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Effect of Strenuous Exercise on Various Blood Parameters in Polo Horses at High Altitude (3,734 M)

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Abstract

Horses require heaps of energy in order to perform well. Proper care and management should therefore be provided to the racehorses so as to keep they perform at their optimum. The experiment used for normal horses. The blood samples were collected in the morning before subjecting the horses to polo match/ strenuous exercise and immediately after the physical activity. Various blood tests such as the complete blood count, lipid, protein tests were done. Significant elevations in the white blood cells (WBC), hemoglobin (Hb) and some serological parameters in the blood polo horses were recorded after exercise. This study confirmed the findings of exercise on different blood parameters which can be possibly used as an index of fitness in horses.

Key Words: Strenuous Exercise; Blood Parameters; Polo Horses; High Altitude.

1. Introduction

Polo horses undergo severe stress during the course of a strenuous exercise. These horses are trained and conditioned to perform over long distances at moderate speeds. When conditioning a horse for long distance competitions, the training program must be designed and monitored to match the specific exercise type and intensity of competitive endurance riding [15]. The major physiological adaptations that can directly influence exercise capacity and stamina of endurance horses include the efficiency of gas exchange, oxygen uptake and delivery to the exercising muscles. The working muscle of endurance horses depends on aerobic metabolism of its glycogen stores, blood fatty acids and volatile fatty acids from hindgut fermentation, heart size and capacity to deliver large volumes of blood to the tissue. Determination of the fitness or exercise tolerance of a horse is by assessment, through physical examination, of heart and respiratory rates [7;3].

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Hematological and biochemical changes may also be evaluated by obtaining the post-ride blood samples [23]. Post-exercise blood lactate concentration is sometimes used to indicate fitness of the horse. As fitness increases, post-exercise blood lactate concentrations of the horse should decrease. In fact, maximal blood lactate steady state concentration and anaerobic threshold have been shown to predict training and long distance race performances [12]. In endurance races, stress and fatigue are clearly expressed by changes in circulating erythrocyte and leukocyte numbers of the horses. Tissue remodeling can also occur in endurance races and this is seen as changes in plasma proteins [4]. The objective of this study was to determine the effect of endurance riding on the hematological and some biochemical parameters and the differences in level of these parameters before and after exercise.

2. Materials and Methods

Total 50 blood samples were collected from polo horses before and after the polo match in EDTA tubes for hematological and biochemical analysis. The hematological parameters that considered were RBC (red blood cells), WBC (white blood cells), Hb (hemoglobin), hematocrit (HCT) white blood cells types (differential) such as eosinophils, neutrophils, lymphocytes, monocytes, erythrocyte sedimentation rate (ESR) and blood platelet count and in biochemical serythrocyte, leucocyte Total protein, albumin, ALP and ALT. All procedures were carried out at Veterinary Research and Disease Investigation Center Balogram Swat.

3. Results and Discussion

The mean values and paired comparison t-test of the complete blood count / full blood count of the polo horses before and after exercise are shown in Table 1. The complete blood count gives important information about the kinds and numbers of cells in the blood. The cells that circulate in the bloodstream such as the white blood cells (leukocytes), red blood cells (erythrocytes) and the platelets (thrombocytes) were primarily analyzed and assessed in the blood of the horses pre and post exercise. Each of which performs different functions in the blood physiology as well as in the entire physiological processes of racehorses. Leukocytes protect the body against infection while the erythrocytes function in carrying oxygen from the lungs to the rest of the body. Thrombocytes, the smallest type of blood cells, function in blood clotting [25].The parameters that were considered in this test include the number of red blood cells (RBC), white blood cells (WBC), hemoglobin (Hb), hematocrit (HCT) white blood cells types (differential) such as eosinophils, neutrophils, lymphocytes, monocytes, erythrocyte sedimentation rate (ESR) and blood platelet counts. Among the different parameters being analyzed, the full blood count values obtained from the pre and post- exercise horse blood samples turned out to be statistically different in terms of WBC and Hb where there was a marked increase in the aforementioned after exercise.

Table 1: Mean values and paired comparison t-test of the complete blood count / full blood count of the Thoroughbred horses before and after exercise

