Exercise and oxidative stress

Egzersiz ve oksidatif stres

Regular physical activity (exercise training) is an important factor in the prevention and treatment of cardiovascular disease. As little as 30 minutes per day of moderate-intensity physical activity, including brisk walking, reduces the incidence of clinical cardiovascular events in men and women (1-4). Exercise training improves vascular endothelial function with improved nitric oxide bioavailability as a result of enhanced synthesis and reduced oxidative stress-mediated destruction (5-7).

However, acute-intense exercise does not elicit the same response as long-term exercise training. Although regular exercise training decreases oxidative stress, strenuous acute physical exercise can cause oxidative stress and subsequent damage to cellular proteins, lipids and nucleic acids as well as changes to the glutathione system (8-12). Gül et al. (13) have found the decrease in superoxide dismutase activity in heart during the acute exercise in untrained rats.

However this was not observed by endurance training in trained rat, revealing its potential role in myocardial antioxidant defense (13). In long term exercise training, the acute exercise-induced increase in oxidative stress may be counter-regulated by nitric oxide-dependent vascular remodeling process leading to an increased vessel caliber and a structural normalization (14-15).

Acute muscular exercise results in an increased production of free radicals and other forms of reactive oxygen species such as superoxide and hydrogen peroxide (16-19). The antioxidant system is used to protect organism from harmful effects of free radicals. This system consists of antioxidant enzymes (catalase, glutathione peroxidase, superoxide dismutase) and non-enzymatic antioxidants (vitamin E, vitamin A, vitamin C, glutathione and uric acid). The imbalance between free radical production and antioxidant defense leads to an oxidative stress state.

In this issue of the Anatolian Journal of Cardiology, a study on the effects of treadmill exercise testing on oxidative and antioxidative parameters, and DNA damage is published (20). The authors investigated acute effects of treadmill exercise testing on total peroxide, total antioxidant capacity, oxidative stress index and DNA damage in 113 untrained subjects. They found that treadmill exercise testing increases oxidants, decreases total antioxidant capacity and vitamin C, but could not observe significant DNA damage with exercise.

Most of studies about exercise and oxidative stress were performed with high or moderate intensity exercise regimens (13,16,18). However, in this study, authors investigated effects of treadmill exercise testing on oxidative parameters and DNA damage. Treadmill stress test is a short-term exercise testing and is widely used in subjects with suspected coronary artery disease. This aspect of the study is important.

However, there are some limitations in this study. It was carried out in subjects with typical angina or angina-like symptoms. Thirty-one subjects had positive treadmill stress testing. Although changes of oxidative and antioxidative parameters were not significantly different in subjects with positive and negative exercise test, coronary ischemia in the patients with coronary artery disease might affect levels of oxidative and antioxidative parameters. Leaf et al. (21) studied exercise-induced oxidative stress in patients during thallium stress testing. They found that patients having ischemia by exercise-thallium testing had an increase in plasma malonaldehyde levels (a marker of lipid peroxidation) with exercise, suggesting that exercise-induced oxidative stress may be related to myocardial ischemia and reperfusion (21).

Dayan et al. also studied effect of short-term intensive exercise on the some oxidative parameters (22). They applied cardiopulmonary exercise stress test to 30 healthy male subjects and could not observe any significant effect of exercise on oxidation products and vitamin E concentration. They concluded that short graded maximal exercise lasting 8-12 minutes, is not sufficient to increase the susceptibility of serum lipids to oxidation, and antioxidant capacity of most healthy subjects provides proper protection from a short exercise. Previous studies showed that, exhaustive aerobic exercise induces DNA damage (23,24). In this study during treadmill exercise testing, authors could not observe any significant DNA damage. The effect of exercise on DNA damage appears to be related to the intensity of the exercise (25).

In conclusion, during the acute bouts of exercise even with a standard treadmill stress testing, a transient increase in vascular oxidative stress may be initiated. So, we have to be careful when prescribing the exercise to patients with cardiovascular disease such as coronary artery disease or heart failure. We have to individualize the exercise programs to patients. However, to achieve beneficial prognostic effects is still uncertain and recommendations vary between 2.5 hours of walking and exercise training equivalent to 10 km of running per week (2, 26). Further clinical studies on this subject are needed.

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