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SHORT COMMUNICATION

ROLE OF ALPHA-TOCOPHEROL IN CARDIOPULMONARY FITNESS IN ENDURANCE ATHLETES, CYCLISTS

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Abstract : Exercise increases oxygen consumption and causes a disturbance of intracellular pro-oxidant-antioxidant homeostasis. Athletes are exposed to acute and chronic stress that may lead to increased generation of oxidative species. Hence oxidative stress increases in athletes. Administration of antioxidant like alpha-tocopherol as supplementation may reduce the cell damage caused due to oxidative stress. In the present study, our aim was to study the effects of alpha-tocopherol supplementation on the cardiopulmonarv fitness in endurance athletes (cyclists) and non-athletes. Our study included 40 cyclists who were trained under District Youth Service & Sports Office. 40 controls were randomly selected from student group of B.L.D.E.A's Medical College. Aloha-tocooherol (Vitamin E) 200 mg/day for 21 days was given to study group and placebo was given to placebo group. Various physiological parameters like heart rate, blood pressure, respiratory rate were recorded, for assessing cardiopulmonarv fitness: Physical Fitness Index (PFI) and VO_2 max ml/min/kg were recorded before and after supplementation of vitamin E in athletes, and were compared with placebo group before and after supplementation of placebo and also with non-athletes. The results obtained from present study indicate that antioxidant like alpha-tocopherol supplementation did not contribute significantly to improve the cardiopulmonarv fitness of endurance athletes.

Key words : antioxidant; vitamin E; endurance athletes; cardiopulmonarv fitness tests

INTRODUCTION

Oxygen consumption increases during exercise resulting in an increased flux of oxygen through mitochondria, 2%-5% of which is not completely reduced to water, thus forming reactive oxygen species. During exercise of higher intensity Reactive Oxygen Species (ROS) are generated by activation of cytokines secondary to muscle damage.

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Exercise stimulates redistribution of blood flow, provoking hypoxia which can increase the production of superoxide by xanthine oxidase in muscle. Bouts of strenuous exercise increases lipid peroxidation, generating malanodialdehyde and F (2alpha)-isoprostanes, release of muscle enzymes like lactate dehydrogenase and creatine kinase, dietary and enzymatic antioxidant defenses appear to play protective role in muscle cells by reducing associated oxidative damage to lipids, nucleic acids and proteins (1). Antioxidant supplementation is likely to provide beneficial effects against exercise induced oxidative tissue damage (2).

Vitamin E deficiency can increase free-radical induced tissue injury to levels and thus an adequate status of vitamin E is important for maintaining membrane integrity during exercise (3, 4). Consequent to various findings on the relationship between exercise and free radical there has been a relatively consistent findings of an increase in antioxidant enzyme activity in various tissues of trained athletes (5). The added protection presumably may come in the form of exogenous supplementation. The most well studied nutritional antioxidants in exercising subjects have been the vitamins E and C (6). Vitamin E is considered to be extremely important because of its association with cell membranes (7). The aim of the present study was to assess the effect of supplementation of alpha-tocopherol on the cardiopulmonary fitness of endurance athletes (cyclists).

MATERIALS AND METHODS

The study employed placebo control double blind random allocation technique. It was conducted on trainee athletes (cyclists), from District Youth Service and Sports Office. Bijapur. Permission to conduct the study was obtained from the Authority of Districts Youth Services and Sports Officer. 40 cyclists in the age group of 18–19 years volunteered for the study. Three subjects could not complete the study due to personal reasons, the subjects were randomly allocated to either experimental (200 mg/day vitamin E treated. n=19) group or placebo (n=18) group for 21 days. Control group (n=33) were selected from the first year MBBS students (age group of 18–19 years) of BLDEA's Shri B.M. Patil Medical College Hospital and Research Center Bijapur. The ethical clearance for the study was obtained from Ethical Committee of BLDEA's Shri B.M. Patil Medical College Hospital and Research Center Bijapur, as per requirements of Rajiv Gandhi University of Health Sciences of Bangalore.

Method of collection of data

All the exercise data were collected during morning hours between 7 am and 9 am to minimize possible diurnal variations. The details of the procedure of the exercise tests were explained and allay apprehension. They were refrained from eating and drinking before the experiment All the parameters were recorded in the Performa. After the supplementation of 21 days once again the parameters repeated on subjects.

Recording of physiological parameters

The following parameters were recorded (1 minute after exercise, pre and post supplementation) in all the subjects.

