, returning to basal values 1h after exercise. These results provide insight into the reining horse's physiological response to exercise allowing to better evaluate the athletic performance of this sport horse.

SOURCES AND MANUFACTURERS

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***Declaration of interest*.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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