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Full Length Research Paper

The effect of acute exercises on blood hematological parameters in handball players

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This study was conducted in order to determine the influence of five-day handball competitions on hematological levels of male handball players. 12 elite male handball players with an average age of 22.16±1.85 years participated in this study on voluntary basis. Physical measurements including body height, body weight, body-mass index and body fat percentages and hematological levels of the handball players were analyzed before (BC) and after the competitions (AC). In order to determine hematological levels, blood samples with 5 ml EDTA (Ethylenediaminetetraacetic acid) were taken from the forearm ante-cubital area in line with hygiene rules before and after competitions, and erythrocyte, leucocytes and blood platelet parameters were analyzed in laboratory with using auto-analyzers. Measurement results were presented as average and standard deviation. Student T-test for dependant samples was used in order to make a comparison between BC and AC values. SPSS 13.0 Package software was used for data evaluation. *P<0.05* value was considered to be significant. As a result of the study, the decrease in BC and AC values for body weight, body-mass index, body fat percentages, MCV, MCH, CH and LY and the increase in RBC and NE values were found significant. Conclusively, erythrocyte, leucocytes and blood platelet levels display different behaviors vis-à-vis acute competition-like exercises.

Key words: Handball players, competition, erythrocytes, leucocytes, blood platelet parameters.

INTRODUCTION

All studies express that long-term regular exercises make positive contributions into human organism. Researchers have reported positive contribution of exercise in physical, physiological, psychological and motor features (Fox et al., 1999). The most important effect of regular exercise is on blood hematology (Koç et al., 2010). When we analyze hematology, the effect of regular exercise on hematology is different. It is stated that these differences depend on the severity, duration and frequency of exercise as well as physical and physiological conditions of subjects (Büyükyazı and Turgay, 2000). Furthermore, the severity, duration and frequency of exercise should be well-organized to have similar positive influence on blood biochemistry (Baltacı et al., 1998; Shephard and Shek, 1994).

There is not a full consensus as to how exercise makes an effect on hematology. Studies in this field contain different findings concerning blood biochemistry depending on the relevant exercise. Despite the studies showing a decreasing (Ricci et al., 1988) and increasing (Baltacı et al., 1998; Ercan et al., 1996; Günay et al., 2006) change in blood biochemistry due to acute and

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Table 1. Physical characteristics of handball players before and after competition.

Variables	BC/ AC	Mean ± SD	T	p
Age (year)	B.C (n=12) A.C (n=12)	22.16±1.85 22.16±1.85	-	-
Height (cm)	B.C (n=12) A.C (n=12)	181.16±5.18 181.16±5.18	-	-
Body Weight (kg)	B.C (n=12) A.C (n=12)	81.59±11.99 81.16±12.14	3.124	0.010*
BMI (kg/(m)^2)	B.C (n=12) A.C (n=12)	24.81±3.07 24.67±3.09	3.165	0.009**
Body Fat Percentage (%)	B.C (n=12) A.C (n=12)	12.08±2.99 11.59±2.49	-2.895	0.015*

BC, Before competition; AC, after competition.

chronic exercises, there are also studies which report that hematological values do not change with exercise (Spiropoulos and Trakada, 2003; Akgün, 1994). This study was conducted to determine the effect of five-day handball competitions on hematology of male handball players.

MATERIALS AND METHODS

12 male handball players who played in inter-university premier league championship competitions participated in this study on voluntary basis. The handball players who participated in this study played in the competition for five days as a single-term league. Handball players who participated into the study played the games as a five-day league. After the permit of the ethic board required for our study was granted, players were informed about the tests and BC and AC measurements were made. Subjects of the study were measured for physical characteristics such as body height, body weight, body-mass index and body fat percentages, and their hematological levels were analyzed. ID-card information was taken as basis in determining the ages of the players. Their heights were measured with a meter (Rodi Super Quality) and recorded in cm terms while their weights were measured (with their shorts and T-shirts on) by means of an electronic weighing machine (premier) and recorded in kg terms. The body-mass index was calculated with the following formula: body weight (kg) /body height (m^2) (Eston and Reilly, 2009). Skin-fold measurements were taken by means of a skin-fold caliper and body fat percentage was calculated by means of the Green Formula (body Fat Percentage = 3.64 + *Total Skin-Fold x 0.097) (Green, 1970) [*Total Skin-Fold: Biceps, triceps, sub-scapular, supra-iliac, abdominal and Q femoris] (Eston and Reilly, 2009). Blood samples were taken in the morning from 9:00 to 10:00 am. Blood samples with 5 ml EDTA (Ethylenediaminetetraacetic acid) were taken from players in the forearm ante-cubital area, in line with hygiene rules before and after the five-day competition. Hematological levels including Red Blood Cells (RBC), Hemoglobin (HBG), Hematocrit (HCT), Mean Red Cell Volume (MCV), Mean Cell Hemoglobin (MCH), Mean Cell Hemoglobin Concentration (MCHC), Red Cell Distribution Width (RDW), White Blood Cells (WBC;), Lymphocyte Number (LYM), Lymphocyte Percentage (LYM%), Neutrophil Number (NE), Neutrophil Percentage (NE%), Monocyte Number (Mono), Monocyte Percentage (Mono%), Eosinophil Number (Eos,) Eosinophil Percentage (Eos%), Basophil Number (BASO), Basophil Percentage (BASO%), Blood Platelets (PLT), Platekri (PCT), Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) were analyzed by means of an Architect-brand blood counting device. Measurement results were presented as average and standard deviation. Student T-test for dependant samples was used in order to make a comparison between BC and AC values. SPSS 13.0 Package software was used for data evaluation. *P<0.05* value was considered to be significant.

