

# CELLULAR IMMUNE SYSTEM AND PHYSICAL EFFORT

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**Abstract:** This paper deals with effects of under-maximal exercises and of training on the components of specific cellular immunity. The concentration of total lymphocytes grows up during effort and diminishes after under-maximal effort. The percentage of T<sub>4</sub> (CD<sub>4</sub>) cells diminishes after the cessation of the effort from  $\bar{X}_1=41,32\pm 2,02$  before effort to  $\bar{X}_2=35,02\pm 4,15$  while the concentration of T<sub>8</sub> (CD<sub>8</sub>) cells diminishes from  $\bar{X}_1=25,50\pm 2,49$  to  $\bar{X}_2=24,06\pm 3,43$  ( $p<0,05$ ) this difference being without statistical significance. It was found a reduction from 1,71 before effort to 1,52 after effort concerning ratio CD<sub>4</sub>/CD<sub>8</sub> (T<sub>4</sub>/T<sub>8</sub>). So the immunomodulation induced by effort is due to the affectation of immune system. Moreover under-maximal efforts cause post exercise immunodepression being different from reduced efforts. In this process it was noticed the possible role of different stress hormones as epinephrine, norepinephrine and cortisol.

## INTRODUCTION

During last years it was accredited the opinion that physical effort preponderantly improves the resistance of the organism to the infections and the majority of sportsman has a good physical state. However this opinion is not sustained by published data and moreover there are communicated data which on the contrary revealed that strong physical exercises induced the increase of sportsman susceptibility for infections.

It is also known that physical stress including traumatism, septic states, burns, acute myocardic infarct, are in interaction with immune system. An outstanding attention was paid recently to the effects of physical exercises on the immune system. So B lymphocytes (CD<sub>19</sub>) have the capacity of recognize an antigen in contrast with T lymphocytes which are specialised also in recognising of histocompatibility antigens. The antibodies remain in circulation so long as sensibilised lymphocytes last indefinitely and answer in the moment of the encounter of the specific antigen. For this reason the cellular immunity is of longer duration than the umoral immunity. On the other hand T lymphocytes do not react with free antigen in a solution and react only with the antigen coupled with other cell (macrophage, tumoral cell, virus-infected cell) or with aggregating antigens.

There is many T lymphocytes populations according their role as follows:

Cytotoxic T lymphocytes (CD<sub>8</sub> or T<sub>8</sub>) having the ability to distinguish the target cell without phagocytosis and without the intervention of the complement system in the second encounter with the antigen.

Suppressor T lymphocytes activated by T<sub>4</sub> (CD<sub>4</sub>) lymphocytes inhibit the T and B lymphocytes.

T helper lymphocytes (CD<sub>4</sub> or T<sub>4</sub>) proliferate after the encounter with the antigen from macrophages surface (CD<sub>11</sub>) in association with MCH (major histocompatibility system). T helper lymphocytes favour the B lymphocytes transforming in plasmocytes and the immunoglobulins secretion.

T<sub>4</sub> lymphocytes (CD<sub>4</sub>) and T<sub>8</sub> lymphocytes are main regulators of the immune response modulating the antibodies producing by B lymphocytes (CD<sub>20</sub><sup>+</sup>) as well as the function of T cytotoxic cell.

This work deals with investigation of physical effort effect and of prolonged training upon CD<sub>4</sub> (helper) and CD<sub>8</sub> (suppressor) subsets of lymphocytes.

## MATERIALS AND METHODS

The physical effort has multiple influences on human body these influences being correlated with the type, the intensity and the duration of the effort. A series of specific reactions determined by the physical effort are immune type reactions (Liesen H. „at all.“,1989). So it was revealed that moderate physical effort has favourable effects on the organism by inducing the resistance for infections while the maximal effort has unfavourable effects.

In this paper we investigated the influence of physical exercises having under-maximal intensity (60-70% VO<sub>2</sub> max/h) on specific cellular immunity respectively on CD<sub>4</sub> and CD<sub>8</sub> subsets of lymphocytes and on cellular CD<sub>4</sub>/CD<sub>8</sub> ratio.

The determinations of these parameters were performed on a group of 10 performance sportsman aged of 18-35 years during previous period of the competitions. The blood samples were obtained in the morning before the effort and at 1 p.m., immediately after effort using Na<sub>2</sub>EDTA as anticoagulant. The determinations were performed by flowcytometry (FACS) 7-8 hours after blood sampling.

Statistical estimation of the results was performed by Student test and the values registered before effort was compared with the values obtained after effort.

## RESULTS

Our determinations performed before and after under-maximal effort revealed the following values before the effort: for CD<sub>4</sub> X<sub>1</sub>=41,32±2,02 for CD<sub>8</sub> X<sub>2</sub>=25,50±2,49 and CD<sub>4</sub>/CD<sub>8</sub>=1,71.

Table 1. Mean values of CD<sub>4</sub> and CD<sub>8</sub> lymphocytes in basal conditions.

CD<sub>4</sub>/CD<sub>8</sub> ratio during the rest.

