Current Topics in Biophysics 2003, 27(1-2), 23-26

EFFECT OF PHYSICAL EXERCISE ON SELECTED BLOOD PARAMETERS IN JUNIOR FOOTBALLERS

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26 junior footballers took part in the experiment. They were tested on a cyclometer with increasing load. Mean time of the test was 17 ± 2 minutes and was conditioned by each player's refusal to continue. Influence of physical exercise on concentration of heme proteins myoglobin and hemoglobin and red blood cells parameters – hematocrit and red blood cell count were measured. Blood samples were taken immediately before and after the exercise, myoglobin concentration was additionally determined 1.5 hour after exercise.

INTRODUCTION

The goal of sport medicine is to improve general physical efficiency. The measurement of the physical efficiency is the time of doing exercise with constant or increasing intensity until complete exhaustion. In practice we look for universal efficiency which on the basis of laboratory test (possibly simple and not requiring hard and long term exercise) would enable to predict the degree of homeostasis disorder and rate of tiredness increase during exercise with different loads. Up to the present moment the measurement of general physical efficiency in sport medical practice is maximum oxygen uptake. It is a complex indicator informing about sportsman's biological potential. Oxygen supply efficiency depends on various important factors including cardiac output, oxygen capacity, oxygen blood saturation. The exercise causes important changes in circulatory system, among others hematocrit, red blood cell count, myoglobin concentration are changed. Myoglobin is first of all found in skeleton muscles and heart muscle. In serum of healthy people myoglobin concentration is extremely low and equals 5-65 ng/ml. Myoglobin concentration (with diagnostic aim) is determined mainly in cases of muscle damage (Motta, Rościszewska., Pokrzywicki, Grzeszczak, Kapustecki & Kochańska, 1995; Pokrzywnicki, Mazur, Urbaniec, Grzeszczak, Rościszewska & Kochańska-Dziurowicz, 1997; Czaplicki, Sakiel, Klementys, Klementys, Siebielec-Górka, Kamieńska, Klimacka-Nawrot, Uchman, Błońska, Wocka-Marek, Kochańska-Dziurowicz & Marx, 1998; Kochańska-Dziurowicz, Prajsner, Szewczyk & Jaworska-Kik, 1998). Research tests are conducted to find new biochemical markers showing physical efficiency of sportsmen allowing for full control of changes taking place during exercise.

METHODS

26 footballers from "Gwarek-Zabrze" junior sports club were taken under research (mean age 17.0 ± 0.8, mean height 178 ± 7.8 cm, mean weight 68.4 ± 7.8 kg). The test with increasing loads was conducted on a cyclometer. The mean time of the test was 17.0 ± 2 minutes and was conditioned by player's refusal to continue. Total mean work done by the player was 120.8 ± 26.6 kJ. Blood samples for hemoglobin concentrations and red blood cell count and hematocrit were taken directly before and after the test and additionally 1.5 hours after exercise for myoglobin concentrations.

Myoglobin was determined using radioimmunology method RIA KIT (IMMUNOTECH International Prague). Hemoglobin determination was done using cyanohemoglobin method and morphological parameters were calculated with hematology analyzer Micros 60 by ABX. The results were analyzed using STATGRAPHICS Package and Microsoft Excel programs. After checking for normal distributions with Schapiro-Wilka test differences between mean values were checked with t-Student test. In the case of non normal distribution the differences between the results were estimated with Smirnov-Kolmogorov test. For non

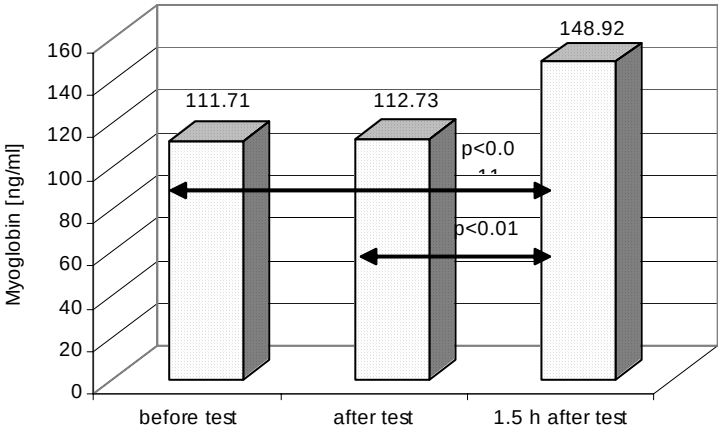

Fig. 1. Mean myoglobin values in sportsmen.

