Medicina Sportiva (2018), vol. XIV no 2, 3054-3058
Journal of the Romanian Sports Medicine Society

Study of the effect induced by physical effort on urinary malonyldialdehyde level on the unschooled young male (smoker and non-smoker)

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Abstract. The beneficial effects of physical effort are known and demonstrated largely on both clinical and non-clinical experimental models. Currently, clinicians recommends physical effort to patients with acute or chronic pathologies and also those under medication. During physical effort, reactive chemical species of oxygen (oxygen free radicals) are generated, and that induce irreversible damage to cells. The oxidative stress generated by the increase in free oxygen concentration and inflammation induced by physical effort is not only about anatomical structures directly involved in supporting physical effort, but also about other organs involved in post-exercise metabolic recovery, or in the elimination of metabolic products , as is these case, the excretory system. The mechanism by which physical effort induces the appearance of transient renal pathologies has as starting point, the free radicals of oxygen and the cascade of reactions that are induces. Malondialdehyde is an indicator of the degree of peroxidation of lipids in the cell membrane structure. The level of malondialdehyde increases only when major destruction of biological membranes occurs. Urinary malondialdehyde gives us information about both, the renal functional status and the general physiological status of the body, undergoing repetitive exercise. The experimental data obtained revealed that in our experimental model the physical effort does not induce the statistically significant increase of the level of urinary malonyldialdehyde in the two experimental groups that was studied. This information indicates that from the metabolic point of view the smoker or non-smoker body can adapt and respond specifically to the new physiological requirements imposed by the medium intensity repetitive effort.
Key words: *exercise, oxidative stress, urinary malonyldialdehyde.*

Introduction

Over the last decade, physiological effects that was studied was focused on the subcellular and molecular domains. Today, the scientific community is talking about a new field of applicability in the sphere of sports medicine and recovery called the "molecular science of physical effort".

The beneficial effects of physical effort are known and demonstrated largely, on both, clinical and non-clinical experimental models. Specialty literature cites experimental studies, demonstrating that regular exercise prolongs lifespan, and improves the physiological ability of many organs, including the nervous system (1-5). Of note is the antitumoral and cytostatic effect of physical exercise demonstrated since 1950, but without its detailed knowledge of the molecular mechanism (6-8). Currently, clinicians recommend physical effort to both patients with acute or chronic pathologies and those under medication.

During physical effort, reactive chemical oxygen species (oxygen free radicals) are generated, mainly as a result of increased oxygen consumption, but also because of physical exercise phenomena such as leucocyte activation and ischemia-reperfusion phenomenon. Free oxygen radicals, are unstable chemical species of high complexity and chemical reactivity that can interact with all biomolecules. In order to limit the biochemical damage induced by free oxygen radicals, cells provide enzymatic antioxidant defense mechanisms (superoxide dismutase, catalase, glutathione peroxidase) and non-enzymatic (reduced glutathione, vitamin A, C, E, Mg) (9, 10).

In effort, the antioxidant system is inactivated by the free oxygen radicals generated in high concentration, and, the oxidative stress phenomenon, also defined as an imbalance of cellular redox signaling, is installed.

Oxidative stress and associated inflammatory phenomena, influence the post-effort physiological recovery phenomenon, and, implicitly, sports performance. Unfortunately, oxidative stress and inflammation induced by physical effort is not only about anatomical structures directly involved in supporting physical effort, but also about other organs involved in post-exercise metabolic recovery or elimination of metabolic products.
Regarding the beneficial effect of physical effort, recent experimental studies have shown that aerobic exercise can have positive effects on patients with chronic renal failure (11-13). The mechanisms by which aerobic exercise improves renal function have not been identified.
During physical exercise, synthesis of nitric oxide that inhibits the renin-angiotensin-aldosterone system, or acts on renal blood flow by altering intraglomerular pressure, increasing these mechanisms could contribute to the physiological improvement of renal function induced by aerobic exercise (14). However, experimental studies have shown that in acute physical effort, oxidative stress can cause acute renal insufficiency, by reducing renal blood flow and lipid peroxidation in the renal parenchyma (15-18).
The mechanism by which chronic physical strain induces the appearance of renal pathologies has its starting point on the free radicals of oxygen and on the cascade of reactions that it induces. Free oxygen radicals interact biochemically with the molecular components of the nephrons, resulting secondary radicals with varying degrees of toxicity.
Malondialdehyde is an indicator of the degree of peroxidation of lipids in the cell membrane structure. The level of malondialdehyde increases only when major destruction of biological membranes occurs.

Material and Method

The experimental study quantifies the functional response of the male excretory system, unschooled, smoker and non-smoker adult, subjected to moderate physical effort for seven days. The biochemical parameter monitored was the level of malondialdehyde in the urine. The urinary malondialdialdehyde level was determined using a FRC device, type - *Free Radicheck FRC-50SF*. Individual values were read and statistically interpreted using a statistical analysis program.
The experimental model was composed of two lots, a smoker's batch and a non-smoking batch. Urine samples were collected before following the training cycle and during the first 7 days of training. During the seven days of training the urine samples were collected after the effort, to get a clear picture of the exertion response to physical effort. The experiment aimed analyzing the response of the excretory device to the physical effort and not comparing the biochemical status of smokers with non-smokers.
Physical effort model. The study comply with all the ethical rules. Before completing the training cycle, subjects were subjected to specific clinical investigations that targeted both, the cardiovascular and the respiratory system. The subjects underwent physical exercise according to the protocol - easy running on tape for 30 minutes (50%VO2max) and progressively pedaling at medium intensity (65-70%VO2max) for 20 minutes/day/seven days.
Statistical Analysis. Data were processed in the program *OriginPro7.5*. The significance threshold was set at $p \leq 0.05$.

