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EFFECTS OF ACUTE PRE-EXERCISE GLICEROL SUPLEMENTATION ON LACTATE AND MAXVO$_2$[2]

ABSTRACT

This study aims to investigate the effects of acute pre-exercise glycerol loading (GL) on including lactate and maximum aerobic power.

In this study, 10 healthy elite athletes with a mean age of 18.20±0.61 years, with a mean body height of 178.20±1.78 cms, with a mean body weight of 65.17±2.049 kgs and 10 healthy sedentars from different profession groups with a mean age of 19.70±0.47 years, with a mean body height of 169,10±2.22 cms and with a mean body weight of 71.09±1.87 kgs, totally 20 males were used as subjects.

On the first day of the research, blood samples were taken from ear lobe for lactate measurement and from analysis before the shuttle run test. On the second day, after loading 1gr/kg^{-1} glycerol mixed with water to the subjects two hours before testing, max VO_2 was determined by using shuttle run test in both groups.

Statistical analyzes were conducted by SPSS. Mean values of standard deviations were calculated. The independent t-tests were used to determine the differences between two groups. Also, paired t-tests were performed to determine the differences within groups.

Results of this study indicated that max VO_2 of experiment and control groups were found higher after loading at 0.05 significance level. Max VO_2 of experiment group was significantly higher than controls. Lactate levels were increased after exercise and GL ($p<0.05$). Control group had a significantly higher lactate level than experiment group but there was no statistical significant difference between two groups after glycerol loading.

As a result, there is a significant effect of acute pre-exercise glycerol loading on maximum aerobic power whereas no significant effect on the lactate may be partly due to the amount of glycerol and the time of loading.

Key words: Exercise, Glycerol, MaxVO$_2$, Lactate

SPORCULARDA VE SEDANTER BİREYLERDE AKUT EGZERSİZ ÖNCESİ GLİSEROL TAKVİYESİNİN LAKTAT VE MaxVO$_2$ ÜZERİNE ETKİLERİ

ÖZET

Araştırmada akut egzersiz öncesi uygulanan gliserol takviyesinin sporcularda ve sedanter bireylerde MaxVO$_2$ ve Laktat üzerine etkisinin incelenmesi amaçlanmıştır.

Yaş ortalamaları 18.20±0.6110 yıl, boy ortalamaları 178.20±1.7814 cm ve vücut ağırlığı ortalamaları 65.17±2.0488 kg olan elit düzeyde atletizm branşı ile uğraşan 10 sağlıklı erkek sporcu ve yaş ortalamaları 19.70±0.4726 yıl, boy ortalamaları 169,10±2.2184 cm ve vücut ağırlığı ortalamaları 71.09±1.8713 kg olan değişik meslek gruplarından 10 sağlıklı erkek sedanter olmak üzere toplam 20 kişi denek olarak kullanıldı.

Her iki gruba 1. gün shuttle run testi öncesi ve hemen sonrası laktat ölçümü için kulak memesinden, kan örnekleri alındı. 2. gün aynı egzersiz testinde 2 saat önce 1 gr/kg gliserol su ile karıştırılarak solisyon halinde her iki gruba verildi ve shuttle run testi uygulandı. Ayrıca her iki gün uygulanan test sonrası her iki grubun MaxVO$_2$ düzeyleri belirlendi.

Elde edilecen verilerin istatistiki analizlerin yapılmasında SPSS paket programı kullanıldı. Tüm deneklerin ölçülen parametrelerinin ortalama değerleri ve standart hataları hesaplandı.İki grup arası farklılıkların tespitinde indepented (bağımsız) "t" testi kullanıldı. Grup içi farklılıkların tespitinde ise paired (bağımlı) "t" testi kullanıldı.

Analizler sonucunda; K ve S (Kontrol,Sporcu) grubunun ES (egzersiz sonrası), MaxVO$_2$ düzeyi TES (takviyeli egzersiz sonrası) dan önemli ($p<0.05$) düzeyde yüksek bulunmuştur. S grubunun ES ve TES MaxVo2 düzeyi K grubundan anlamlı düzeyde yüksektir. ($p<0.05$). İki grubun her iki egzersiz sonrası (ES,TES) Laktat parametresi anlamlı ($p<0.05$) düzeyde artmıştır. K grubunun ES Laktat seviyesi S grubundan önemli ($p<0.05$) düzeyde yüksek iken TES iki grup arasında istatistiksel bir fark yoktur ($p<0.05$).

