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The salivary oxidant/antioxidant balance in young basketball players
Balanţa oxidanţi/antioxidanţi la nivel salivar la jucătorii de baschet tineri

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Abstract

Background. Moderate physical exercise and low intensity training improve the antioxidant status. Exhausting exercise, extreme intensity endurance exercise significantly increases oxidative and nitrosative stress.

Aims. The oxidant/antioxidant balance based on salivary indicators was studied in junior basketball players with specific training in the pre-competition period and pupils with general sports training, who practice sport according to the school curriculum.

Methods. The study included six groups (n=10 subjects/group): group I (15 years), group II (16 years), group III (17 years), control groups; and group IV (15 years), group V (16 years), group VI (17 years), groups of athletes. The oxidant/antioxidant balance was measured based on salivary indicators, malondialdehyde (MDA), and hydrogen donors (HD).

Results. MDA values in the groups of athletes IV, V and VI in the pre-competition period were higher compared to control groups. There were differences in HD values both between groups IV and VI and between groups V and VI.

Conclusions. The increase in the intensity of training and aerobic exercise capacity in the pre-competition period determines changes in the salivary oxidant/antioxidant balance. Training is a distressing salivary biochemical oxidative factor.

Key words: oxidative stress, basketball players, malondialdehyde, hydrogen donors, physical exercise.

Rezumat

Premize. Practicarea exerciţiilor fizice moderate şi antrenamentul de intensitate scăzută, îmbunătăţesc statusul antioxidant. Exerciţiile extenuante, exerciţiile de anduranţă şi intensitate extremă, cresc semnificativ stresul oxidativ şi nitrozativ.

Obiective. S-a studiat balanţa oxidanţi/antioxidanţi, pe baza unor indicatori salivari, în perioada precompetiţională la jucătorii de baschet juniori cu pregătire specifică și la elevii cu pregătire sportivă generală, care practică sport conform programei şcolare.

Metode. S-a lucrat cu 6 loturi (n=10 subiecţi/lot), lotul I (15 ani), lotul II (16 ani), lotul III (17 ani), martori şi lotul lotul IV (15 ani), lotul V (16 ani), lotul VI (17 ani), sportivi. Balanţa oxidanţi/antioxidanţi s-a măsurat pe baza indicatorilor salivari, malondialdehida (MDA) şi donorii de hidrogen (DH).

Rezultate. Valorile MDA la loturile IV, V şi VI de sportivi în perioada precompetiţională sunt mai mari faţă de loturile martor. Există diferenţe atât între valorile DH la lotul IV şi VI, cât şi între lotul V şi lotul VI.

Concluzii. Prin creşterea intensităţii antrenamentului şi a capacităţii aerobe de efort în perioada precompetiţională apar modificări ale balanţei oxidanţi/antioxidanţi în salivă. Antrenamentul constituie un factor distresant biochimic oxidativ salivar.

Cuvinte cheie: stres oxidativ, sportivi baschetbalişti, malondialdehida, donori de hidrogen, efort fizic.

Introduction

Oxidative stress can be defined as an imbalance between reactive oxygen species and antioxidant systems to the detriment of antioxidant defense means.

The presence of reactive oxygen and nitrogen species in the muscles, as well as their role in muscle activity have been reported by many studies (Goto et al., 2007; Radak et al., 2008). The production of reactive nitrogen species is related to that of reactive oxygen species. Skeletal muscle fibers generate reactive oxygen and nitrogen species, their quality increasing during muscle contraction. Long duration high-intensity endurance exercise, exhausting physical exercise, overtraining, as well as overcoming of the overtraining phase induce an increase in oxidative and nitrosative stress (Finaud et al., 2006).

The increase of antioxidant defense during physical exercise in athletes and the increase of performance can be obtained by adequate natural antioxidant nutrition, supplementation with non-nutritional antioxidants and an

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adequate physical, technical-tactical and psychological training program (Tache & Ciocoi, 2013). Antioxidant status can be improved by moderate physical exercise, prolonged low-intensity training (Apor & Radi, 2006).

Physical exercise in its turn may have paradoxical effects on redox homeostasis: at moderate intensities, it stimulates antioxidant defense and at high intensities, it has prooxidant effects (Finaud et al., 2006).

