

The paradox of the oxidants/antioxidants balance in exercise

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Abstract

The generation of reactive oxygen and nitrogen species is a ubiquitous biological phenomenon in eukaryotic cell life. Oxidative stress is defined as an imbalance between the reactive oxygen species and antioxidant systems or prooxidant/antioxidant status, in disfavor of antioxidant defenses.

Our lifestyle: smoking, alcoholism, adequate or inadequate diet, physical exercise, training or untraining status, age and gender contribute to produce oxidative and nitrosative stress.

Numerous studies have revealed the presence of reactive oxygen and nitrogen species at muscle level and their role in the regulation of muscular activity. Production of reactive nitrogen species is connected to that of the reactive oxygen species. Skeletal muscle fibers continually generate reactive oxygen and nitrogen species at a slow rate that increases during muscle contraction. They exert multiple, direct and indirect effects on the muscular activity (contractility, excitability, metabolism and calcium homeostasis) and are also involved in the muscular fatigue of skeletal muscle during strenuous exercise.

Strenuous exercise, exhaustive acute physical exercise, endurance exercise of extreme duration and extreme intensity, ultra endurance exercise, overtraining syndrome and overreaching as the initial phase of overtraining syndrome induce a marked response of oxidative and nitrosative stress.

Moderate exercise, low intensity training, long term exercise training improve the antioxidant status. Reactive oxygen species play an important role in cell signaling and in the regulation of antioxidant genes expression. Exercise causes an upregulation of nuclear factor kappa B and mitogen-activated protein kinase; these are two major oxidative-stress-sensitive signal transduction pathways that have been shown to activate gene expression and proteins that play important roles in the maintenance of intracellular oxidant/antioxidant homeostasis.

The analysis of prooxidant/antioxidant ratio (Loverro's coefficient) has showed significant changes in response to muscle-damaging exercise and demonstrated the practical application of this ratio to evaluate the risk of oxidative and nitrosative stress in athletes.

Key words: oxidative stress, nitrosative stress, exercise, prooxidant/antioxidant status.