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Response of Physiological Indices Associated with Fatigue to Consumption Acute of Sodium Bicarbonate Supplementation Loading Along with Exhaustive Activity in the Soldiers

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Keywords

Soldier
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Lactate
Exercise

Abstract

Background & Objective: The design objective of research was to investigate comparison between the effects of sodium bicarbonate ($NaHCO_3$) different loading in high intensity intermittent activity on fatigue parameters of Soldier. 30 s Soldier s accomplishment Wingate test in two situations: $NaHCO_3$ (SB) consumption and placebo.

Materials and Methods: The SB (0.3 $g \cdot kg^{-1}$ of body mass) or the placebo was ingested 60 min before the training in Solution 250ml. before and After Wingate test, blood sample was collected. All parameters were compared using two-way repeated measures ANOVA, followed by Tukey post-hoc test , significantly level was set at 5%.

Results: lactate concentration in Wingate test after SB (15.62 ± 5.1 $mmol \cdot l^{-1}$) supplementation was significantly higher than placebo (12.17 ± 4.39 $mmol \cdot l^{-1}$) ($P<0.05$). No difference was found between SB and placebo for hr number. Performance in supplementation group was significantly higher than placebo ($p<0/05$).

Conclusion: $NaHCO_3$ didn't improve performance in Soldiers, but supplement consumption induced increase ph and bicarbonate concentration.

1. Introduction

The professionalism now associated with the game of rugby union has brought with it a more scientific approach to preparation for, and recovery from, competition and training. One key area that has developed as a result of the increasing demands placed on players is nutrition along with the use of ergogenic aids. Nutritional interventions are widespread in sport, with the majority of athletes

incorporating some form of nutritional strategy into their training to optimise performance. This may range from simple healthy dietary choices for the amateur athlete to supplementation with ergogenic aids, such as creatine, for elite competitors. Adequate nutrition between bouts of high intensity exercise is essential to optimise performance, recovery and subsequent exercise performance. In The achievement to success in intensity drilling training is dependent on activity type and effort recovery relationship that consists of increases both aerobic and anaerobic components (1-4). People participating in Daily events, sports, amateur and professional sports and the search results are ranked higher during the tournament (5, 6). So they try to show their best performance . they can prevent the occurrence of several factors. Intracellular PH in intense muscular activity may be changed, so that in the beginning, because the catabolism of creatine phosphate, alkaline created and further intensification of glycolysis, the prevailing acidic environment And the continued rise in glycolysis, the ruling acid (7). The findings in the expression and location of the causes of fatigue, such as energy devices (ATP-PC, glycolysis and aerobic oxidation), the accumulation of by products of metabolism, nervous system, and impaired contractile mechanisms have focused It has been suggested that the maximum activity, increased lactic acid itself can be a cause of fatigue But lactic acid is decomposed and converted to lactate and hydrogen ions, leading to aggregation and loss of muscle cell PH (8). Incremental increase in hydrogen ions decreases in intracellular PH that can contribute to fatigue in most sports (9). Increased proton buffering can delay fatigue by improved utilization of energy substrates and the work done to preserve muscle contraction.

When compared to continuous training of the same energy expenditure, intensity activity need to carbohydrate and lactate metabolism (5, 6). the effect of reduced pH are the encumbrance of calcium ions delivered from the sarcoplasmic reticulum, the coupling of actin and myosin, and of the activity of phosphofructokinase. There factors lead to downfall force production during performance(10-13).

Sodium bicarbonate (NaHCO3 or SB) is a buffer which occurs naturally in the body. Exogenous supplementation with SB prior to exercise has been shown to increase pH levels and standard blood bicarbonate ($StdHCO_3$) concentrations, thereby enhancing the extracellular buffering capacity (3, 4). During high intensity exercise, hydrogen ions (H+) are formed as a by product of anaerobic glycolysis (13). This inhibition of cellular processes results in a diminished capacity for muscular force production leading to fatigue (13). By creating a state of pre-exercise alkalosis within the body, SB is purported to have the capacity to delay acute fatigue caused by exercise induced metabolic acidosis (10, 11).