Hypotheses

The alteration of redox homeostasis evidenced in blood during exercise led us to suppose its presence in biological fluids and the possibility of a non-invasive study in saliva and urine.

Material and methods

Research protocol

a) *Period of the research*

Before the initiation of the research, the approval of the Ethics Board of the "Iuliu Haţieganu" University of Medicine and Pharmacy Cluj-Napoca and the informed consent of the subjects were obtained. The time of sample collection for groups I, II and III was May 2012 and for groups IV, V and VI, May 2013, after training for three weeks.

Subjects and groups

The determinations were performed in 6 groups (n=10 subjects/group):

- 3 control groups; I (15 years), II (16 years), III (17 years)
- 3 groups of athletes; IV (15 years), V (16 years), VI (17 years)

The groups of young professional athletes were members of the "U Mobitelco Cluj-Napoca" Club and the control groups were pupils of the Informatics High School of Cluj-Napoca.

b) *Tests applied*

The saliva samples were collected using the Holmes procedure (Tache, 1994).

The determinations were performed in the Laboratory for the Study of Oxidative Stress of the Department of Physiology, "Iuliu Haţieganu" UMPh Cluj-Napoca, for two indicators of the O/AO balance, non-invasively measured from the saliva, in the pre-competition period:

- *malondialdehyde* (MDA) using Cheeseman's dosage method (Cheeseman, 1994), values expressed in nmol/mg creatinine;
- *hydrogen donors* (HD) using Janaszewska's dosage method (Janaszewska & Bartosz, 2002), percent values;

c) *Statistical processing*

The statistical processing of the results was performed using the SPSS medical statistical software (version 13.0) and Microsoft Excel (Microsoft Office 2007). Data were statistically processed using the Kolmogorov-Smirnov test; depending on the result of this test, we decided to apply the Student t test, ANOVA variance analysis, multiple comparison post-hoc analysis (Scheffe test) or Welch test, monitoring the bilateral p value with an alpha significance threshold of 0.05. Statistical processing used the Excel application (Microsoft Office 2007) and StatsDirect v.2.7.2 software.

Results

a) Malondialdehyde (MDA)

Table I shows statistical centrality, dispersion and location indicators of MDA and the comparative analysis between the studied groups.

Table I

Statistical centrality, dispersion and location indicators and comparative statistical analysis of MDA for the studied groups.

Groups	Mean	Std. deviation	Std. error	Statistical significance (p)
I	0.338	0.402	0.127	I-II=0.001; I-III=0.01; II-III=0.01; I-IV=0.002; II-V=0.041; III-VI=0.012; IV-V=0.22; IV-VI=0.11; V-VI=0.35;
II	0,618	0.348	0.109	
III	0.572	0.443	0.140	
IV	0.927	0.303	0.096	
V	0.928	0.296	0.094	
VI	1.149	0.475	0.150	

According to the Kolmogorov-Smirnov test, data were normally distributed, so the study was continued with the application of the parameteric Anova test. As part of the test, the application of the Levene test was required, according to which the data of the studied control groups (I, II, III) were homogeneous. The result of the Anova test (F=13.92. p=0.000) evidenced differences between the means of the 3 groups. In this context, we applied post-hoc Scheffe analysis, in order to decide the groups between which there were significant differences.

The results were obtained based on the application of the Anova test to the groups of athletes (IV, V, VI), in the pre-competition period. The Levene test p=0.02 showed that dispersion within the 3 groups was not homogeneous. In this context, the application of the Welch test was required (p=0.4), according to which there were no statistically significant differences between the pre-competition MDA values of athletes.

There were significant differences between the groups of athletes (IV, V and VI) and the control groups (I, II and III) of the same age. In athletes, values were significantly increased compared to controls.

b) Hydrogen donors (HD)

Table II shows statistical centrality, dispersion and location indicators of HD for the studied groups.

Table II

Statistical centrality, dispersion and location indicators and comparative statistical analysis of HD for the studied groups.