Sonuç; oral olarak uygulanan gliserol takviyesinin MaxVO$_2$ düzeylerine önemli bir etkisinin olduğu fakat Laktat üzerinde en azın bu miktar ve sürede uygulanan gliserol takviyesinin bir etkisinin olmadığı söylenebilir.

Anahtar Kelimeler: Egzersiz, Gliserol, MaxVO$_2$, Laktat

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[2] This study was summarised from Çiğdem Öztürk' s master thesis with a report of ethical committee numbered in 2007/14 dated 20/04/2007.

INTRODUCTION

It is informed that they will increase the performance of the sportsmen in case the agents such as glycerol and dextran are given to the sportsmen and glycerol is loaded on them for increasing the plasma volume and maintaining exercise for a prolonged time. As a matter of fact, glyserol which is an osmotically active agent, positively affects on cardiovascular and thermoregulatory system during the exercise and decreases the urine volume and expands the plasma volume by increasing the plasma osmolarity. Also, glyserol given before the exercise has important effects on decreasing the internal body temperature and increasing the rate of sweating during the exercise (Murray va et al 1991, Robers and Griffen 1998).

Glyserol is used as a means of hyperhidration for sportsmen rather than the source of potential energy. Glyserol taken orally is absorbed by the digestive system in a rapid way and it increases the osmolarity of intravascular liquid. Not only does glyserol inhibit the decrease in the liquid volume, but also it helps long-term preservation of the plasma volume. For hyperhidration with glyserol ingestion it is common that 1-1.5 g/kg glyserol per weight and 25-35 ml/kg water are taken together. It is suggested that glyserol provides the advantage of liquid of 600 ml on average in urine system due to the retention of liquid and the expansion of liquid (Robers and Griffen 1998).

Another study suggests that glyserol ingestion be applied 60-120 min before races and competitions to environmental conditions, the exercise volume and intensity and 1gr glyserol per kg of body weight be given with 1,5 litres of water together. Also, glyserol ingestion does not carry any risk in terms of health (Wagner 1999).

The loss of sweating is high during the exercise at high volume in hot and humid environments, the liquid loss as well. It is thought that the loss rate of liquid decreases with the glyserol ingestion before exercise. Glyserol ingestion in training season or in intervals of races for sportsmen is effective for preventing the liquid loss of body. Researches show that hyperhidration with glyserol before endurance trainings and races increase endurance. Glyserol ingestion is beneficial for the performance to the sportsmen who regularly train in general (Robergs and Griffin 1998). In contrary to this, there are different views suggesting that the ingestion of glyserol, amino acid and neurotransmitter substance is not beneficial to the sportsmen (Coyle 2004).

MATERIAL AND METHOD

Material

In this research total 20 persons were identified as subjects including 10 healthy sportsmen interested in elite track and field (long and middle distance) with the average age of 18.20±0.6110 years, the average height of 178.20±1.7814 cm and the average body weight of 65.17±2.0488 kg and 10 healthy, sedentary men from different groups of profession with the average age of 19.70±0.4726 years, the average height of 169,10±2.2184 cm and the average body weight of 71.09±1.8713 kg.

Groups

1. Group: Control (sedentary) Group; (C) (n:10)

2. Group: Sportsmen Group; (S) (n:10)

Measurement Schedules and Abbreviations

C: Control Group
S: Sportsmen Group
EB; Before Exercise
EA; After Exercise
SEB; Before Supplementation Exercise
SEA; After Supplementation Exercise

Method

On the first day, blood samples were taken from ear-lobes of the subjects in both groups for measuring the lactate level before the 20 m shuttle run test and after

this test. On the second day, 1 gr/kg glyserol and water were compounded two hours before the same exercise test, these were given to two groups as a solution, and then the 20 m shuttle run test was applied.

Test of Exercise

The purpose of the test applied on C and S groups was to guess maximum VO_2 value of person and to make sportsmen tired. With this aim, the 20 m shuttle run test applied involves multi-steps, the first step includes warm-up. The subjects ran 20 m distance as roundtrip. Running speed was controlled with a tape giving a signal tone at certain intervals. The subjects started to run when they heard the first signal tone and reached the other line until the second signal tone. When they heard the second signal tone, they returned to the starting line and the running went on with these signals. When the subjects heard the signal tone, they adjusted their paces by themselves to be at the other side of track at the second signal. The speed was slow at first, then increased at every 10 seconds. If the subject missed the first signal tone and caught the second tone, the person went on for the test. If the subject missed two consecutive signal tones, the test finished. In this way, subjects were made to be exhausted at the end of the test (Tamer 2000).

