Original Article

Improvement of the Anaerobic Power and Phosphate Mediated Recovery of Cricketers: Role of Vitamin C

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ABSTRACT

Anaerobic exercise has been considered as short duration high-intensity exercise. This type of exercise is essential for the anaerobic conversion of available biological phosphates to its active phosphorylated form by the enzymatic action of creatine kinase. Several research studies have been pointed out the role of vitamin supplementation and amelioration from exercise-induced oxidative stress. Vitamin C has significant roles in amelioration of free radicals generated during endurance exercise. In this study, our attempt is to observe the effect of vitamin C towards the development of anaerobic power and recovery by restoration of biological phosphates. It was observed that the cricketer subjects with vitamin C supplementation have better running ability as confirmed from the test and quicker recovery than subjects whom vitamin C supplementation was not given; which are correlated with serum creatine kinase and creatine level suggesting that the vitamin C can improve in anaerobic performance. From this study, it can be concluded that vitamin C supplementation develops the anaerobic power and phosphate mediated recovery of cricketers.

Keywords: Vitamin C, Anaerobic exercise, Creatine kinase, Phosphate recovery.

INTRODUCTION

Vitamin C is the major water soluble antioxidant present in the cell and extracellular fluids. This vitamin is able to provide protection against phagocyte-derived oxidants by reducing the adhesion of phagocytes to endothelium, attenuating respiratory burst, and preventing sub- sequent lipid peroxidation[1]. Vitamin C in humans, the aim of this study was to examine the effect of Vitamin C supplementation and oxidative stress and neutrophil inflammatory response in acute and regular exercise. Vitamin C is an essential component of the diet and may reduce the adverse effects of exercise induced reactive oxygen species, including muscle damage, immune dysfunction, and fatigue[2]. However, antioxidant supplements such Vitamin C (ascorbic acid) seems to be controlling BP. Ascorbic acid protects cells against oxidative stress, a significant reduction in systolic blood pressure in response to consuming vitamin C in hypertensive rats. Also, it has been reported that consumption of vitamin C during the swimming training for ten weeks, five days per week, and one hour per session in rats can decrease the lipid peroxidation and increase level of activities of enzymes of TCA cycle, although it is ineffective on enzyme and non-enzyme antioxidants and muscle damage[3]. In any case, it seems that exercise and vitamin C have useful effects on BP in those with hypertension. However, the mechanism of their effect has not been examined comprehensively.

The purpose during recovery from exercise is to restore the homeostatic condition and energy balance of muscles and active part of the body involved in the exercise to their pre-exercise condition[4]. Restoration of the body during recovery includes replenishing the energy stores that were depleted and removing lactic acid that was accumulated during exercise processes which require adenosine triphosphate (ATP). The oxygen consumed during the recovery period supplies the immediate ATP energy required during the recovery. Restoration of the phosphate muscle stores (ATP+PC) requires only a few minutes whereas full restoration of the muscle and liver glycogen stores requires a day or more[5]. The speed of removal of lactic acid from blood and muscle can be greatly increased by performing light exercise rather than by resting during the recovery period.

Small amounts of oxygen stored in muscle in chemical combination with myoglobin, are important during the performance of intermittent exercise because they are used during the work intervals and are quickly restored during the recovery intervals.

One of the most important factors in sprinting activity is to win the series of contests which typically involve high-intensity efforts. These high-intensity efforts will leave the player with depleted creatine phosphate (CP) stores and an accumulation of lactic acid in the muscle and blood. The levels of CP depletion and lactic acid accumulation will depend upon the duration and intensity of the efforts[6]. The ability of players to keep producing high-intensity efforts may be dependent upon how effectively the CP system is replenished and upon the removal of metabolic by products such as intracellular hydrogen ions and inorganic Phosphates which are known to peak force during the high -intensity exercise. The replenishment of CP stores and the oxidation of lactate are both oxygen dependent processes[7].

The present study is an attempt to find out the relationship between the vitamin C supplementation on the development of the anaerobic capacity and phosphate mediated recovery. This is no evidence about the vitamin C supplementation mediated development of the anaerobic capacity and phosphate mediated recovery.

