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Physiological Changes in Gymnasts during Training Process

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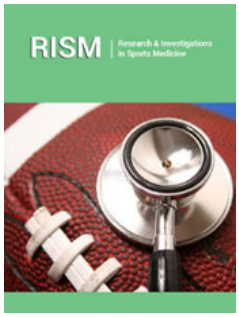

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Abstract

Thanks to systematic training in artistic gymnastics, diverse movement skills are formed and agility, strength and speed are perfected. Under influence of work that is repeated many times and continuously, biochemical, physiological, morphological and functional changes occur in human body, which depend on the characteristics of work being performed. During physical exercise, temporary changes in blood composition are observed, especially in number and distribution of leukocytes. An important role in this process is played by adrenal gland, which secretes hormones such as adrenaline, noradrenaline and cortisol. These hormones participate in regulation of energy metabolism, blood pressure, heart rate and inflammatory processes during and after physical activity. The intensity and duration of exercise directly affect level of these hormones in the blood. In our work, we studied fluctuations and changes in leukocytes, leukocyte formula, as well as changes in adrenal gland hormones. To determine above parameters, we monitored 20 adult gymnasts, of whom 10 were male and 10 were female. The obtained data were subjected to statistical processing with ANOVA ($p \leq 00.5$). Systematic training and physical exercises increase function cortical layer of the adrenal gland, increasing body's resistance to action of various stressors. Hormones play an important role, because they quickly mobilize forces of athlete's body.

Introduction

Gymnastics training induces a series of changes in body, which represent adaptive mechanisms to repeated physical loads. These adaptations affect the cardiovascular, respiratory, hematological and endocrine systems, improving body's ability to cope with the demands of sports activity [1].

During physical exercise, temporary changes are observed in composition of blood, especially in the number and distribution of leukocytes. Moderate or high-intensity physical activity causes mobilization of immune cells in the bloodstream, as a result of action stress hormones and increased sympathetic activity [2]. These changes constitute an important indicator of the body's response and adaptation to training loads.

An important role in this process is played by adrenal gland, which secretes hormones such as adrenaline, noradrenaline and cortisol. These hormones participate in regulation of energy metabolism, blood pressure, heart rate and inflammatory processes during and after physical activity. The intensity and duration of exercise directly affect level of these hormones in the blood [3].

Artistic gymnastics represents an interesting model for studying these changes, as it combines strength, speed, coordination and flexibility exercises, evoking specific physiological responses. The study of changes in blood counts and adrenal hormones helps to assess level of adaptation of athletes to training process and to optimize training loads [4].

The purpose of this paper is to analyze changes that occur during training process in gymnasts regarding blood elements, leukocyte formula and adrenal gland hormones, as indicators of physiological adaptations to physical activity.

Methodology

In our paper, we have studied changes in leukocytes, leukocyte formula and changes in adrenal gland hormones. To determine above parameters, we have monitored 20 adult gymnasts, of which 10 male and 10 female. For male gymnasts, data was collected during training on bars, rings, and floor exercises. For female gymnasts, data was collected during training on floor exercises, balance beam and uneven bars. Blood samples were taken at beginning and end of training process and sent for hormonal parameter diagnostics in a certified biochemical laboratory. The obtained data were subjected to statistical processing with ANOVA ($p \leq 00.5$), analysis results and conclusions of study.

Results and Analysis

Changes in blood composition, mainly leukocytes and leukocyte formula

During our observations, blood tests were performed before and after training, as well as after 14 hours of training.

Based on data, we divided gymnasts into 4 groups:

A. The first group included 4 gymnasts whose leukocyte count before training was 6400 in $1mm^3$ of blood.

B. The second group included 5 gymnasts, whose leukocyte count was 6800 in $1mm^3$ of blood before training.

C. The third group included 3 gymnasts, whose leukocyte count was 7200 in $1mm^3$ of blood before training.

D. The fourth group included 8 gymnasts, whose leukocyte count was 7500 in $1mm^3$ of blood before training.

In analysis done after the training it turns out that:

a) In 1st group of gymnast's number of leukocytes increases to 9500, in $1mm^3$ of blood.

b) In 2nd group of gymnasts this number increases to 10200, in $1mm^3$ of blood.

c) In 3rd group of gymnast's number of leukocytes increases to 10,800, in $1mm^3$ of blood

d) In 4th group of gymnasts this number increases to 11,800, in $1mm^3$ of blood.