Analyses

Using diaglobal LAC 342 lactate kit 10 micron venous blood taken from ear-lobe, Lactate levels were determined by the Photometer device marked VARIO (Made in: Berlin/GERMANY)

Statistical Analyses

SPSS program was used in the statistical analysis of data obtained. Mean values and standard deviations of measured parameters were estimated for all subjects. The Kolmogorov-Smirnov test was used to determine if dependent and independent variables were normally distributed. The Levene test was used to determine if there was homogeneity of variance. Independent t-test was used for the determination of the differences between two groups. Paired t-test was used for determining the differences within the groups.

RESULTS

Table 1. Comparison of $MaxVO_2$ Levels for C and S Groups After Exercise (EA)

Group	Parameter	Timing	n	$\bar{X} \pm SS$	t	p
C	$MaxVO_2$	EA	10	36.79 ± 4.16	-10.877	0.000 *
S		EA	10	54.65 ± 3.09		

*p<0.05

SEA Max VO_2 levels of C and S groups significantly increased in comparison to ES levels (p<0.05).

Table 2. Comparison of $MaxVO_2$ Levels for C and S Groups After Suplementatıon Exercise (SEA)

Group	Parameter	Timing	n	$\bar{X} \pm SS$	t	p
C	MaxVO2	SEA	10	43.73 ± 3.60	-12.91	0.000 *
S		SEA	10	59.97 ± 1.69		

*p<0.05

Difference between two groups (C,S) SEA $MaxV0_2$ levels of S group was significantly higher than C group (p<0.05).

Table 3. Comparison of $MaxVO_2$ Levels for C and S Groups After Exercise (EA) and After Suplementatıon Exercise (SEA)

Group	Parameter	Timing	n	$\bar{X} \pm SS$	t	p
C	$MaxVO_2$	EA	10	36.79 ± 4.16	-8.01	0.000 *
		SEA	10	43.73 ± 3.60		
S		EA	10	54.65 ± 3.09	-6.64	0.000 *
		SEA	10	59.97 ± 1.69		

*p<0.05

Difference between two groups (C,S) SEA $MaxV0_2$ levels of S group was significantly higher than C group (p<0.05).

Table 4. Lactate Levels for C and S Groups

Parameters	n	Group	Timing	$\bar{X} \pm SS$	t	p
Lactate (mmol/l)	10	C	EB	2.47 ± 0.59	-4.050	0.003*
	10	C	EA	7.12 ± 3.37		
	10	C	SEB	2.30 ± 0.54	-9.578	0.000*
	10	C	SEA	6.83 ± 1.39		
	10	S	EB	1.67 ± 0.30	-10.689	0.000*
	10	S	EA	6.67 ± 1.46		
	10	S	SEB	2.44 ± 0.24	-8.910	0.000*
	10	S	SEA	6.64 ± 1.25		
	10	C	EB	2.47 ± 0.59	0.877	0.403
	10	C	SEB	2.30 ± 0.54		
	10	C	EA	9.03 ± 1.36	4.936	0.001*
	10	C	SEA	6.83 ± 1.39		
	10	S	EB	1.67 ± 0.30	-5.477	0.000*
	10	S	SEB	2.44 ± 0.24		
	10	S	EA	6.67 ± 1.46	0.049	0.962
	10	S	SEA	6.64 ± 1.25		
	10	C	EB	2.47 ± 0.59	3.807	0.002*
	10	S	EB	1.67 ± 0.30		
	10	C	EA	9.03 ± 1.36	3.742	0.002*
	10	S	EA	6.67 ± 1.46		
	10	C	SEB	2.30 ± 0.54	-.749	0.468
	10	S	SEB	2.44 ± 2.24		
	10	C	SEA	6.83 ± 1.39	0.312	0.759
	10	S	SEA	6.64 ± 1.25		

* p<0.05

C: Control Grubu, **S:** Sportsmen Group, **EB**; Before Exercise, **EA;** After Exercise, **SEB;** Before Suplementatıon Exercise, **SEA;** After Suplementatıon Exercise

When examined the lactate levels (EB,SEB) of C group before both exercises in the study, there is no statistical difference between EB and SEB. SEB lactate level of S group is significantly higher than EA level (p<0.05). While the lactate level of C group before exercise is significantly higher than S group (p<0.05), there is no statistical difference between the SEB lactate levels of two groups. The EA and SEA lactate levels of two groups have showed a significant increase in comparison to the EB and SEB levels (p<0.05).