1. Respiratory rate (cycles per minute)

2. Heart rate (beats per minute)

3. Systolic and diastolic blood pressure (mm Hg) by using mercury sphygmomanometer.

Recording of Cardiopulmonary Fitness Parameter included :

1. Recording of physical fitness index by using Harvard step test :

Physical fitness index of each subject was recorded by using Harvard Step Test (8). Each subject completed up and down task (24 steps per minute) on an 18 inch bench for 3 minutes or until exhaustion whichever is early. Exhaustion is defined as when the subject could not maintain the stepping rate for 15 per second.

The physical fitness index (PFI) (9) score was calculated as follows :

$$PFI = \frac{\text{Duration of exercise in seconds} \times 100}{5.5 \times \text{pulse rate (1-1.30 minute after exercise)}}$$

2. Determination VO_2 max :

VO_2 max was measured in subjects applying the step test of Margaria et al (10) as described by as and Bhattacharya (11). Accordingly study has been carried out on a 33 cm, step height and the two step frequencies are 15 and 20 per minute respectively. Five minute rest pause was given in between two step test works. With the following equation VO_2 max was determined (12).

$$VO_2 \text{ max } (ml.kg^{-1}, min^{-1}) = \frac{f.max\,(V''O_2 - V'O_2) + f''V'O_2 - f''V'O_2 - f'V''O_2}{f' - f'}$$

where f max = maximum exercise heart rate, f' and f" are two exercise heart rates at two workloads $V'O_2$ and $V'O_2$ respectively.

The indirect maximum heart rate was obtained with time taken for five beats using electronic stopwatch immediately at the end of each step test work.

Statistical analysis

Means and standard deviations of all the sets of observations were calculated. By applying 'Z' test and 't' test. 'P' value <0.05 is taken as significant (13).

RESULTS AND DISCUSSION

Various physiological parameters recorded in subjects of both experimental (n=19) and placebo (n=18) group before and after supplementation of either vitamin E or placebo drug is presented in Table I. It is

TABLE I : Physiological parameters of subjects in experimental and placebo group, before and after supplementation.

Parameter	*Experimental (n=19)*		*Placebo (n=18)*	
	Before supplementation	*After supplementation*	*Before supplementation*	*After supplementation*
Resp rate/min	17.15±1.98	16.68±1.21	17.05±1.84	17.33±1.59
Heart rate Bpm	74.36±7.20	76.26±5.60	72.11±6.47	70.22±4.74
SBP mm Hg	121.05±7.17	122.94±6.87	117.0±6.47	117.33±6.99
DBP mm Hg	76.84±7.14	76.73±7.17	76.77±4.52	76.44±4.59

Values are means±SD's; P>0.05=Not significant.

evident that none of the parameters showed significant change before and after supplementation for both vitamin E treated and placebo treated groups.

Table II shows comparative values of physical fitness index in experimental and placebo subjects fore and after supplementation of vitamin E and placebo. Neither of the group has shown significant difference in physical fitness index.

Values of VO_2 max recorded in placebo and experimental groups before and after supplementation of vitamin E and placebo are given in Table III. Mean values of VO_2 max recorded did not show any significant change in these groups.

In the present study physiological parameters like blood pressure, respiratory rate and heart rate of non-athletes (control) and athletes (subjects) before and after 21 days supplementation of Vitamin E were recorded. Analysis of present data showed that supplementation of vitamin E did not result in improvement of physiological parameters in the study subjects. The chance is within the limit of normal physiological range. A few groups have earlier reported of Vitamin E supplementation on physical performance of no significant effect (14). Heart protection study collaborative group have reported no significant effect on physical performance from vitamin E supplementation (15). Highly physically active persons who can perform well in various snorts and possessing higher values of VO_2 max have capacity to yield larger amount of energy and can perform better in athletic field activities. Determination of VO_2 max is thus an important criteria to assess cardiopulmonary efficiency & physical fitness of a subject (16). In view of this we have assessed the effect of supplementation of antioxidant on performance of athletes by recording both PFI score and VO_2 max as cardiopulmonary fitness tests. Previous studies have reported that vitamin E is playing a significant role during the training of runners and lower level of vitamin E in the blood can hamper the performance of runners (17). Chatterjee and Mitra in their study found that Vitamin E intake significantly increased endurance capacity of untrained girls during their three phases of menstrual cycle (18).

Our observations are in agreement with Peterson et al (19) where vitamin E and C supplementation did not influence the cytokine, muscle enzyme or lymphocyte response to exercise. Alpha tocopherol

TABLE II : Comparison of physical fitness index before and after supplementation in experimental and placebo group.

Variable	*Experimental group (n=19)*	*Placebo group (n=18)*
Before supplementation	83.12±8.90	85.34±9.91
After supplementation	84.08±9.12	85.22±9.37

Values are means±SD's; P>0.05=Not significant.

TABLE III : Comparison of VO_2 max in placebo and experimental groups before and after supplementation of alpha-tocopherol.