The bicarbonate buffering system is the main buffering system in the extracellular fluid and is responsible for approximately 80% of extracellular

buffering. The bicarbonate buffer is considered to be effective due to its high concentration in plasma (~24mmol/L) and also because of the tight regulation of two of its components, CO2 and HCO3, by the lungs and kidneys respectively (14). The degree of metabolic alkalosis is altered by the dosage and timing of NaHCO3 ingestion. However, although much research has investigated the types of exercise that are enhanced with NaHCO3 ingestion, to date, there has been limited research on the dosage and timing of NaHCO3 ingestion that optimizes metabolic alkalosis and the associated ergogenic effects. This is important because doses between 0.2 and 0.3 gkg21 have commonly resulted in equivocal performance findings (15-17). For example, lindh et al. (2008) reported that dosages of 0.2 gkg21 or less were ineffective for improving sprint performance, whereas McNaughton (18) reported that, with dosages of 0.1, 0.2, 0.3,0.4, and 0.5 gkg21 ,only0.1gkg21did not significantly enhance sprint performance. Dosages of 0.15 and 0.20 gkg21 have also been reported by others to enhance performance (18, 19). If NaHCO3 help the maintenance or even mollification the forfeiture in important parameters during the sessions of intensity drilling training, it would be reasonable to conclude that the Soldiers would benefit from this nutritional strategy (20-22). However, to our knowledge, no study assessed the effects of NaHCO3 on the changes in the parameters of Soldier activity together with the performance of the Soldier Thus, the aim of the present study was to evaluate the effect of supplementation of NaHCO3 on the Chemical a mechanical parameters of Soldier, physiological responses and performance of high-level Soldier.

2. Material & Method

2.1. Participants

Thirty solider voluntarily participated in this study. The participants were recruited from sanandaj Garrison Prior to testing , subjects were randomly assigned into one of two groups, placebo and treatment.

The participants were instructed to avoid any high-intensity exercise during the testing sessions and to continue their nutritional habits. Prior to participation in the study, each subject provided written informed consent and completed medical screening. individuals who have health problems and disorders of the cardiovascular and respiratory are, eliminated of research processes.

2.2. Sodium Bicarbonate Supplement ingestion

Sodium bicarbonate supplement (alkalosis) in the form of white powder was produced from pars azmoon company (Tehran, Iran). Sodium bicarbonate supplement was used with dosage of 0/3 grams per kilogram of body weight in two different loading (19, 21), 30 minutes before the performance test. Placebo was tab water(250 ml)that ingested, 30 minutes prior to the performance test . The volunteers had not eaten or drunk for 12 hours before the test (10).

2.3. Acute Supplementation

Acute supplementation consisted of ingesting either SB (0.3g/kg BM) or PLA split into three equal doses taken at 90, 60 and 30 minutes prior to the performance test . Each dose of 0.1g/kg BM of SB (0.3g/kg BM in total)

or PLA was consumed with 250 mls water taken with each of the three doses every 30 minutes prior to the performance test

2.4. Performance Test

The performance test was a high-intensity test on a 'Monark 824E' cycle ergometer (Monark Exercise, farberg, Sweden). The cycle ergometer recorded various forms of power output and was automatically calibrated by the patented self-regulating braking system. Wingate test was set at a resistance 7.5% BM[1] for each subject. Mean power output (MPO) were recorded for all participation. MPO were also expressed relative to body mass (relative MPO). Total work was calculated as a product of the sum of the MPO for each Wingate and the duration of the Wingate (10s). Fatigue index was also calculated for each participation as the MPO minus the minimum power output, expressed as a percentage of the MPO (13).

2.5. Blood Sampling

There were two blood sampling phases : before test,5 min and 60 minutes after test . In both loading, the blood samples were poured into lab tubes containing heparin. The blood samples were immediately sent to a laboratory for analysis.

2.6. Biochemical Measurements

5ml of blood were obtained from the Vein of forearm. lactate was measured with enzymatically method by lactate kit (Pars Azmoon, Tehran, Iran), Bicarbonate were measured enzymatically by bicarbonate kit (ABL5 Radiometer, Copenhagen, Denmark). PH was measured by PH meter instrument(I-STAT Abbott Laboratories, USA).

2.7. Heart rate

Heart rate was measured throughout each test and recorded at similar intervals to pretest, posttest and after one hour performing test. Heart rate was recorded using a wireless Polar heart rate monitor (Polar Vantage NV™ Polar, Port Washington, NY).

2.8. Statistical Analysis

Statistical analyses were completed using SPSS for Windows software (release 16.0; SPSS, Inc., Chicago, IL, USA). The required sample size of 8 subjects was determined by prospective statistical power analysis using PASS 2008 software (NCSS, LLC, Kaysville, UT, USA), with alpha at 0.05. Blood acid-base (pH, HCO3) profiles were analyzed using two-way (condition 3 time) analysis of variance (ANOVA) for repeated measures. One-way ANOVA for repeated measures were used to analyze differences in baseline values (pre-ingestion) between conditions for all variables. Where a difference was found, this was investigated using a Tukey post-hoc test.