Results

Table 1. Level of urinary malondialdehyde pre-workout and post-workout

	Statistical Analysis	Smoker`s Group Urinary malonyldialdehyde level (nmoli/g)	Non-smoker`s Group Urinary malonyldialdehyde level (nmoli/g)
pre- workout	X±ES	13.15±0.64	11.60±0.80
	n	6	6
post-workout.	X±ES	13.26±0.57^{NS}	11.83±0.72^{NS}
	n	6	6
	t	0.35	0.57
	p≤	NS	NS

X±ES = mean ± standard error; n = the number of individual samples that represented the arithmetic mean in the end; t = the value of the "t" test taken by the Student; p ≤ the threshold of significance established on the basis of the "t" value; NS = insignificant change.

Discussions

Malonyldialdehyde is a lipid peroxidation product of the cell membrane structure. The malonyldialdehyde level is correlated with the degree of peroxidation of lipids in the structure of the biological membranes.

The biochemical method used in our experiment has a very high degree of sensitivity and was cited in clinical studies of oxidative stress.

Malonyldialdehyde most commonly uses the renal elimination pathway in the body but there are studies showing that malonyldialdehyde can use the pulmonary or skin pathway in excretion. Malonyldialdehyde most commonly uses the renal elimination pathway in the body but there are studies showing that malonyldialdehyde can use the pulmonary or skin pathway in excretion. Physical effort is a transient physiological state, but with important implications in the functional dynamics of organism. Most experimental studies are summarized in skeletal muscle as a single structure involved in supporting physical effort. But the new metabolic requirements are imposed by physical effort involves other organs in order to adapt the body to physical effort.

The kidney is responsible for eliminating metabolic products and implicitly adapting the body to the new metabolic requirements imposed by physical effort. Being a structure adapted to physical effort, skeletal muscle presents a biochemical memory capable of activating metabolic systems involved in the adaptive response to physical effort.

We can not say the same about the excretory device. Experimental studies conducted on laboratory animals have shown that, medium intensity physical exercise induces the onset of oxidative stress in kidney paralysis. The main cause of the occurrence of the oxidative stress phenomenon in the kidney is the phenomenon of ischemic reperfusion.

During physical effort, redirection of the vascular volume takes place to organs actively involved in supporting exercise, such as striated muscle. Functional alterations of the post-stress excretory system are also responsible for inflammatory events that are associated or represent the consequence of installing oxidative stress.

The oxidative stress phenomenon can activate via signal-mediated intermediates the above-mentioned mechanisms or may exert a destructive effect with limiting renal function and implicitly altering the dynamics of urine constituents.

Non-invasive techniques to monitor the main functions of the body during physical effort and port-effort have been captured over the last five years.

Physical effort is the basic component of the concept of healthy lifestyle. Clinicians define the concept of healthy lifestyle as a cumulative set of rest, nutrition and physical effort. As mentioned above, physical effort is centred to the concept of a healthy lifestyle, however, during physical exercise, there are a number of cellular metabolic changes capable of triggering cell death.

This biological disadvantage can be limited by observing a correct diet and in relation to the needs of the body subjected to physical effort and rest.

Verifying the degree of compatibility between physical effort and physiological adaptability to time and type of physical effort is a desideratum of modern sports medicine. Establishing the degree of physical exercise compatibility - adaptive physiological response, eliminates the risks of physical effort on the body.

In addition to non-invasive or minimally invasive biochemical tests performed from saliva, urine or blood, and non-invasive imaging, it provides general information about the response of organs to repetitive physical effort, or can highlight pre-existing pathologies that can influence sports performance or put danger to the athlete's life.

In the process of adapting to physical effort, the excretory system plays a key role. Post-elderly renal disease affects the adaptive phenomenon and, implicitly, sports performance.

In our experimental model we studied a biochemical parameter indicating the installation of the oxidative stress phenomenon correlated with the disturbances of the joint membranes. We studied both smokers and non-smokers for practical reasons, without making a comparison between the physiological response of the excretory system of the two categories studied.

Urinary malondialdehyde gives us information about both the renal functional status and the general physiological status of the body undergoing repetitive exercise. The experimental data obtained revealed that in our experimental model the physical effort does not induce the increase of urinary malonyldialdehyde level in the two experimental groups studied.

This information shows that from a metabolic point of view the smoker or non-smoker body can adapt and respond specifically to the new physiological demands induced by physical effort. Non-invasive tests are recommended for monitoring the metabolic status of the body subjected to physical effort and adjusting new requirements through nutritional models.
Our experimental data opens up a topical area for researchers but especially for clinicians, such as pre-body monitoring and post-physical effort.

Conclusion

Repetitive physical effort did not lead to a change in malondialdehyde level in the urine, a parameter that indicated the state of renal integrity and functional adaptation to physical effort without the occurrence of the oxidative stress phenomenon.

Acknowledgments. Thanks in this way to Mr. Vibor Babic and to Edina Marti from SC Energopharma HPE SRL (Timisoara, Romania) for the technical support provided for this study with the help of modern medical measuring instruments (portable analyzer for quantitative detection of malondialdehyde in urine - Free Radicheck FRC-50SF).

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Received: April 10, 2018
Accepted: September 15, 2018