THE INFLUENCE OF PHYSICAL EFFORT ON NONSPECIFIC CELLULAR IMMUNITY AND LEUKOCYTARY FORMULA AT TEENAGE SPORTSMAN

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ABSTRACT (online version)
This paper deals with the effects of physical exercises and training on some components of the immunitary system. The study was made on a lot of (n=10) male sportsmen (athletes) between the age of 13 and 15. In relationship with submaximum intensity physical effort (55% of VO₂ max/hour) a nonsignificant increase of posteffort total leukocytes (white cells) concentration takes place. Also it is noticed a significant increase of the monocytes percentage in the recovery period in comparison with the situation from basic conditions (10,0±1,28 toward 7,3± 0,094, p<0,001). As far as lymphocytes percentage in posteffort recovery is concerned, this shows a significant decrease (22,0± 5,33 toward 25,6±3,33, p<0,02). This suppression however doesn`t concern all the lymphocytes subpopulations.

Unsignificant increase in the recovery period concerns the neutrophile percentage, doubled by an easy eosinopenie "decrease of the eosinophils population". If we refer to the phagocitary capacity of the neutrophils as a reponse to submaximum effort (the basic NBT test) we notice a significant increase in the recovery period (6,1±3,24 toward 3,8±1,39, p<0,05) explained by the increased capacity of blood neutrophils to produce microbicidal oxygen forms like H₂O₂ and HOCl –though the other two tests NBT stimulant % and IFL % presents percentage increase (growth) ,these are however insignificant (p>0,05).

This increased oxidative activity of the neutrophile can stimulate resistance to infections by stimulating the killing capacity (bactericidie) of the neutrophils. On contrary the extensive periods of intense exercises can lead to increasing susceptibility to common by decreasing this capacity.

KEY WORDS: phagocitosis, eosinophils, neutrophils, monocytes, lymphocytes, eosinopenie, phagocitary.

INTRODUCTION
The influences of constante physical activity upon the immunitary system are extremly varied. A multitude of informations were achieved regarding the relationship between physical effort and the number of granulocytes and lymphocytes especially the distribution of the lymphocytes subpopulations.
Not so much problem of immunodeficiency at performance sportsmen is a current issue but the acute influence of physical activity upon the “cellular” and “humoral” components of the specific and unspecific immunitary sistem and its possible influence on the whole organism.

In a series of former researches (Cotuna D., Goţia S. R. 1993) we have emphasized the changes of the leukocytary formula and the fagocitary activity of the neutrophils at sportmen, respectively the late modifications of training of these parameters after continuous activity in performance sport.

In this paper we have investigated the influence of physical stress on the leukocytary formula and on the fagocitary capacity of the neutrophils at a group of sportmen at puberty age who where initiated in the physical activity of performance considering (the fact) that puberty age was less studied from the point of view of the immunitary function.

**MATERIALS AND METHODS**

The determinations were made on a group of 10 healthy males, initiated in the sport of performance (football), with ages between 13-15. The submaximum effort was done at the cycloergometer in steps of 25W/2 min., with a constant peddaling rhythm of 40 rounds/min. till it reached FMO, age = 174 beats/min.

Blood samples were obtained from the antecubital vein before and after effort (at 3 min.). The weekly training program lasted 6-9 hours per week, and the determinations were made after 2 weeks of training.

From all the people blood samples were taken on anticoagulant (Na2 E.D.T.A.), and the determination of the fagocitary capacity of the neutrophils was made through 3 parallel tests: NBT stimulated test; NBT test and the test of determination of the fagocitary index of the latex particles (IFL %). In parallel the leukocytary formula was established before and after effort (3 min.).

The results were expressed in NBT neutrophils per cent + or neutrophils that included latex particles. The statistic estimation of results was interpreted by the “T” Student test and the comparisons were made between the values registered before and after effort.

**RESULTS**

The characteristics of the individuals are listed in the table 1.
In the day of test no individual presented infections of the respiratory tractus. The data from the literature concerning the fagocitary capacity of the neutrophils of the teenagers is not sufficient.