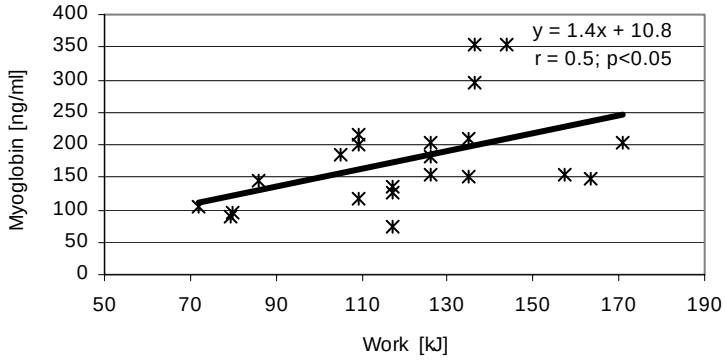

Fig. 2. Dependence between myoglobin concentration (1.5 hours after the exercise) and the amount intensity of exercise.

normal distribution geometrical mean and square deviation are given.

DISCUSSION

Analyzing the results of the research it was found that long term exercise (test with steadily increasing loads) caused the increase in heme proteins (hemoglobin and myoglobin) concentrations in the group of sportsmen under research. Mean geometrical values of myoglobin concentrations in serum were 111.71 ± 26.51 ng/ml before the test and 112.73 ± 28.49 ng/ml after the test. Both obtained mean concentration values of myoglobin were much higher than physiological concentration. The largest statistically significant increase in myoglobin concentrations was observed 1.5 hours after the exercise (mean geometrical value was 148.92 ± 47.75 ng/ml). Fig. 1 presents mean myoglobin concentration values in sportsmen. Statistically significant ($p < 0.05$) increasing linear dependence between work done by the player and myoglobin concentration 1.5 hours after exercise was found (Fig. 2). Mean hemoglobin concentration values in sportsmen under research were 8.8 ± 0.6 mmol/l before exercise and 9.01 ± 0.55 mmol/l after exercise. The obtained results were within physiological values (7.5 – 11 mmol/l). It was found that for the whole group there is statistically significant increase in hemoglobin concentrations after exercise in ratio to concentrations before exercise ($p < 0.0001$). Changes of mean myoglobin and hemoglobin concentrations before and after exercise were also estimated for footballers' subgroups: attackers (6) helpers (11) and defenders (9). No statistically significant differences between concentrations in these subgroups were found.

Before the beginning of the test with increasing loads till refusal the mean red blood cell count in 26 sportsmen was $(4.53 \pm 0.29) \cdot 10^6/mm^3$, mean red blood cell count after the exercise was $(4.76 \pm 0.28) \cdot 10^6/mm^3$ and was within physiological values $(3.8 – 5.8) \cdot 10^6/mm^3$.

In the same test the initial hematocrit value was 43.2% (normal value 35 – 50%).

Using t-Student test it was proved that there are statistically significant differences between red blood cell count before and immediately after the exercise and between hematocrit value before and immediately after the exercise.

It was found that there is positive linear correlation ($r = 0.87$) (Fig. 3) between red blood cell count before and after the exercise.