FINDINGS

Analysis of the Tables 1-4 showed a decrease in body weight, body-mass index and body fat percentages before and after competition was significant. RBC levels were found to be BC 4.92±0.33 and AC 5.23±0.42; MCV levels, BC 88.03±1.79 and AC 85.65±3.41; MCH levels, BC 31.55±0.99 and AC 30.18±1.72; NE% levels, BC 53.20±4.61 and AC 58.73±6.68 and LYM% levels, BC 36.10±4.38 and AC 30.00±5.45. It was seen that the decrease in MCV, MCH, and LYM% and the increase in RBC and NE% were statistically significant.

DISCUSSION AND CONCLUSION

This study was conducted in order to determine the influence of single-term league competitions on hematological levels of elite handball players; it was observed that there were changes in terms of decrease and increase in red blood cells, white blood cells and blood platelet parameters before and after the competition. The changes in RBC, MCV, MCH, NE and

Table 2. Red blood cell parameters of handball players before and after competition.

Variables	BC/ AC	Mean ± SD	T	p
RBC	B.C (n=12)	4.92±0.33	-2.408	0.035*
	A.C (n=12)	5.23±0.42		
HGB (g/dL)	B.C (n=12)	15.82±0.82	1.407	0.187
	A.C (n=12)	15.17±1.42		
HCT (%)	B.C (n=12)	44.25±2.19	0.960	0.358
	A.C (n=12)	43.49±2.23		
MCV	B.C (n=12)	88.03±1.79	2.739	0.019*
	A.C (n=12)	85.65±3.41		
MCH (pg)	B.C (n=12)	31.55±0.99	3.040	0.011*
	A.C (n=12)	30.18±1.72		
MCHC (g/dL)	B.C (n=12)	35.69±0.89	0.882	0.396
	A.C (n=12)	35.36±0.88		
RDW	B.C (n=12)	13.03±0.55	0.309	0.763
	A.C (n=12)	12.95±0.49		

BC. Before competition; AC. after competition.

LYM% levels after the competition were significant whereas the changes in red blood cells, white blood cells and blood platelet parameters were not significant. When a comparison was made between these changes and those in other studies carried out on hematological levels, both similarities and differences were observed.

Baltacı et al. (1998) examined blood biochemistry at the end of an acute maximal exercise and found that hematological parameters increased depending on severity and duration of an exercise. Magazanik et al. (1988) examined the chronic effects of exercise and found out a decrease in red blood cell parameters. Ricci et al. (1988) found that hematological parameters decrease after chronic exercise. Çakmakçı (2009) stated in a study on taekwondoers that there was not a significant difference in white blood cell, red blood cell, blood platelet and Hematocrit parameters in blood samples taken before and after the camp. Ünal (1998) found that there was a significant increase in hemoglobin values of subjects after 8-week aerobic exercises. Although, there was an increase in red blood cell levels in our study, it was seen that there was a decrease in red blood cell parameters. Spiropoulos and Trakada (2003) expressed in their study on marathon runners that, there was no significant difference in hematological parameters before and after the marathon competitions. Rietjens et al. (2002) compared the blood samples of subjects before and after the season in their study on 11 Olympic athletes and determined that there was no significant change in MCHC levels. In our study, changes in MCHC parameter were not found significant.

Akar et al. (1992) expressed that red blood cell, blood platelet and white blood cell values significantly increased after acute sub-maximal exercise and Ercan et al. (1996) stated that red blood cell, blood platelet and white blood cell figures significantly increased after long-term endurance run.

Arslan et al. (1992) stated that Hematocrit and red blood cell values were higher than the control group in elite athletes, whereas Moğulkoç et al. (1997) expressed that there was no significant change in red blood cell parameters, however white blood cell and blood platelet parameters were high in the sports-doing group. Varol and Taşkıran (1995) stated that pre-season red blood cell levels of handball players were significantly different from the levels at the end of the season whereas there was no significant difference in other parameters.

Büyükyazı and Turgay (2000) stated that continuous and common interval running exercises resulted in exercise-related acute decreases in hematological parameters other than white blood cells whereas both type of exercises produced acute increases in white blood cell figures and the only parameter with a significant chronic decrease was the white blood cells. Özyener et al. (1994) found out that, short-term exercises at maximal severity do not have any impact on red blood cell levels, but it had an influence on white blood cell and blood platelet parameters. Patlar and Keskin (2007) stated that sub-maximal exercise had a significant impact on WBC, RBC, HGB, HCT and PLT levels whereas its impact on MCV, MCH and MCHC levels was insignificant. Kara et al. (2010) expressed that there was no statistically significant difference in hemoglobin, Hematocrit, red blood cell, white blood cell and blood platelet values in elite athletes in two different branches. Ersöz (1997) stated that sub-maximal exercise did not result in any statistically significant increase in Hematocrit value and red blood cell numbers whereas he reported an increase in the white cell number and not a significant change in blood platelet numbers.