MATERIALS AND METHODS

The totals of forty eight (48) male cricketers (age ranging from 16-26 years) were taken as the subject of the study who has represented their District. The age of the subject ranged from 16-26 yrs. They were guided by the experts for a specific training programme throughout the year. The personal data of the subject were taken. The subjects were divided into 2 (Two groups)- 1) Cricketers without Vitamin C supplementation and 2) Cricketers with Vitamin C supplementation. The subjects were informed in detail about the study and the consent of them regarding their voluntary participation was taken. Blood samples were collected by professionals in the presence of a doctor. Vitamin C was supplemented in the form of capsules (Vitamin C 500) at the dose one capsule for every day[8] after lunch for 5 days per week for six weeks duration for group no 2 with exercise and for group no 1 only exercise, no supplementation was given. Procedure for collecting data Age, Height, and Weight of the subjects was considered as personal data.

The procedure followed for collecting data for these measurements were as follows–

Age- Age was collected from the date of birth, and the information was obtained from the school records.

Height- The subjects were barefooted and stood erect with heels together, and the arms are hanging naturally by the sides. The heels, buttocks, upper part of the back of the head were in contact with the upright to look Straight ahead and take a deep breath; then the head was brought down to the vertex of the subject.

Weight- The weights of all the subjects were taken from a standard weighing machine. During weight taking the subjects were barefooted erect with heels together and hanging naturally by the sides on the platform of weighing machine.

Running based anaerobic sprint test- Prior to the test, the weight of each subject was taken for use in calculations followed by a warm-up. Cones were set up at each end of thirty-five meters of running track. Two testers were required as one person is required to time each run of thirty-five meters the other to time the ten seconds recovery period. The subject stands at one end of the thirty-five-meter track and starts a maximal sprint on the command 'go' ensuring the subject runs maximally through the line each time. After ten seconds the next run starts from the opposite end of the thirty-five-meter track. The procedure was repeated six times.

Scoring- The time taken was recorded for each sprint to the nearest hundredth of a second (using timing gates provides greater accuracy). The running times along with body weight can be used to calculate maximal, minimal and average anaerobic power outputs in watt.

Phosphate recovery test- This test involves seven flat-out runs each lasting five minutes, with ten minutes recovery. Marker cones were placed two meters apart for the first twenty meters. At forty meters from the first cone, cones were again placed two meters apart to sixty meters apart. The subjects set themselves at the first cone (Start 1); on the command "go" each subject ran all out for five minutes. At the end of the run "time" is called and an observer had noted at what cone the subject had just passed. The subject then had a ten minutes passive recovery (walk/jog) period before the next run. For the second run subjects were set themselves at the last cone (Start 2) facing back along the cones. At this point same thing was done and the distance run was recorded[9].

Scoring- The drop off distance was calculated by subtracting the distance covered in the last run by the distance covered in the first run. It is expected that the last run would cover less distance than the other run due to fatigue.

Blood collection and serum preparation- Blood was collected by using sterile dispovan syringe, and this blood was used to prepare the serum[10].

Creatine determination in serum- Creatine level in serum was determined directly on serum. Creatine was removed from ten ml of serum by the passage of the serum over one ml of a column of Dowex 50-H+. This step was required to separate the creatine from a large amount of pyruvate present in the serum as this amount will oxidize all the DPNH in the assay system. The creatine was eluted from the column with five (N) NHIOH and the solution evaporated to dryness. This creatine was then measured after dissolving it in a known volume of water. All of the creatine was removed, as repassage of the same serum over the column did not yield any more creatine. In addition, the passage of a known amount of creatine onto this column with subsequent elution gave full recovery of the creatine without conversion to creatinine. The serum contained 13.8 mg per liter of creatine[11].

Measurement of serum creatine kinase (CK)- Creatine kinase was determined according to the Alternate assay methods which were described by Dinovo*et al.*, (1973)[12].

Statistical evaluation- Each experiment was repeated at least six times. Data were presented as means±SE. The significance of mean values of different parameters between the various groups was analyzed using Students't' test. Statistical tests were performed using Microcal Origin version seven for Windows.

RESULTS

The data gathered from different tests were statistically analyzed adopting the method mentioned in methodology. The data on the personal variable and the fitness variables were analyzed in this chapter. Personal data of subjects were measured, and these have been shown in table 1.

Table 2 represents the Pearson correlation between phosphate recovery and anaerobic power. It was observed that the r value was found to be greater than the corresponding r value at 0.01 level hence the null hypothesis was rejected. Therefore a significant correlation exists between phosphate recovery and anaerobic power with vitamin C supplementation in case of a cricketer.

