Effect of intermittent doses of glucose solution on blood lactic acid during endurance performance

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Abstract

Blood lactate is produced due to muscular activities during work. It was found that blood lactate level increased as 2.32 ± 0.97 mm/lt (mean ± SD, n=20) in place-bo condition. The value of increment of blood lactate level in case of glucose supplementation (single dose, i.e. 30 min. after commencement of the work) was reported to be 1.54 ± 0.02 mm/lt (mean ± SD, n=20). The value of increment of blood lactate level, in case of glucose supplementation (double dose, i.e. 30 and 50 minutes after commencement of the work) was found to be 1.042 ± 0.05 mm/lt (mean ± SD, n=20). The value of increment of blood lactate level in case of triple doses of glucose supplementation (30, 50 and 70 minutes after commencement of the work) was found to be 0.519 ±0.01 mm/lt (mean ± SD, n=20). As per as blood lactic acid is concerned, correlation between blood glucose and blood lactate was calculated in different doses (place-bo condition, single, double and triple doses). It was found negative with the blood glucose. The value of correlation coefficient for blood glucose (double dose of glucose supplementation) and blood lactate was found to be (-0.280). When it was measured for triple dose of glucose against lactic acid, was found to be (-0.495). The value was significant, in case of triple dose of glucose supplementation while the rest values are non-significant. Therefore we can conclude that blood supplementation has definite role in the decrement of blood lactate during prolonged work.

Key words: Endurance performance, place-bo, lactic acid, multiple doses

1. Introduction

Sports have become inseparable phenomenon of our social life. It has made its own place at the apex of human civilization because of its trial, competitive event and improving nature. Physiological aspects of exercise in sports are gaining much attention among sports

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administrators. Work efficiency is directly related with the accumulation of lactic acid in the body muscles. Considering the importance of endurance in athletics and every day life, it was thought desirable to conduct a study regarding the improvement of work efficiency during prolonged performance by supplementation of glucose in different times of the work.

2. Materials and Methods

20 "Cross Country" runners who had represented West Bengal state for National "Cross Country" Championship, age ranging between 23-26 years had been selected as subject randomly. In Place bo trial, supplementation of single dose (saccharine mixed water) was given to the individuals after at 30th minutes of run. Supplementation of a single dose (glucose mixed water) was administrated at 30th minutes of run. Supplementation of double doses of glucose mixed with water was administrated at 30th and 50th minutes of run. Supplementation of triple doses of glucose mixed water was given at 30th, 50th and 70th minutes of run. In previous three cases, the dose of the given glucose was 6 mg in 500 ml / Kg body weight. Blood lactic acid was tested by latest scientific Autoanalyzers (ELCO, Model No.03/Sx/453N, Germany).

Estimation of blood lactate (Lactic oxidase – Peroxidase) was done following the method of Gau N.,Kaplan, A, *et al*.[1] and Young[2,3].

The tests were conducted in the early morning (6.30 am) for all those days. Subjects were well informed about the day and time of tests. They were also advised to have a comfortable life style during entire study period.

In all the four days of the tests,, the subjects were suppose to run for 90 minutes continuously at a pace of 160 meters/minute i.e. 400 meters within two and half minutes.

The first day of the test was the Placebo trial. In that day, subjects were run in a notion that they were supplied with glucose mixed water but virtually only saccharine water (without any amount of glucose) were supplied at 30th minutes of run.

On the second day of the test, subjects were supplemented to glucose mixed water (6mg in 500ml / Kg body weight) at 30th minute of the run.

On the third day of the test the subjects were supplemented to glucose mixed water at 30th and 50th minute of run. The glucose was supplemented to the subjects in a proportion of 6mg in 500ml / Kg body weight. During this time same 500ml was given twice during the endurance performance.

On the fourth day of the test the subjects were supplemented glucose mixed water at 30th, 50th and 70th minutes of run. The glucose will be supplemented to the subjects in a proportion of 6mg in 500ml / Kg body weight. During this time same 500ml was given thrice during the endurance performance. The data, thus collected, were subjected to statistical analysis for the conclusion.