In our study, it was seen that there was no significant change in the number of white blood cells after the competition program which was implemented. The increase in the white blood cell number is explained by participation of marginal white blood cells into circulation (Akgün, 1994; Chen et al., 1989).

Changes in white blood cell parameters vary. There is a rapid decrease in the number of lymphocytes after the exercise. The decrease in lymphocytes is attributed to the lymphopenic effect of the increased cortisol (Özgürbüz, 2003). Exercise does not have long or short term effects on neutrophil functions. The increase of eosinophilic cationic proteins in blood after the maximal exercise shows that eosinophils increase with exercise. However, it is yet to be well determined how it varies according to different exercise types and what function it fulfills during the exercise. It is still not fully-discovered how basophil cells respond to exercise. The monocyte number remains higher for 24 h following long-term exercise with severity (Özgürbüz, 2003).

In our study, there was no significant change in the

Table 3. White blood cell parameters of handball players before and after competition.

Variables	BC/ AC	Mean ± SD	T	p
WBC	B.C (n=12) A.C (n=12)	6.74±1.39 6.86±1.16	-0.206	0.840
NE%	B.C (n=12) A.C (n=12)	53.20±4.61 58.73±6.68	-2.173	0.050*
EOS%	B.C (n=12) A.C (n=12)	2.08±1.01 2.05±1.16	0.069	0.947
LYM %	B.C (n=12) A.C (n=12)	36.10±4.38 30.00±5.45	2.658	0.022*
BASO%	B.C (n=12) A.C (n=12)	0.36±0.11 0.28±0.15	1.283	0.226
MONO%	B.C (n=12) A.C (n=12)	6.08±1.07 5.80±1.18	0.636	0.538
NE#	B.C (n=12) A.C (n=12)	3.67±1.08 4.36±1.08	-1.321	0.213
LYM #	B.C (n=12) A.C (n=12)	2.44±0.48 2.22±0.35	1.162	0.270
MONO#	B.C (n=12) A.C (n=12)	0.41±0.12 0.42±0.16	-0.138	0.893
EOS#	B.C (n=12) A.C (n=12)	0.15±0.18 0.25±0.17	-1.708	0.116
BASO#	B.C (n=12) A.C (n=12)	2.58±0.96 2.75±1.48	-0.272	0.791

BC. Before competition; AC. after competition.

Table 4. Blood platelet parameters of handball players before and after competition.

Variables	BC/ AC	Mean ± SD	T	p
PLT	B.C (n=12) A.C (n=12)	255.83±72.57 264.41±87.09	-0.241	0.814
MPV	B.C (n=12) A.C (n=12)	8.07±0.54 8.69±0.70	-2.110	0.059
PCT	B.C (n=12) A.C (n=12)	0.21±4.65 0.19±5.94	0.641	0.534
PDW	B.C (n=12) A.C (n=12)	49.39±6.66 47.99±6.56	0.741	0.474

BC. Before competition; AC. after competition.

number of blood platelets after the competition program which was implemented. There are different findings concerning the changes in blood platelets due to exercise (Drygas, 1988). It is stated that such differences depend on severity and duration of the exercise program. It is reported that short-term exercises with lower severity do not result in any change in blood platelet level whereas longer-term exercises with higher severity increase the blood platelet level (Manucci et al., 1988). It is stated inthe literature that exercises with maximal and sub-maximal severity result in temporary increase in peripheral blood platelet number whereas shorter-term, moderate exercises do not change the number (De Scalzi et al., 1987; Chen et al., 1989; Drygas, 1988). Koç et al. (2010) stated that changes in hematology did not stem from practical courses but depended on the life quality of individuals. İbiş et al. (2010) expressed that the difference in red blood cells before and after the exercise was insignificant, and any change could not be detected in white blood cell values due to aerobic exercises, whereas there was a significant increase right after anaerobic exercises, and there was no significant change in blood platelet values depending on exercise types.

There are also studies reporting that there was no change in red blood cell numbers after acute exercise (Neumatr et al., 2002). It is reported that acute exercise increases the red blood cell levels, which stems from the plasma loss due to the exercise (Londeann, 1978). Many studies report that especially dense exercise increase white blood cell concentration, which is widely affected by density of exercise as well as the physical condition of the individual (İbiş et al., 2010). The increase in blood platelets can be explained with the exercise-related hemoconcentration and as such that factors coercing the body and producing stress activate the neural system and increase the number of blood platelets (Günay et al., 2006). As a conclusion; although there were changes in terms of increase or decrease in hematological levels of volunteers who participated into the study before and after the competition, it was found that these changes were within regular limits and most of them were statistically insignificant. From this perspective, red blood cell, white blood cell and blood platelet levels display different behaviors exhibit acute exercises under competition conditions.

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