Groups	Mean	Std. deviation	Std. error	Statistical significance (p)
I	21.93	8.56	8.56	I-II=0.001; I-III=0.5; II-III=0.001; I-IV=0.165; II-V=0.065; III-VI=0.086; IV-V=0.65; IV-VI=0.001; V-VI=0.007;
II	25.88	7.09	7.09	
III	20.46	7.54	7.54	
IV	27.413	8.33	2.634	
V	24.723	3.66	1.158	
VI	14.844	6.24	1.972	

According to the Kolmogorov-Smirnov test, the data were normally distributed, so the study was continued with the application of the parameteric Anova test. The result of the Anova test (F=1.31, p=0.29) indicated that there were no differences between the means of the 3 control groups (I, II and III).

The results obtained based on the application of the Anova test to the 3 groups of athletes (IV, V and VI) in the pre-competition period evidenced statistically significant differences in HD (F=10.79, p=0.000). In this context, we applied post-hoc Scheffe analysis in order to decide about the significant differences between the studied groups.

Significant differences were found both between groups IV and VI and between groups V and VI. HD values decreased with the increase of age in the groups of athletes compared to control groups.

Discussion

The majority of the studies regarding the O/AO balance have been carried out in adult athletes and animals, using invasive methods for determinations (Ortenbland et al., 1997; Tache, 2001; Sen, 2001; Chevion, 2003; Liu, 2005; Radak, 2008; Buldus, 2012; Vadan, 2012). There are few literature data on the O/AO balance based on urinary and salivary determinations (Tache, 2001; Popovici et al., 2009, Boros-Balint, 2011). During intense exercise, an OS increase associated with a deregulation of redox homeostasis occurs; physical training may have positive or negative effects on OS depending on the basal level, specificity and load (Finaud et al., 2006).

Studies carried out in mdx mice show that low-intensity physical training induces a decrease of OS markers in skeletal muscles. In white muscles, there is a decrease in MDA and PS and an increase in AO and mitochondrial enzyme activity (Kaczor et al., 2007). Studies performed in human subjects evidence changes in the O/AO balance in muscle tissue (Finaud et al., 2006; Nicolaidis et al., 2007, Kaczor et al., 2007).

Physical activity determines an increase in antioxidant defense and contributes to the reduction of OS. Physical exercise influences the O/AO balance, with plasma changes (Sen, 2001; Chevion et al., 2003; Bloomer & Goldfarb, 2004; Dekany M et al., 2006, Shing et al., 2007, Yilmaz et al., 2007).

Physical training may cause adaptations of AO defense mechanisms, which can reduce exercise-induced OS by increasing AO defense. The non-invasive changes in the urinary and salivary O/AO balance have been investigated by many authors (Tache, 2001; Popovici C et al., 2009; Boros-Balint, 2011).

Moderate physical exercise practiced regularly may induce an adaptation of AO and repair systems; at the same time, it may develop a compensation of OS by overcompensating the counterproduction of RONS and oxidative lesions; it decreases the risk of infections and oxidative lesions and not least, it may have beneficial effects, contributing to an increase in the quality of life (Radak et al., 2008).

Our research showed a significant increase in MDA in the 16 and 17 year control groups compared to the 15 year group; significant increases in athletes of all ages compared to the controls matched for age; insignificant increases between the examined groups of athletes: in the 16, 17 year groups compared to the 15 year group and in the 17 year group compared to the 16 year group.

The results show that training in athletes, compared to controls who perform general physical training, determines an increase in OS with age (15-16-17 years) .

HD are significantly increased in the 16 year control group compared to the 15 and 17 year groups; they are significantly decreased in the 17 year group of athletes compared to the 15 and 16 year groups; the are insignificantly decreased in the 16 and 17 year groups of athletes compared to the control groups of the same age.

Our results evidence a decreased AO capacity in the groups of athletes, which is significantly decreased in the 17 year group, which recommends the administration of nutritional and non-nutritional AO for the improvement of AO defense and the periodic control of the O/AO balance.

Conclusions

1. MDA is significantly increased in the groups of athletes.
2. HD values decrease in the groups of athletes with the increasing age.
3. The changes in the O/AO balance in athletes develop early, which recommends the monitoring of redox homeostasis by AO supplementation and the monitoring of training.
4. Oxidative stress changes studied non-invasively in the saliva of athletes recommend its use for the biochemical exploration of stress during exercise and the monitoring of training.

Conflicts of interests

Nothing to declare.

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