Parameter	n	X	SD	CV%	CD <sub>4</sub> /CD <sub>8</sub> ratio
T <sub>4</sub> (CD <sub>4</sub> )	10	41,32	2,019	0,287	1,71
T <sub>8</sub> (CD <sub>8</sub> )	10	25,50	2,490	0,154	

Immediately after effort the situation of the same parameters is the following (Table 2):

Table 2. Mean values of CD<sub>4</sub> and CD<sub>8</sub> after effort. CD<sub>4</sub>/CD<sub>8</sub> ratio after effort.

Parameter	n	X	SD	CV%	CD <sub>4</sub> /CD <sub>8</sub> ratio
T <sub>4</sub> (CD <sub>4</sub> )	10	35,02	4,15	0,249	1,52
T <sub>8</sub> (CD <sub>8</sub> )	10	24,06	3,43	0,319	

Statistical analysis of the two parameters CD<sub>4</sub> and respectively CD<sub>8</sub> was performed by Students "t" test.

Parameter	Mean±SD	T	P
CD <sub>4</sub>	41,32±2,02	1,97	0,05(S)
CD <sub>4</sub>	35,02±4,15		
CD <sub>8</sub>	25,50±2,49	0,315	0,6(NS)
CD <sub>8</sub>	24,06±3,43		

## DISCUSSIONS AND CONCLUSIONS

Literature data concerning the effect of physical effort on specific cellular immunity reveal that there is an important agreement with significant decrease of CD<sub>4</sub>/CD<sub>8</sub> ratio respectively T<sub>4</sub>/T<sub>8</sub> from moderate effort to intense effort (60/90% VO<sub>2</sub> max during) limits of 15-20 minutes (Kinderman W."et al.",1992, Kindermann W."et al.",1989, Nieman D.C."et al.",1991, Order U."et al.",1989, Pedersen B.K.,1991, Ricken K.H."et al.",1990). This decrease is conditioned by the diminution of the proportion of T helper cells in general population of lymphocytes while the proportion of T suppressor cells (CD<sub>8</sub>) remains constant.

The analysis in the phase after physical solicitation reveal that at 2 hours after effort acute changes are coming again into equilibrium.

From the analysis of results registered in the two situations in basal conditions and respectively immediately after under-maximal effort it was found that physical effort

during training combined with specifically competition stress determines evident effects on cellular mediated immune capacity on lymphocytes subsets and on CD<sub>4</sub>/CD<sub>8</sub> ratio. Analysis obtained on performance sportsmen during effort lead to the assumption of duration decreases of the CD<sub>4</sub>/CD<sub>8</sub> ratio with an individual coefficient of 0,5. In comparison with normal values performance sportsmen have not only a low CD<sub>4</sub>/CD<sub>8</sub> coefficient but also a clear reduced cellular number in subpopulations of T lymphocytes (Berg A.“et al.“,1994). However were not established correlations between the reduction of T lymphocytes number and the decrease of the activity of these cells (Liesen H.“et al.“,1989, Pedersen B.K.,1991). Probably anaerobic effort leads rather to significant modifications in cellular system by introducing in blood flow of the stress hormones (adrenaline, noradrenaline, cortisol) more then aerobic effort.

It is known that in various physical stress the concentrations of adrenaline, noradrenaline and cortisol are higher and that stress hormones has an immunomodulating effect. On the other hand adrenaline administration induce only minor increases of leucocytes concentration immediately after effort in comparison with physical effort and this administration can not entirely explain after-effort leucocytosis. Other data suggests that both catecholamine and cortisol can be responsible for the leucocytosis during effort.

McCarthy and Dale (McCarthy D.A.”et al.”,1988) had a satisfactory explanation for all leucocytes modifications during and after physical effort to sportsmen. They supposed that leucocytes modifications during the effort could be the result of catecholamines concentration increase while the cortisol proceed by a mechanism involving a late time of action on the total number of leucocytes from blood vessel.

The data about physical effort and immune system demonstrate the alteration of the mononuclear cells an especially of lymphocytes. Major mediators of the immunomodulation in effort are catecholamine and cortisol which produce a redistribution of mononuclear cells, respectively of the subsets of lymphocytes.

Fitzgerald (Fitzgerald L.,1988) revising the literature about exercise and immune system concludes: “although moderate effort has general stimulating effects on the immune system intense effort could represent the cause of immunodeficiency.”

Checking organizing of the training and the effort dosing could prevent a possible immunodepression in the performance sport (Kinderman W.“et al.“,1992).

## CONCLUSIONS

Immediately after effort CD<sub>4</sub>/CD<sub>8</sub> ratio decrease from the basal value of 1,71 to 1,52.

The proportion of T<sub>4</sub>(CD<sub>4</sub>) cells decrease from X=41,32 during the rest to X=35,02 immediately after effort being statistically significant.

The ratio of T<sub>8</sub>(CD<sub>8</sub>) cells remains approximatively constant: the values before effort are significantly higher from X=25,50 before effort to X=24,06 immediately after effort.

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