Parameters	**Before**	**After**	**Paired Comparison**		
	Mean± SEM	Mean± SEM	D ± SE	t	Pr> |t|
RBC(B) ($10^6/\mu\ell$)	8.19±1.21	8.90± 0.68	-0.71± 0.27	-2.59	0.0813
WBC(B)($10^3/\mu\ell$)	7.01± 1.36^{b}	8.00± 1.63^{a}	-1.00± 0.14	-6.87**	0.0063
HCT (%)	36.13± 3.40	39.50± 0.98	-3.38± 1.45	-2.33	0.1023
Hb (g/dL)	14.28± 1.41^{b}	15.80± 0.56^{a}	-1.53± 0.48	-3.20*	0.0494
ESR (mm/hr)	37.25± 18.66	22.50± 6.61	14.75± 8.61	1.71	0.1851
Platelet ($10^3/\mu\ell$)	74.75±41.27	92.00± 43.93	-17.25± 6.94	-2.48	0.0890
Eosinophil count ($/\mu\ell$)	370±249.40	220±115.76	150±88.22	1.70	0.1876
S. Neutrophil (%)	63.15±2.92	64.13±7.58	-0.98±2.68	-0.36	0.7398
Lymphocyte (%)	29.20±5.48	31.65±9.21	-2.45±2.17	-1.13	0.3401
Monocyte (%)	1.48±0.59	1.03±0.30	0.45±0.26	1.73	0.1817
Eosinophil (%)	5.93±4.95	3.00±2.17	2.93±1.57	1.86	0.1594

^{a,b,c}mean values within a row with different letter superscripts differ significantly *p < 0.05, **p<0.01

Exercise can be considered a form of stress since it induces physiological “tension” on the body which results to a number of chemical (hormonal) and cellular changes apart from physical change as increased blood pressure, body temperature and oxygen intake. It is also said to induce immune-like response resulting to leukocytosis which is quantitatively similar to physiological insults to the immune system [5]. Several studies have proven that WBCs are increased during exercise in different species including humans, dogs and horses [5;20;16]. [20] citing the works of [13] and [20] reported that the leukocytic response to exercise is believed to be caused by mobilization of WBC from the marginal pool in response to catecholamines and has also been associated with the release of blood rich in lymphocytes from the spleen in horses. Exercise could influence immune cells so profoundly and the factors which were found out to induce physiological perturbations during physical activity apart from the factor mentioned above as studied include thermodynamic (increased temperature), physiochemical (lactic acidosis and hypoxia), hormonal (cytokine) and physical (turbulence and dynamic shear forces) which can all alter leukocyte function [6;8;2;24;10] as cited by Radom [19]. The leukocytosis of exercise has been often compared to inflammation-like reaction. In fact, [9;11] reported that a mild inflammatory response to exercise without clinical signs has been described in horses and humans, with increased levels of pro-inflammatory cytokines and leukocytosis [20]. Hemoglobin which is a protein-based component of red blood cells with a primary function of transferring the oxygen from the lungs to the rest of the body is expressed as the amount of hemoglobin in grams per deciliter of blood. Elevated hemoglobin levels may indicate higher RBC count and is usually the result of increased RBC production as a compensatory mechanism when blood oxygen carrying capacity is compromised to meet the demand of tissues and contracted plasma volume resulting

in an appearance of greater red cell volume [21]. This is essentially true in this study since the RBC in the blood of horses after exercise, although not statistically significant, was higher than before engaging the horses to physical activity. A similar study on horses revealed significant increase in the packed cell volume, erythrocyte count, hemoglobin concentration, mean corpuscular volume, plasma protein, total white cell count and lymphocytes in the blood samples as compared to blood samples taken before exercise [22].

3.1 Proteins and Enzymes

The blood protein test basically measures the total amount of protein in the blood. It measures the amounts of two major groups of proteins in the blood: albumin and globulin [25]. Blood enzyme tests, on the other hand, measure the amount of different enzymes in the blood. Enzymes play a vital role in the body as they help to control chemical reactions [4]. The blood enzyme test serves as an indicator/marker of the body's chemical processes whether or not a condition or disorder is developing within the body. Physiological processes involving heart, liver, kidney etc. utilize large amounts of enzyme materials. When cells are damaged, enzymes are released into the bloodstream. Normal readings indicate that the organs and systems in the body are functioning properly while results which do not fall within the normal profile may mean that perturbations and disturbances are present in the body [14].

Table 2: Means, standard deviations and paired comparison t-test of the blood protein and enzyme test of the Thoroughbred racehorses before and after exercise

Parameters	**Before**	**After**	**Paired Comparison**		
	Mean± SD	Mean± SD	$\overline{D}$ ± SE	t	Pr> |t|
T. Protein (g/dL)	5.70± 0.72	5.78± 0.85	-0.07± 0.73	-0.10	0.9246
Albumin (g/dL)	2.95± 0.39	3.00± 0.59	-0.05± 0.39	-0.13	0.9052
ALP (U/L)	126.00± 22.32	126.50± 32.51	-0.50± 18.75	-0.03	0.9804
ALT (U/L)	12.25± 5.25	10.00± 1.83	2.25± 2.10	1.07	0.3618

^{a,b,c}mean values within a row with different letter superscripts differ significantly *p < 0.05, **p<0.01

4. Conclusion

The results of the study showed significant elevations in the WBCs and Hb in the blood of polo horses after being subjected to exercise. The study basically reinforced the findings of several studies on the effect of exercise on different blood parameters which can be possibly used as an index of fitness in horses.

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