In leukocyte formula of gymnasts, a slight increase in number of lymphocytes was observed, about 40%. The other elements were within normal limits. These changes coincide with the first phase of myogenic leukocytes. In analysis done after 14 hours, their number dropped to normal range. Under influence of activity, number of leukocytes in blood increases and, depending on work, a change in leukocyte formula occurs. During short medium-intensity work such as gymnastics, an increase in number of leukocytes is observed after a few minutes. When a task is performed for a long time, percentage of neutrophils slowly increases and reaches peak one and half to three hours after task is completed. After heavy loads for a long time (in a marathon) initial number and composition of leukocytes return to normal limits within 2-3 days (i.e., in late recovery phase). Myogenic leukocytosis is a protective reaction for athlete's body, because it protects it from infections and traumas that can occur during training [5].

Changes that occur in gymnasts in adrenal gland hormones

The paper then presents changes that occur during training process in gymnasts in hormones of the adrenal glands, specifically catecholamines (epinephrine, norepinephrine) and steroids. Human muscular work is closely related to activity of endocrine glands. The influence of hormones in general has been experimentally proven in terms of increasing muscle performance.

During training process, we determined changes of catecholamines (epinephrine, norepinephrine) as well as 17 catheosteroids in 24-hour urine of gymnasts.

A. Epinephrine before training 4.6mg. in 24 hours, while after it 7.11mg. in 24 hours

B. Norepinephrine before training 8.2mg. in 24 hours, while after it 12.7mg. in 24 hours.

C. 17 telosteroids before training 10.5mg. in 24 hours, while after it 12mg. in 24 hours.

During physical exertion, according to data of many authors, changes in blood composition of those hormones that participate in regulation of energy balance have been observed. It has been noted that in the blood plasma, the content of cortisol and aldosterone is increased during or after sports activities. Many other factors can affect adrenocortical response to muscular actions, such as psychological component, physical ability, training time, diet, difficulty and duration of exercise. Thus, during a not very intense work in gymnasts, the concentration of norepinephrine in blood increases [6].

When we perform work with great intensity and for a more or less prolonged period of time (hypoxia), production of epinephrine increases, action of which is 5-10 times more powerful than that of norepinephrine. The physiological activity of epinephrine (produced by medullary layer of adrenal gland) in body is similar to that of sympathetic nerves. It has a comprehensive effect, and increasing its amount during sports activities increases body's ability to work [7].

Hormones produced by cortical layer of adrenal gland, especially group of glucocorticoids and genotocorticoids, affect muscular activity and physical strength of a person. If their content in the blood is insufficient, fatigue quickly appears. The hormones of adrenal cortex and in particular glucocorticoids, take an active part in body's adaptation reactions to action of external or internal environmental agents, especially to physical overloads that occur during sports activities. These actions cause a state of tension in body called stress, as a result of which a series of changes arise that are known by term General Adaptation Syndrome (GAS) [8].

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In such conditions, body copes with created situation by increasing adrenocorticotropic hormone from pituitary gland, as well as glucocorticoid hormones of the adrenal gland. In development of muscular strength, production of androgen hormones is important [9].

Conclusion

During training process, depending on the load, functional changes occur in gymnast body that appear with changes in composition of blood, mainly leukocytes and adrenal glands.

The repetitive processes (normalization of above indicators) in these high-level gymnasts are carried out quickly. This shows adaptations of these systems to load given as training of their organism.

Only systematic training (against action of these agents) and physical exercises increase function of cortical layer of adrenal gland, increasing body's resistance to action of various stressors.

Depending on specific characteristics of different types of sports, hormones play an important role, because they quickly mobilize forces of gymnast body. In these types of sports that are characterized by speed, hormones of cortical layer of adrenal gland play a major role.

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