Group	*Experimental (n=19)*	*Placebo (n=18)*
Before supplementation	37.06±2.18	35.44±1.71
After supplementation	38.38±2.43	35.97±1.54

Values are means±SD's; P>0.05=Not significant.

supplementation on serum creatine kinase levels in response to exhaustive treadmill running was not beneficial (20). Thus majority of the studies that investigated the effect of vitamin E on exercise performance have found no beneficial effect on endurance or aerobic capacity (21, 22). Our results are in agreement with them. In conclusion, our study supports the generally accepted view that alpha-tocopherol supplementation does not help in increasing the endurance capacity in athletes.

REFERENCES

1. Sacheck JM, Blumberg JB. Role of vitamin E and oxidative stress in exercise. *Nutrition* 2001; 17: 809–814.
2. Sen CK. Antioxidants in exercise nutrition. *Sports Med* 2001; 31: 891–908.
3. Cheeseman KH. Slater TF. An introduction to free radical biochemistry. *British Medical Bulletin* 1993; 49: 481–493.
4. Anstey AV. Systemic photo protection with alpha-tocopherol (Vitamin E) and beta-carotene. *Clin Exp Dermatol* 2002; 27: 170–176.
5. Jenkins RR. Exercise oxidative stress and antioxidants. A review. *Int J Sports Nutr* 1993; 3: 356–375.
6. Sen CK. Oxidants and Antioxidants in exercise. *J Appl Physiol* 1995; 79: 675–686.
7. Biorneboe A. Biorneboe GA, Drevon CA. Absorption, transport and distribution of vitamin E. *J Nutr* 1990; 120: 233–242.
8. Neisner JS, Laurie JA. Human Biology – A guide to field methods, 2nd Edition. Oxford and Edinburgh; Blackwell Scientific Publications 1969; 325–328.
9. Chaterjee S, Anirban M. The relationship of physical fitness score with different morphological parameters and VO_2 max on adult female athletes and non athletes. *Ind J Physiol and Allied Sci* 2001; 55: 7–11.
10. Margaria R, Aghemo P, Rovelli E. Indirect determination of maximal oxygen consumption in man. *J Appl Physiol* 1965; 20: 1070–1073.
11. Das SK, Bhattacharya G. A comparison of VO_2 max with Margaria step test measuring exercise heart rate directly and with time taken for five beats immediately after work. *Ind J Physiol and Allied Sci* 1991; 45: 32–33.
12. Das SK. Simplification of Margaria equation in determination of VO_2 max. *Ind J Physiol & Allied Sci* 1995; 49: 153–155.
13. Mahajan BK. *Methods in Biostatistics.* Jaypee Publications 1991; 5: 129–153.
14. Jeffrey D Lawrence, Richard C Bower, Winston P Riehl, Jack L Smith. Effects of alpha-tocopherol acetate on swimming endurance of trained swimmers. *Am J Clin Nutr* 1975; 28: 205–208.
15. Heart Protection Study Collaborative Group. MRC/BHF Heart protection study of antioxidant supplementation in 20.536 high risk individuals a randomized placebo controlled trial. *Lancet* 2002; 360: 23–33.
16. Taylor HL. Buskirk E. Maximal oxygen intake as objective measure of cardiorespiratory performance. *J Appl Physiol* 1955; 8: 73.
17. Sohal H, Sohal MS. Effect of exercise on level of vitamin E with special reference to physical performance. *Ind J Physiol Allied Sci* 1991; 45(3): 156–159.
18. Chatterjee Pratima, Maitra Subhalakshmi. Vitamin E supplementation: Its effect on endurance capacity of young girls during different phases of menstrual cycle. *Ind J Physiol and Allied Sci* 2000; 54: 41–46.
19. Petersen Emil Wolsk, Ostrowski Kenneth, Tobias Ibfelt, Myriam Richelle, Eliazabeh Offord, Bente Pedersen. Effect of vitamin supplementation on cytokine response and on muscle damage after strenuous exercise. *Am J Physiol-Cell Physiology* 2001; 280(6): c1570–c1575, p. 1–12.
20. Maxwells Jakeman P. Effect of antioxidant: vitamin supplementation on muscle function after eccentric exercise. *Eur J Appl Physiol Occup Physiol* 1993; 67(5): 426–430.
21. Piercy R, Hinchcliff K, Disilvestro R. Effect of dietary supplements containing antioxidants on attenuation of muscle damage in exercising sled dogs. *Am J Vet Res* 2000; 61: 1438.
22. Williams SL, Strobel NA. Antioxidant requirements of Endurance Athletes: Implications for Health, Nutrition Reviews 2006; 64: 93–108.