Table 3 represents the mean value of the activity of the enzyme (i.e. creatine kinase) and level of creatine at serum for cricketers. It was observed that the r value was found to be greater than the corresponding r value at 0.01 level hence null hypothesis was rejected. Therefore, a significant correlation exists between phosphate recovery and anaerobic power with vitamin C supplementation in case of cricketers.

Table 1: Personal data of the subjects

Personal data of the subjects Group	Height(cm)	Weight(kg)	Age(years)
Cricketers without Vitamin C supplementation (n=24)	170.04±7.19	53.12±8.09	21.00±3.21
Cricketers with Vitamin C supplementation (n=24)	179.01±9.45	54.11±2.95	21.45±0.55

Values are expressed as mean±SE for all of the four groups.

Table 2: Pearson product moment correlation of between phosphate recovery and anaerobic power between cricketers with and without vitamin C supplementation

Groups	Phosphate recovery (meter)	Anaerobic power (watt)
Cricketers without Vitamin C supplementation (n=24)	58.94±1.02	5.09±0.21
Cricketers with Vitamin C supplementation (n=24)	60.49±4.25*	8.01±0.11*

The values are expressed as mean±SE; *P<0.001 as compared to values of the subjects without Vitamin C supplementation using Student't' test.

Table 3: Effect of vitamin C supplementation on the activity of serum creatine kinase (CK) and creatine level of cricketers after exercise

Groups	Creatine kinase activity (Units/min/ml)	Creatine level (mg/ml)
Cricketer without Vitamin C supplementation (n=24)	42.01±2.27	0.95±0.04
Cricketer with Vitamin C supplementation (n=24)	21.37±1.55*	0.58±0.05*

The values are expressed as mean±SE; * P<0.001 as compared to values of the subjects without Vitamin C supplementation using Student't' test.

DISCUSSION

Lactate formation is being triggered within the muscular tissue by anaerobic exercise. It is used by athletes in non-endurance sports to promote strength, speed and power and by the body, builders to build muscle mass. Anaerobic exercise is much more important for muscle energy systems compared to aerobic exercise, leading to a greater performance in sports, high-intensity activities[13]. The purpose during recovery from exercise is to restore the muscles and the rest of the body to their pre-exercise condition. During the recovery phase body replenishes the energy store and removes the lactic acid that was accumulated during exercise processes. The oxygen consumed during the recovery period supplies the immediate ATP energy required during the recovery period. Restoration of the phosphate muscle stores (ATP+PC) requires only a few minutes whereas full restoration of the muscle and liver glycogen stores requires a day or more.

In case of an athlete it is important to generate anaerobic power at maximum threshold, simultaneously recovery from this high-intensity exercise is also an important factor as because replenishing of energy stores by inorganic phosphates like ATP, GTP, CTP, TTP, CP prepares for further activity and restore the energy balance. Serum creatine kinase enzyme activities increase during and after exercise. The highest post-exercise serum enzyme activities are found after very prolonged competitive exercise such as ultra distance marathon running or triathlon events[14]. Weight-bearing exercises, which include eccentric muscular contractions such as downhill running, induce the greatest increases in serum enzyme activities[15]. We have observed that vitamin C supplementation significantly reduces serum creatine kinase activity in the cricketers tested after exercise.

In this study, we have found that there is a significant positive correlation between phosphate recovery as well as anaerobic power with vitamin C supplementation in the cricketers. There is a significant correlation between total sprinting time and anaerobic power[16]. For high-intensity exercise, this mediate phosphate recovery is important as it de-phosphorylated ATP, CTP, TTP, GTP combines with Creatine phosphate to restore the biological triphosphates by the enzymatic action of creatine kinase[17]. As anaerobic power refers the ability to produce high energy within a very short duration of time, so this production route bypasses glycolysis and directly produce ATP,GTP,CTP,TTP by the enzyme creatine kinase which in turn use de-phosphorylated phosphates as the substrate, so it is extremely important that anaerobic power generation is largely based on phosphate mediated recovery, and in this study we have reported a relationship between vitamin C supplementation with anaerobic power and phosphate mediated recovery.

CONCLUSION

This study has established that vitamin C supplementation can potentially improve anaerobic performance. Further studies to be focused on appropriate diet combined with supplements with a complex set of exercise towards quicker phosphate mediated recovery will open a new avenue in this field.

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