3. Results

3.1. Bicarbonate Concentration

In supplement group blood bicarbonate concentration significantly were greater than placebo group at all time points. The peak blood ($HCO3^-$) (30.3 mmol/L)and the greatest change in ($HCO3^-$) from baseline (6.6 mmol/L) were recorded after ingestion commenced. StdHCO3 - levels were significantly greater with acute SB

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supplementation for all time points post-ingestion when compared to all placebo (p<0.001).

3.2. PH

Following ingestion, blood pH was found to be significantly higher at all time points for acute SB supplementation when compared to placebo **(**p<049**).**

3.3. Lactate

Baseline lactate levels were identified as lying within the normal ranges prior to supplementation for all subjects (0.8-1.8 mmol/L) with no significant differences between the groups (p = 1.000). Following acute SB supplementation, blood lactate concentrations were found to be significantly greater than the other supplementation protocols after the Wingate only. Following the Wingate, acute SB ingestion resulted in a mean blood lactate concentration of (12.71) (4.11 mmol/L), which was significantly greater than placebo (8.6) (p<0/041).

3.4. Mean power output

Mean power output (MPO) was analyzed for each Wingate using each of the experimental supplementation protocols with not significant differences observed between protocols in Wingate test (p <0/03).

Table 1: The physical characteristics of the participants.

Factor	BMI	Weight(kg)	Height (cm)	Age (years)
Placebo	21.24±1.4	65±2.4	175±2.8	23.3±1.3
Acute loading	22±1.5	66±5.4	177±8.5	23.74±2.5

3.5. fatigue index

No significant differences between supplementation protocols were found for fatigue index over the Wingate (p=1.000). Fatigue index was calculated as (27.2 ± 2.2), (27.5 ± 1.65) for placebo, acute SB, respectively, (p<0/045)**.**

3.6. Heart rate

No significant differences between supplementation protocols were found for HR number over the Wingate (p>0/05) . HR number was calculated as (173), (177) for acute SB, PLA, respectively. heart rate number One after of Wingate test, no different among all group, (p<0/048). The results fully in the tables below.

Table 2: Effect of sodium bicarbonate acute loading on power, fatigue index, bicarbonate concentration, PH.

Group	PH	Bicarbonate Concentration	Fatigue Index	Power
Placebo (pretest)	0.6±0.095	0.25±0.2	25.86±0.16	1±0.89
posttest	0.5±0.015	0.65±0.45	29.28±0.40	0.9±0.88
p-value	0.8	0.79	0.65	0.59
Acute loading (pretest)	0.7±0.092	0.2±0.65	25±0.26	0.92±0.55
Posttest	0.5±0.025	1.6±0.66	28±0.88	0.96±0.68
p-value	0.049	0.025	0.045	0.03

Table 3. Effect of sodium bicarbonate acute loading on lactate and heartbeat.

Group	Heart rat			Lactate		
	Pretest	Five minute after test	One hours after test	Pretest	Five minute after test	One hours after test
Placebo	71.8±0.9	180±2.1	147±1.1	1.35±0.13	12.7±0.19	10.29±0.19
Acute loading	70.2±0.7	174.8±1	145.4±0.6	1.32±0.12	16.6±0.17	8.33±0.15
p-value placebo			0.59	Pretest		0.65
acute loading			0.048			0.041

4. Discussion

The primary finding was that NaHCO3 acute loading had'nt ergogenic effect on the Soldier performance of Wingate test. Although NaHCO3 possess an ergogenic effect on activate that lasting 1 to 10 min (16, 22), the present study showed not improvement in the performance of Wingate test in the SB acute loading.

These findings are in disagreement with Lindh and colleagues (2008) reported a single effort of 200 m performance improvement in elite athletes, They also seem to present greater anaerobic capacity that allows for a higher level of acidosis and, therefore, benefit from NaHCO3 more than non-elite athletes. In 2001, McNaughton and Thompson disagreement the effects of acute SB ingestion. The authors found that acute ingestion of 0.5g/kg BM of SB over a period of six days significantly improved work output for at least two days after cessation of ingestion when compared with acute ingestion of 0.5g/kg BM 90 minutes prior to performance of a 90 second maximal cycling test. Siegler and Gleadall-Siddall (2010) reported on the effect of NaHCO3 supplement consumption in trained swimmers following eight sets of 25 m with a 5-sec pause, and detect a reduction in the total time of the performance(placebo: 163.2 ± 25.6sec, SB: 159.4 ± 25. 4 sec).

