

ALLERGOLOGY

Relationship Between Strenuous Physical Exercise and Immediate Type Allergy

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Daily intense exercise prevents the development of immediate type allergy in subjects of any age due to inhibition of all three stages of allergy mechanism.

Key Words: *strenuous physical exercise; allergy; immune system*

Strenuous physical exercise (SPE) deteriorates the immune status, impairs nonspecific defense, and disorders many functions of the organism [5]. These changes promote the development of many diseases (infections, cancer, cardiovascular, autoimmune diseases, etc.) [8]. The reports about allergic diseases are scanty and contradictory. G. A. Makarova [3] describes cholinergic, cold, solar, and aquagenic urticaria, symptomatic dermatographism induced by physical strain. Recently anaphylaxis after SPE in athletes has been reported [11]. This condition was similar to allergen-induced anaphylaxis and required urgent therapy. The mechanisms of development of allergic diseases in athletes are still little studied.

We examined the relationship between SPE and development of immediate type allergy.

MATERIALS AND METHODS

Experiments were carried out on male guinea pigs weighing 150-200 g (young) and 300-350 g (mature). The animals were divided into 2 groups. Group 1 (control) comprised 52 young and 56 adult sensitized and not trained animals and group 2 (experiment) consisted of 66 young and 66 adult sensitized and trained animals.

Group 2 animals were subjected to treadmill exercise for 40-60 min twice a day, which corresponded

to SPE. The training was carried out for 42 days; on day 30 the animals were sensitized by subcutaneous injection of 0.1 ml allergen (equine serum). On day 10 of sensitization blood was collected for analysis, and on day 12 anaphylactic shock was induced by repeated intracardiac injection of 0.1 ml allergen. The severity of shock was scored as described previously [10].

For characterizing all 3 stages in the mechanism of allergy, peripheral blood T and B lymphocytes were counted [7]; lymphocyte blastogenesis test with phytohemagglutinin was carried out [8]; antibody titers were evaluated in passive hemagglutination test [6] and homocytotropic antibodies (HCTA) IgE, IgG1a, IgG1b [9] were assayed, phagocytic activity of neutrophils (PAN) and alveolar macrophages (PAM) was studied [6], and histamine concentrations were measured in the plasma and mast cells [4]; mast cell degranulation test [6], histamine shock [2], Schultz-Dale test (on an isolated sensitized small intestine) were performed [1], and complete blood count was determined [4].

RESULTS

Injection of allergen on day 30 of SPE induced a significantly weaker anaphylactic shock (2.86 ± 0.09 and 2.57 ± 0.09 for young and adult animals, respectively) than in the control (3.15 ± 0.09 and 2.89 ± 0.09 , respectively). For elucidating the mechanism of this effect of SPE, each stage the development of allergic reac-

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TABLE 1. Time Course of Some Immunity Parameters, Pathochemical and Pathophysiological Stages of Allergic Reaction under Conditions of Strenuous Physical Exercise ($M \pm m$)

Parameter	Control ($n=15$)		Experiment ($n=18$)	
	young animals	adult animals	young animals	adult animals
Immune status				
T lymphocytes, $10^9/\text{liter}$ (%)	2.66 ± 0.14 (45.8 ± 1.5)	2.47 ± 0.12 (49.7 ± 2.0)	$1.57 \pm 0.13^*$ (38.6 ± 2.7) [*]	$1.65 \pm 0.11^*$ (43.8 ± 2.4) [*]
B lymphocytes, $10^9/\text{liter}$ (%)	2.81 ± 0.14 (48.4 ± 1.7)	2.20 ± 0.11 (44.3 ± 1.7)	$1.23 \pm 0.09^*$ (30.1 ± 2.9) [*]	$1.18 \pm 0.11^*$ (31.3 ± 2.1) [*]
LBT, arb. units	6482 ± 516	5607 ± 509	$2431 \pm 262^*$	$1909 \pm 217^*$
AT, arb. units	1046 ± 163	1493 ± 143	$581 \pm 47^*$	$993 \pm 82^*$
HCTA, arb. units				
IgE	34.8 ± 1.3	28.7 ± 1.4	$30.5 \pm 1.2^*$	$25.2 \pm 1.7^*$
IgG1a	15.4 ± 1.7	13.7 ± 1.4	$10.8 \pm 0.9^*$	$9.9 \pm 0.6^*$
IgG1b	27.2 ± 2.1	23.9 ± 2.6	$19.5 \pm 2.8^*$	$17.1 \pm 1.2^*$
PAM, %	81.1 ± 6.2	84.9 ± 6.6	$57.4 \pm 4.6^*$	$63.8 \pm 5.1^*$
PAN, %	49.3 ± 2.9	54.1 ± 3.2	$31.2 \pm 2.5^*$	$38.1 \pm 2.9^*$
Pathochemical stage				
Mast cell degranulation, %	55.1 ± 3.8	52.7 ± 4.1	$41.2 \pm 4.3^*$	$39.7 \pm 3.8^*$
Plasma histamine content, μg	4.3 ± 0.3	5.1 ± 0.4	$5.6 \pm 0.4^*$	$6.3 \pm 0.4^*$
Pathophysiological stage				
Severity of histamine shock, arb. units	3.2 ± 0.3	2.6 ± 0.2	$2.4 \pm 0.2^*$	$2.0 \pm 0.2^*$
Schultz—Dale test, %	32.1 ± 3.3	26.2 ± 2.9	$23.5 \pm 2.2^*$	$16.6 \pm 2.5^*$

Note. *Differences are significant. LBT: lymphocyte blastogenesis test; AT: antibody titer in passive hemagglutination test.

tion was investigated. The immunological stage covers all changes in the immune system from the appearance of the allergen in the body and includes the formation of HCTA. The content of serum HCTA of all classes decreased in animals sensitized after training (Table 1). In order to disclose the causes responsible for changes in the titers of serum HCTA, the immune system was examined. Both quantitative and functional parameters of T and B immunity as well as PAN and PAM were decreased in guinea pigs sensitized under conditions of SPE (Table 1).

No doubt, such changes in the immune system promote a decrease in the production of HCTA.

In addition, SPE reduced allergen-provoked mast cell degranulation in the presence of increased histamine concentration in the plasma (pathochemical stage). This increase might be due to activation of histaminergic systems, since histamine concentrations in the blood and urine in the majority of athletes increase during exercise [5].

The severity of histamine shock decreased under the effect of SPE irrespective of age (Table 1). The Schultz—Dale test confirmed the results of histamine shock. Hence, we conclude that the response of shock organs was attenuated by SPE, *i. e.*, the pathophysiological stage was inhibited.

Thus, SPE prevented the development of immediate type allergic reaction irrespective of age due to inhibition of all three stages: immunological, pathochemical, and pathophysiological.

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