Table 2 sums up the basal values and the values of the recovery after submaximum effort for the fagocitary capacity of the neutrophils determined through NBT test, NBT stimulating test and IFL %. As for the values of the untrained adults individuals former research specifies them between 9,25 ± 2,21% for the NBT test and 58,30 ± 11,30 for IFL test.

**TABLE 1.** The characteristics of the individuals (Average ± SE).

<table>
<thead>
<tr>
<th>Athlets</th>
<th>n</th>
<th>Age</th>
<th>High (cm)</th>
<th>Weight (kg)</th>
<th>V0₂ max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>13,35±0,47</td>
<td>165±10</td>
<td>53,9±13,05</td>
<td>55,2±1,6</td>
</tr>
</tbody>
</table>

In over research on the group of young sportsmen we registered before effort and after effort the following results (at the NBT bazal test 3,8±1,39% to 6,1±3,24 %; at the NBT stimulating test 7,2 ±2,84 to 9,3±4,37 %, and at the IFL test 63,80 to 4,13%).

**TABLE 2.** Bazal values and after submaximal effort recovery values of the fagocitary capacity of the neutrophils (Average ± ES).

<table>
<thead>
<tr>
<th>The test</th>
<th>Nr. of ind</th>
<th>Bazal</th>
<th>Recovery (3min)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBT Bazal%</td>
<td>10</td>
<td>3,8 ± 1,39</td>
<td>6,1 ± 3,24</td>
<td>2,024</td>
<td>&lt;0,05</td>
</tr>
<tr>
<td>NBT Stimul%</td>
<td>10</td>
<td>7,2 ± 2,48</td>
<td>9,3 ± 4,37</td>
<td>1,298</td>
<td>&gt;0,05</td>
</tr>
<tr>
<td>IFL %</td>
<td>10</td>
<td>63,80 ± 3,7</td>
<td>67 ± 4,13</td>
<td>1,80</td>
<td>&gt;0,05</td>
</tr>
</tbody>
</table>

Table 3 expresses our results concerning the leukocitary formula and the total leukocytes. In this way the pre- and post-effort determinations show an insignificant increase of total leukocytes from 5280 ± 384 to 5700 ± 386 (p > 0,05). If we refer to the leukocitary formula the values are the following:

- for neutrophils: 60,6 ± 5,3 to 64,4 ± 5,4;
- for eosinophils: 4,8 ± 2,32 to 3,55 ± 1,94 ;
- for monocytes: 7,3 ± 0,94 to 10 ± 1,88;
- for lymphocytes: 25,6 ± 3,3 to 22 ± 5,33.

The values of the neutrophils post-effort are insignificantly more higher compared to the bazal values: 60,6 ± 5,33 to 64,4 ± 5,48.
In the case of eosinophils the situation inverts post-effort values are inferior, without being significant: $4.8 \pm 2.32$ to $3.55 \pm 1.94$ it's a matter of an easy eozinopenie.

As for the percentage of the lymphocytes in postsolicitation stage, this decreases significantly from $22.0 \pm 5.33$ to $25.6 \pm 3.3$ ($p > 0.02$), and for monocytes we noticed a significant increase of the percentage: $10 \pm 1.88$ to $7.3 \pm 0.094$ which reflects an increased chemotactic and fagocitary activity.

**TABLE 3:** Variations of the leukocitary formula at young sportsmen in basal conditions and after submaximum effort (Average ± SE).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Nr. of ind.</th>
<th>Basal</th>
<th>Recovery (3min)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophils %</td>
<td>10</td>
<td>$60.6 \pm 5.33$</td>
<td>$64.4 \pm 5.48$</td>
<td>1.54</td>
<td>&gt;0.05 (NS)</td>
</tr>
<tr>
<td>Eosinophils %</td>
<td>10</td>
<td>$4.8 \pm 2.32$</td>
<td>$3.55 \pm 1.94$</td>
<td>1.41</td>
<td>&gt;0.05 (NS)</td>
</tr>
<tr>
<td>Monocytes %</td>
<td>10</td>
<td>$7.3 \pm 0.94$</td>
<td>$10.0 \pm 1.88$</td>
<td>4.22</td>
<td>&lt;0.001 (ES)</td>
</tr>
<tr>
<td>Lymphocytes %</td>
<td>10</td>
<td>$25.6 \pm 3.33$</td>
<td>$22.0 \pm 5.33$</td>
<td>2.40</td>
<td>&lt;0.02 (S)</td>
</tr>
<tr>
<td>Leukocytes %</td>
<td>10</td>
<td>$5280 \pm 383$</td>
<td>$5700 \pm 386$</td>
<td>0.74</td>
<td>&gt;0.05 (NS)</td>
</tr>
</tbody>
</table>

