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**DYNAMICS OF URGENT ADAPTATION OF ERYTHROCYTES IN REGULAR PHYSICAL ACTIVITY IN YOUNG MEN**

**Introduction**. Red blood cells are among the first to respond to the impact of the load factor. Under the influence of the load at the initial stage,a change in hemoconcentration occurs due to release of erythrocytes into the bloodstream. And with further load operation, there will be increase in hemodilution and erythrocytosis (Khmeleva SN, 1998, Belchenko LA 2001, parapara AA 2005; Perier C., 1999, Deitrick RW, 2002, Minetti M., 2006). Hemodilution occur due to the decrease in the number of red blood cells in the plasma and increase in the total volume of plasma. The plasma flow from blood and organs.This result in redistribution of the total blood volume, hematocrit, and red cell content. According to works Merrill E., Wells R., 1961 and Snigger G., 1971, there is an increase in hematocrit about 25%, which leads to an increase in blood viscosity by 20%.

Table 1 - Maximum duration of physical activity of varying intensity (Karpman VL et al., 1988)

|  |  |  |
| --- | --- | --- |
| The intensity of muscular work,% of M.O.C. | Time of work | |
| untrained people | trained people |
| 100 | 1-5 min | 10-15 min |
| 90 | 10 min | 50 min |
| 75 | 20 min | 3 hr |
| 50 | 1 hr | 8,5 hr |
| 30 | 8,5 hr | — |

Under conditions of a long-acting intense exercise, a part of the plasma, leaving the vascular bed into the extracellular fluid. Due to this, there will be an increase in the concentration of blood cells, particularly red blood cells which transport oxygen. Under these conditions the same amount of blood is able to move more oxygen to the working muscles. Erythrocytosis willincreasethe acid capacity of the blood by 4-10% [2]. Erythrodiaersis is a destruction of red blood cells which act as stimuli for erythrogenesis in bone marrow cells, spleen and lymphatic tissue. Erythropoietin is produced mainly in the kidney unit (juxtaglomerular)in response to decrease in the partial pressure of oxygen in the blood [3,4]. When there is physical load there will be an increased in energy consumption and oxygen consumption (VO2). The gradual increase in power causes an increase in cardiac output and arteriovenous oxygen difference (AV O2). Moreover, in the initial stages it shows a linear relationship between VO2 and AB O2, which at some point reaches the limit level. According to table 2 [5] limit for trained people, after which VO2 stabilized and no further increases, despite the increase of load and the point in time corresponding to the 15-minute mark. At this point blood reaches the maximum oxygen consumption (M.O.C. or VO2Max), which is defined as the highest amount of oxygen consumed per minute. M.O.C. is a measure of aerobic capacity of cardiorespiratory system and it’s expressed in a volume of oxygen per kilogram of body weight (ml / kg) per minute. The magnitude of M.O.C. affect by the age, sex, body size, and physical activity level table 2 [5].

Table 2 - Power of Aerobic cardio-respiratory system untrained and trained young people [5]

|  |  |  |
| --- | --- | --- |
| Age, years | Maximum oxygen consumption, ml / (kg min) | |
| untrained | trained |
| 20 | 45±5 | 60±5 |
| 30 | 52±7 | 80±4 |

The magnitude of the M.O.C. is closely related with the results of physical performance on the test PWC170. Where the load range is 1100-1800 kgm / min, the relation is linear and it’s used to evaluate aerobic capacity of circulatory apparatus and the physical state of the organism as a whole.Thereforit’s better to use method of indirect determination of the M.O.C. resultsin PWC170 or step test. Using the linear dependence of the M.O.C. and physical performance allows us to trace the nature of the workload of cardio-respiratory system at different stages of the exercise. And to evaluate the mechanism of erythrocyte adaptation, we studied the dynamics of urgent adaptation of red blood cells to the action of physical activity and its relationship with physical performance in a group of young men involved in sports.

**Material and Methods of Research:** To achieve this goal on the basis of the Department of Zoology, Physiology and Genetics SO "Gomel State University. Skaryna,SO"Gomel Federation of Jiu-Jitsu"and RSC RM&HEfor two months surveyed the group of men aged 20 to 35 years old. In a survey of 57 people who took part in this study, and different physical exercises experience. The training sessions are included with a 30 minute workout, which includes 15 minutes of jogging at a moderate level (30 m / min), a 15-minute set of strength exercises (pull 20 times per minute, push-ups 50 times per minute, squats 50 times in a minute). After the warm-up exercises, participants performed 30 minutes of sparring elements (throws). The initial phase of the training can be described as a set of average aerobic power exercises, which corresponds to the oxygen consumption rate of 55-65% of the individual maximal absorption. This exercise,shows the energy of the working muscles is provided by aerobic processes. The survey included a sampling of peripheral blood prior to beginning exercise and immediately after.Within an hour, the samples were delivered to the clinical-diagnostic RSC RM&HE lab and processed on an automated hematology analyzer SX10000i, intended for the diagnosis in vitro. Erythrocytes were analyzed using erythrocyte detector hydrodynamic focusing method is used [7]. To determine the physical performance and the subsequent evaluation of the M.O.C. test was used «PWC-170» (Physical Work Capacity), proposed by T. Sjostrand (1947) and a modified V.Karpman (1974). By definition, physical performance - is a value expressed in one load power, in which the heart rate reaches 170 beats per minute. The subjects performed successively two load for 5 minutes with a 3-minute rest interval between them. In the last 30 seconds of the fifth minute of each load was calculated pulse palpation. The value of the first load was 1 W per kg of body weight, the value of the second load was 1.5 W / kg. Capacity of the first load (W1) was chosen depending on the body weight of the subject in such a way that at the end of the 5-minute pulse (f1) reached 110-115 beats / min. Second load capacity determined by the formula 1:

W2 = W1 · [1 + (170 - f1) / (f1 - 60)], (1)

Where W1and W2are thefirst and second output loads,f1 and f2 –are heart rate per minute after the first and second loads.To perform the test used ergometer M32-B1, Belarus. Pedaling frequency is maintained at 60 rpm. After the test result value is recalculated to kilogram-meters in 1 minute (kgm). Calculation of physical work level held by the formula ofKarpman V. (1974):

PWC-170 = (W1+(W2-W1)) · ((170-f1)/(f2-f1)), (2)

Determination of the M.O.C. was performed using formulas Karpman (1976) for persons with a low level of fitness. Statistical analysis of survey results performed using MS Excel 2007 and Statistics for Windows 6.0 applications. Assessment of the significance of differences was carried out on the basis of Student's t-test. Effect of exercise on blood parameters assessed by one-way ANOVA (ANOVA).

**Results and discussion:** Investigation of the peripheral blood to load showed that hemoglobin in the blood averaged 151,19 ± 0,88 g / L and the content of the erythrocyte - 4,92±0,05×1012 / L, these indicators are within (p <0,05). Mean hemoglobin content after the load has increased up to the upper limit of normal, 159, 44 ± 0,96 g / L. The average value of the erythrocyte content was 5,50±0,10×1012/ L, upper limit of normal at 8%. According to [8, p. 195] in terms of exercise, the number of erythrocytes can reach 6,0×1012/ L. Comparison of the average values of the indicators showed a significant difference between the content of hemoglobin and red blood cells before and after exercise (p <0.01). ANOVA method estimated that the strength of the effect of the load factor in the variation of hemoglobin values is 26% and for red blood cells 28% (p <0,05). The nature of urgent adaptation has individual characteristics that can be caused by many factors, among which are the length and frequency of training activities.

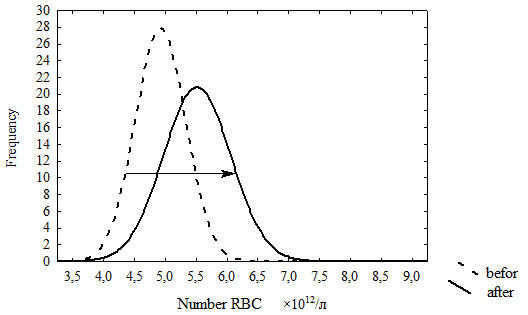


Figure 1 - The distribution of the number of red blood cells before and after exercise young men

Table 3 - Reaction of red blood cells to physical stress

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Stage | Indicators | | | |
| Hemoglobin, g / l | | Erythrocytes, × 1012 / L | |
| Before | After | Before | After |
| 1 | 152,64±1,51 | 159,55±1,54 | 4,76±0,10 | 5,36±0,08 |
| 2 | 137,93±1,34 | 145,37±1,38 | 4,63±0,08 | 5,45±0,07 |
| 3 | 149,08±1,30 | 157,20±1,98 | 5,08±0,09 | 5,73±0,25 |

Table 4 - Assessment of the M.O.C of young men who have a different training experience

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Level physical training | Stage, Age | | | | | |
| 1 | | 2 | | 3 | |
| % | M.O.C, ml / kg | % | M.O.C, ml / kg | % | M.O.C, ml / kg |
| Below the average | 4 | 48,05±1,36 (2,36)\* | 5 | 47,44±1,48 (2,17) | - | - |
| Average | 11 | 50,91±1,16 (2,84) | 28 | 51,58±1,00 (4,02) | 9 | 52,76±1,72 (3,84) |
| Above average | 5 | 51,73±0,57 (0,98) | 19 | 59,08±0,78 (2,63) | 7 | 58,01±1,89 (3,78) |
| high | - | - | 5 | 63,13±0,10 (0,96) | 7 | 68,45±2,48 (4,96) |

-\* standard deviation

**Conclusion:** This study evaluated the reaction of the red blood cells to the physical activity. The increase of the amount of hemoglobin and red blood cells in the peripheral blood, which was significantly different from baseline. There was no significant effect on the dynamics of exercise time before and after the measurements. Evaluation of physical performance surveyed on cohort study showed that there is an uneven increase in uptime. The average value of the M.O.C, depending on the length of training is increased, but statistically significant correlation could be established between the blood and the M.O.C.

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