Thus, the elimination of noisome components could have influenced the subjects' improvement in performance. In the present study, significantly difference seen in SB was found in per) the technical and competitive level of the subjects may have influenced their performance and, therefore, the turn may have diluted the improvement in SB.

Although the present study did analyze pH alterations, acute SB loading was used in other studies (3, 18,

20) and showed to be effective in changing pH and the concentration of bicarbonate ion. The lactate concentration was significantly higher at the end of the last 100 m effort (placebo: 15.67 ± 3.29 mmol·l-1 and SB: 17.93 ± 3.80 mmol·l-1; P<0.05). The increase in lactate concentration was reported by several studies (7, 9). Some hypotheses may explain the higher values of lactate concentration on SB. The first one is related to the fact that the elimination of lactate is increased when the extracellular pH increases, lactate depletion from muscle increased with the NaHCO3 supplementation (12, 13). The second relates to the higher glycolytic activity and anaerobic energy production due to a better internal environment, which would increase performance. However as to this hypothesis, in the present study, it was confirmed since there was significant difference seen the Wingate test in SB.

Notwithstanding, the protocol used in the present study consisted of Wingate test for improvement in the tolerance to acidosis, so SB, besides achieving the goal of training, allowed for a higher production of (La-) without a decrease in the performance of the subject. The MPO was used to estimate performance not improvement during exercise. This approach is due to the close relationship between MPO and physiological markers related to intensity (such as heart rate and blood lactate) (17, 20). The present study found not significant difference between the values of MPO in SB. Numerous studies have shown elevated lactate concentration after NaHCO3 supplementation (18, 22). So, it seems that despite the change in MPO, SB increased the production capacity and the lactate tolerance. Therefore, the ergogenic effect may be beneficial in training that is aimed at increasing tolerance and/or (La-) production.

As to the effect of SB on HR number, no differences were found. Although the majority of the research involving SB supplementation demonstrates fluctuation in the acid-base balance inducing a state of alkalosis, this condition does not always translate into an enhanced performance. No improvements were recorded, either for work performed or power output, following 90 seconds of maximal cycling exercise by untrained males (11). The lack of significant findings in certain studies may also be as a result of factors such as sample size, subject characteristics, SB doses and insufficient durations and/or intensities of exercise. The exact reasons for these conflicting results are unclear but may in part be due to inadequate exploitation of the maximum buffering capacity through insufficient duration or intensity of exercise, thereby limiting the ergogenic benefits (6). In addition, there appears to be a highly individual response to SB ingestion, which may be partially accounted for by the gastrointestinal side effects associated with SB ingestion.

Another explanation for the lack of performance enhancement with SB supplementation found in some previous studies may be the use of untrained subjects. Plasma pH and (HCO_3^-) measured before the test in the present study was comparable to those reported by Lindh et al (2008). From these results it appears that 0.3g/kg BM of SB was sufficient to induce metabolic alkalosis in Soldier. In support of this data, previous research has exhibited a significantly higher alkalinity in trained males (8) and elite female athletes (4). This finding is widely supported in the research, particularly in investigations involving high intensity exercise with a heavy reliance on anaerobic metabolism (1, 3). An increase in the activity of the lactate/H^+ contransporter, promoting an increased efflux of lactate from the muscle cells, is purported to be the mechanism

underpinning the increased post-exercise lactate concentrations observed with SB ingestion in acute loading (13, 15).

However, the sample size utilized in the current study was higher than the average of 8 ± 2 subjects observed in a review of research involving SB ingestion (19). Sodium bicarbonate loading may have additional buffering effects in more subjects with enhanced intracellular buffering mechanisms (21). In relation to performance, acute SB ingestion resulted in no significant difference between trials for subjects. However, significant differences in performance in acute loading were observed. Previous studies have reported improved short-duration high-intensity cycling performance after acute loading of NaHCO3 (6, 7). We conclude that the NaHCO3 supplementation does not improve performance and its parameters after supplementation consumption. In general, studies that have found an increase in exercise performance following SB supplementation have been those that have utilized a continuous or intermittent exercise protocol that induced a large disturbance in the acid-base balance (8).

During continuous dynamic exercises, performance not enhancements tended to be observed in studies whereby the test protocol exhausted the subjects in 1410 minutes (11).

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