The increase in red blood cells number, hematocrit and hemoglobin could also have been caused by releasing into blood circulation system blood with high hematocrit value, which been retained in capillary system of non-active muscles. Hormones first of all catecholamines , mainly adrenalin, have indirect influence on post-exercise increase in red blood cells number. Adrenaline causes dilatation of blood vessels in skeleton muscles and at the same time causes contracting vessels of abdominal cavity, among others spleen. Laube *et al.* (1993) on the basis of isotope research stated that red blood cells from spleen contraction during exten-

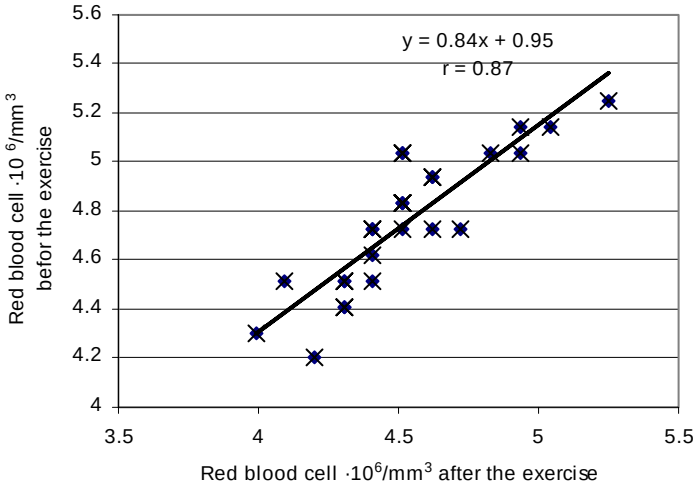

Fig. 3. Relationship between red blood cells number before and after the exercise in a test with increasing load till refusal conducted in a group of 26 footballers of "Gwarek-Zabrze" sports club. **Nigdzie w tekscie nie ma odwolania do tego rysunku**

sive physical exercise can be responsible for hematocrit increase of at least 25% of observed change.

Literature data (Davidson, Robertson, Galea & Maughan, 1997; Neuhaus & Gaehtgens, 1994; Szyguła, 1990) suggest that physical exercise induces the increase in the red cells count and hematocrit as well as increase in hemoglobin blood concentrations (Davidson *et al.*, 1997). The increase in these parameters is first of all the result of dehydration and blood concentration, and the proportion of these changes depends on such factors as intensity, time of exercise, conditions of the room where the exercise is done and degree of training. The greater the exercise the more extensive changes in blood parameters. The more the organism is trained the lower their extension. Literature data (Szyguła, 1990; Freund, Claybuch, Dice & Hashiro, 1987; Laub *et al.*, 1993) show that efforts lasting 0-20 minutes cause larger increase in blood cells count and hematocrit of 4-10%. In the group under research of 26 junior footballers the increase in red blood cell count was of 5.2% and hematocrit value increased. Hemoglobin concentration changed from 8.8 mmol/l to 9.01 mmol/l (3%).

The mean myoglobin concentration directly before exercise was 111.71 ± 26.51 ng/ml, which means that the footballers under research had this protein concentrations in blood above physical value, which is 85 ng/ml, yet before the beginning of the test. It can mean, that endurance training caused changes mainly in red, slow contraction fibres causing increase in myoglobin amount in muscles and its increased release to blood.

Increased amount of myoglobin is connected with increased oxygen supply, which can be used at moments of rapid increase in oxygen need by a working muscle. Directly after the exercise no changes in myoglobin concentrations were observed. However, after 1.5 hours after the exercise myoglobin concentration increased of 33%, which can be caused by the hypoxia of tissue, muscle cells destruction, that is increase in permeability of their membranes (Pokrzywnicki *et al.*, 1997).

Changes of myoglobin concentrations under the influence of exercise (test with gradually increasing loads) were also observed in a group of short distance runners (juniors), however in this group after 1.5 hours myoglobin values went back to initial values (Kochańska-Dziurowicz, Gaweł & Gabryś, 1998) In the group of junior footballers it was shown that the heme protein concentration increased after 1.5 hours after the exercise.

CONCLUSION

It was shown that conducting a test with increasing loads till refusal of continuation in a group of 26 junior sportsmen causes:

The increase in hemoglobin concentrations and red blood cells parameters (red blood cell count and hematocrit).

The increase in myoglobin concentrations and the greatest increase was found 1.5 hours after the exercise and it was the higher the harder exercise was done by the player.

Acknowledgement

For conducting the research permission was obtained from Bioethical Committee of Silesia Medical Academy NN-013-260/I/01. The research was done within grant NN-4-025/02.

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