**DISCUSSIONS AND CONCLUSIONS**

Looking at the results registered at teenage sportsmen in basal conditions and submaximum post-effort we ascertained that physical effort combined with competitional stress has significant effects on the immunitary function of the organism cellullary mediated, expressed through the change of the fagocitary power of the neutrophils.

For untrained adults the literature shows as normal values for the fagocitary capacity of neutrophils the following values: 50% for IFL %, for NBT % the limits quoted by the literature are between 1-14% (our values: $6.1 \pm 3.24$) and for stimulated NBT % the values are doubled compared to NBT basal. If the case of IFL % the basal values are with 22% superior of than those in the literature; for both tests the values are lower compared to the control groups with 37% for NBT test and with 44% for stimulated NBT test, statistically the effect being significant.

We interpret the increase only for 7,95% of the circulating leukocytes (from $52.80 \pm 383$ to $5.700 \pm 386$ ) as being the result of a good adaptation at effort of the youth. The submaximum effort didn't need a suddenly spleen contraction to mobilise the blood stored up in the spleen.
The post-effort hemoconcentration could represent a possible explanation for the unsignificant increase of the circulant leukocytes. Concerning leukocitary formule we ascertain insignificantly higher for neutrophils and very significantly rises for circulating monocytes. Also we notice significantly diminutions for lymphocytes (p=0,02) and in the same time eosinophils are at the limit of significance. The diminuation of circulating lymphocytes and eosinophils could be the effect of the stimulation of the axle of hypothalamus-hypophyses-cortico-suprarenal gland with elimination of glucocorticoids. These hormones give the metabolic support for effort, also they have as secondary effect the producing of lymphopeny and eosinophily.

The answer of neutrophils at the stimulation before effort is situated between normal limits (bazal NBT =3,8±1,39 %) and stimulated NBT growths at 7,2 ±2,48. After submaximal effort we notice the tendency of significantly rise of the values for NBT 6,1± 3,24 (p<0,05) and for NBTs the rise being at the limit of significance 9,3± 4,37 (p>0,05).

The comparative analyses of stimulated NBT tests related to bazal NBT reveal that the values of NBTs are higher but also the variations of NBTs before effort are plainly higher (with 89,47%) comparatively with NBTs after submaximal effort.

The answering capacity of granulocytes for a stimulation is much reduced after effort in comparison which the same values before effort. Physical submaximal effort represents in the same time a stimulation inducing the rise of oxidative metabolism of granulocytes revealed by values of 60,5% higher of NBTbazal. So granulocytes suffer a functional transitorily deficiency after effort although as their number is between normal limits. This phenomenon explain the susceptibility of sportsmen for infections after the maximal effort.

The intimate mechanism of these process involves more aspects. So it was noticed that the physical effort decrease the activity of some oxidative enzimatic systems which determine the killing of bacteria included in granulocytes as mieloperoxidase and NADPH-oxidase. This decrease determine a lower phagocytic capacity of neutrophils.

Also it was noticed that a modification of citokines ratio eliminated in circulation during effort which influence oxidative activity of neutrophils.
A series of tests revealed the influence of physical effort on microbicid activity of neutrophils by the change in blood level of some mediators as adrenaline, of some neuropeptide like P substance and beta-endorphine and of prostaglandins (3,8).

Also endogenous glucocorticoids and ACTH grows these hormones block interleukine I and phosphorilase A$_2$ inducing the diminution of immunitary capacity.

A series of observations point out that young persons are more sensitive to such modifications determined by physical effort and immunodepressive effect of the sport-stress is much more pronounced that in adults (5).

REFERENCES