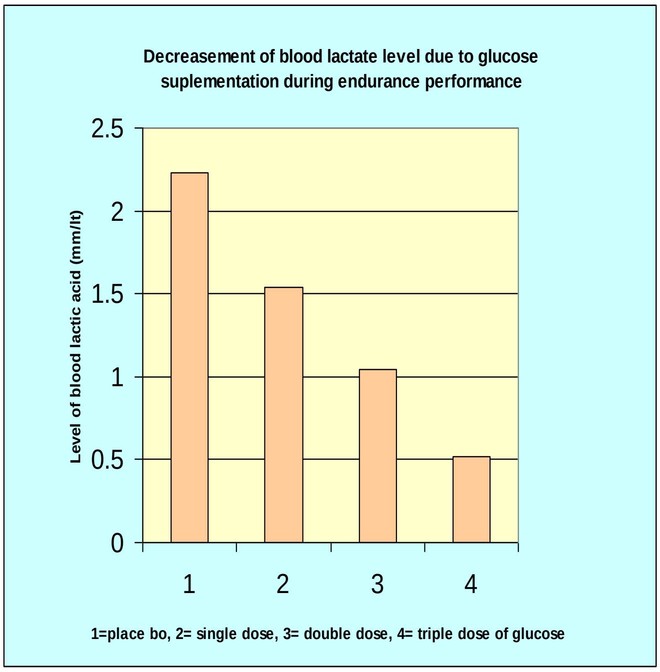
3. Results

Blood lactate is produced due to muscular activities during work. The level of blood lactate was estimated during the entire study. In place-bo condition, the difference between blood lactate level was found in both, before and after the extensive work. It was found that blood lactate level was found to be increased as 2.32 ± 0.97 mm/lt (mean ± SD, n=20) (Table-1).

The value of increment of blood lactate level in case of single dose of glucose supplementation (single dose, i.e. 30 min. after commencement of the work) was reported to be 1.54 ± 0.02 mm/lt (mean ± SD, n=20). The value of increment of blood lactate level, in case of double doses of glucose supplementation (double doses, i.e. 30 and 50 minutes after commencement of the work) was found to be 1.042 ± 0.05 mm/lt (mean ± SD, n=20) (Table-1). The value of increment of blood lactate level in case of triple doses of glucose supplementation (triple doses, i.e. 30, 50 and 70 minutes after commencement of the work) was found to be 0.519 ±0.01 mm/lt (mean ± SD, n=20).

Table- 1: Change of blood lactate level during the study period.

Experiments	Blood lactate level before the commencement of the work (mean ± SD, n=20)	Blood lactate level after work (mean ± SD, n=20)	Difference (mean ± SD, n=20).
Place-bo condition	1.62 ± 0.03 mm/lt	3.85 ± 0.218 mm/lt	(+) 2.23±0.97 mm/lt
Glucose supplement single time	1.62 ± 0.03 mm/lt	3.16 ± 0.034	(+)1.548±0.02 mm/lt
Glucose supplement twice	1.62 ± 0.03 mm/lt	2.66 ± 0.35 mm/lt	(+)1.042 ± 0.05 mm/lt
Glucose supplement thrice	1.62 ± 0.03 mm/lt	2.13 ± 0.92 mm/lt	(+) 0.519 ±0.01 mm/lt
(+) = Increment, (-)= Decrement.			



As per as blood lactic acid is concerned, correlation between blood glucose and blood lactate was calculated in different doses (place bo condition, single, double and triple doses). It was found negative with the blood glucose. The value of correlation coefficient for blood glucose (double dose of glucose supplementation) and blood lactate was found to be (-0.280). When it was measured for triple doses of glucose against lactic acid, was found to be (-0.495). The value was significant in case of triple doses of glucose supplementation, while the rest values were non-significant. (Table-2).

Table 2: Correlation values between blood glucose and blood lactate level

	Place-bo	Single dose of glucose	Double dose of glucose	Triple dose of glucose
Value of blood lactate level	-0.033	-0.098	-0.280	-0.495

(-) = Negative , (+) = Positive.

Therefore, we can conclude that blood supplementation has definite role in the decreasement of blood lactate during prolonged work.

ANOVA analysis performed with the increase of lactic acid level during endurance performance. It was found that
μ_o (Hypothesis)= $\mu_{1=}$ μ_2 = μ_3. It means that intermittent glucose supplement has no definite effect on the blood lactate level and work efficiency. Three observations are independent to each other.
Correction factor (Cf) = (G^2/N) = 1120.736, Treatment sum of square (Tr.S.S) = 8993.761, Total sum of square (T.S.S) = 11092.230
Error SS (ESS) = T.S.S-Tr.S.S = 2098.46

Sources of variables	df	Tr.S.S	M.S.S. = SS/df	F
Treatment	4-1=3	8993.761	2937.92	2937.92 / 145.95 F = 20.129
Error	76	11092.230	145.95	
Total	80-1=79	--	--	

Critical value of F, in α = 0.05 and 0.01 level of significance is 2.01 and 2.67 respectively (df=79). Our calculated F value is 20.129. It clearly indicates that the μ_o is **rejected**. Therefore, we can say that intermittent glucose supplement has definite effect on the blood lactate level and work efficiency during prolonged extensive work.

For the confirmation of the result, paired 't'-test was performed between the variables. When 't'-test was performed between blood lactate in place-bo condition, and lactate level in case of single glucose supplementation, it was found to be 't' = 6.39. It was beyond the critical value (Under df = 19, critical value at 5% level of significance is 2.09). Therefore, there seemed to be a relation between extensive work and blood lactate level. Crude data showed increment of blood lactate level during endurance performance in place-bo condition (Table-3).

When 't' test was performed by taking μ_o (Null hypothesis) = their was no relationship between glucose supplementation (single dose) and blood lactate level, it was found that t=13.07. It was well beyond the critical value at 5% level of significance (2.09), df =19. Therefore, the null hypothesis was rejected.

So, there was a relationship between lactate level decrement and glucose supplementation. Therefore, it can be concluded that blood lactate level gradually decreases with the increment of glucose supplementation. Hence, work performance also increases during prolonged extensive activity.

Table -3: Increment or decrement of blood lactate level during prolonged work

No of individuals	Age (Year)	Weight (Kg)	Difference Before-After work (Place-bo)	Difference Before-After work (Single dose)	Difference Before-After work (Double dose)	Difference Before-After work (Triple dose)
1	26	59	(+) 2.15	(+) 1.55	(+) 1.06	(+) 0.50
2	24	56	(+) 2.40	(+) 1.54	(+) 1.01	(+) 0.49
3	25	52	(+) 2.35	(+) 1.58	(+) 1.02	(+) 0.52
4	25	59	(+) 2.35	(+) 1.58	(+) 1.04	(+) 0.53
5	25	59	(+) 3.15	(+) 1.56	(+) 1.05	(+) 0.51
6	26	58	(+) 2.20	(+) 1.53	(+) 1.07	(+) 0.54
7	26	52	(+) 2.30	(+) 1.54	(+) 1.03	(+) 0.50
8	26	55	(+) 2.30	(+) 1.57	(+) 1.06	(+) 0.52
9	24	55	(+) 2.15	(+) 1.56	(+) 1.05	(+) 0.53
10	25	56	(+) 2.30	(+) 1.50	(+) 1.04	(+) 0.54
11	25	51	(+) 2.20	(+) 1.58	(+) 1.06	(+) 0.51
12	25	58	(+) 2.15	(+) 1.51	(+) 1.03	(+) 0.52
13	25	59	(+) 2.35	(+) 1.53	(+) 1.04	(+) 0.52
14	24	53	(+) 2.25	(+) 1.56	(+) 1.05	(+) 0.50

15	25	54	(+) 2.45	(+) 1.57	(+) 1.06	(+) 0.54
16	24	62	(+) 2.30	(+) 1.55	(+) 1.02	(+) 0.53
17	25	58	(+) 2.25	(+) 1.54	(+) 1.04	(+) 0.51
18	24	56	(+) 2.20	(+) 1.56	(+) 1.06	(+) 0.52
19	24	52	(+) 2.25	(+) 1.57	(+) 1.04	(+) 0.53
20	23	55	(+) 2.35	(+) 1.56	(+) 1.02	(+) 0.52

(+) = Increment, (-)= Decrement

4. Discussion

Coggan and Coylee reported that[4] during first hour of exercise, most of the energy is derived from muscle glycogen. They also reported that the contribution of muscle glycogen decreases over time as muscle glycogen become depleted and that blood glucose uptake and oxidation increases progressively to maintain –CHO oxidation. Blood can potentially provide all of the –CHO energy needed to support the exercise during prolonged performance, In our present study, It is also revealed that intermittent glucose supplementation can increase blood glucose level and it will also decrease blood lactate level during prolonged extensive activity. Therefore, the present result confirms the previous observations. Febbraio & Stewart reported that intermediate glucose supplementation increases the power of endurance performance by decreasing blood lactate level significantly[5]. Therefore, our present finding confirms the previous observations. Coyle *et. al.*, in an experiment, provided some amount of glucose polymer solution, 20 min after the onset of exercise[6]. It was found that blood glucose concentration was 20-40% higher during exercise after carbohydrate ingestion than during the exercise without carbohydrate feeding. The exercise induced decrease in plasma insulin was prevented by carbohydrate feeding. In our present experiments it was found that blood lactate level decreased considerably during prolonged activity, if glucose supplementation was given. Therefore, our findings confirm the previous observations. Peter et al., in an study [7], showed that carbohydrate drink increases performance by limiting lactate accumulation and improved work efficiency by keeping a low heart rate, thereby delaying the onset of fatigue.

Sayed, Rattu and Roberts examined[8] the effect of carbohydrate ingestion on exercise performance capacity. Nine male cyclists performed two separate trials for 60 min followed by a maximal ride for 10 min. During trials, subjects were fed either an 8% glucose solution or a place-bo solution, which were administrated at rest and during and immediately after sub-maximal exercise. Statistical analyses indicated that glucose levels, at rest, increased significantly 15 min after the ingestion of glucose compared to placebo condition. Like the present study, they also concluded that carbohydrate ingestion improves maximal exercise performance during prolonged exercise.

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