DISCUSSION AND CONCLUSION

In this study, SEA Max VO_2 levels of C and S groups significantly increased in comparison to ES levels (p<0.05). Given the difference between two groups (C,S), ES and SEA $MaxV0_2$ levels of S group was significantly higher than C group (p<0.05). Hyperhidration with glyserol before endurance trainings and races increases

aerobic capacity. Generally, glyserol ingestion is beneficial for the performance of sportsmen who regularly train (Robergs and Griffin 1998). Moreover, Montner et al. (1996) stated that the use of glyserol during the exercise results in decreasing heart rate and increasing endurance. Coutts et al. (2002) observed that the load of glyserol before olympic triothlan race organized at high temperature and in humid enviroments decreases the urinary volume, preserves the body water and increases the performance in the last 10 km of the race. On the other hand, other studies in literatures show that the load of glyserol does not have any effects on sportive performance (Latzka and Sawka 2000).

Considering the significant increase in Max VO_2 ($p<0.05$) after the suplementatıon of glyserol for both groups in the study, it can be said that glyserol increases aerobic capacity and Max VO_2 level, and this increase will give benefits for the performance. The reason for significant higher level of EA and SEA Max VO_2 in S group than C group is that the persons included in S group are elite athletes. Glyserol, which is released in systematic circulation, is generally used by liver. The less amount of glyserol is used in other cells. Glyserol taken by liver is resolved into glucose (Landau 1999). It can be said that (SEA) Max VO_2 level after suplementatıon exercise is higher than the level (EA) after exercise for two groups (C,S) ($p<0.05$) due to glyserol taken orally.

The interesting one is; sportsmen' glyserol ingestion, which was published in a review article by Robergs and Griffin (1998), was approved by USA Olympic Committee in 1997. Glyserol ingestion increases aerobic strength and capacity in races especially such as half marathon, marathon and ultra marathon for branches in which endurance is more important, this indicates that it contributes to the endurance performance in a positive way.

Van Rosendal et al. (2010) informed that the liquid loss of 2% in body weight negatively affected cardiovascular system and heat balance, and it would reduce the endurance performance; so 1.2 g/kg glyserol was mixed with 26 ml/kg water, this one was given to the sportsmen 60 min before exercise, then it was said to have positive effects on the endurance performance for glyserol ingestion before exercise. Goulet et al. (2010) emphasized that glyserol ingestion before exercise made ergogenic contributions for the sportsmen and increased the endurance performance in this way. Beis et al (2011) 15 male endurance runners, the objective of the present study was to investigate the effects of a combined creatine and glycerol supplementation on thermoregulatory and cardiovascular responses and running economy during running for 30 min at speed corresponding to 60% of maximal oxygen uptake ($\dot{V}O2max$) in hot and cool conditions. No significant differences were found in sweat loss, serum osmolality, blood lactate and in plasma volume changes between pre- and post-supplementation. Combining creatıne and glycerol is effective in reducing thermal and cardiovascular strain during exercise in the heat without negatively impacting on running economy. Van. Rosendal SP and et al (2012) Nine endurance-trained men were dehydrated by 4% bodyweight via exercise in the heat. They then rehydrated with 150% of the fluid lost via oral glycerol. Following this they completed a 40 km cycling performance test in the heat. Compared to oral rehydration, there were significant performance benefits ($P<0.05$) when rehydrating with oral glycerol (improved time to complete 40 km by 3.7%), There were no differences in heart rate, tympanic/skin temperatures, sweat rate, blood lactate concentration, thermal stress or rating of perceived exertion between groups. Combining fluid with oral glycerol resulted in the greatest fluid retention, however it did not improve exercise performance compared to either modality alone.

When examined the lactate levels (EB,SEB) of C group before both exercises

in the study, there is no statistical difference between EB and SEB. SEB lactate level of S group is significantly higher than EA level ($p<0.05$). While the lactate level of C group before exercise is significantly higher than S group ($p<0.05$), there is no statistical difference between the SEB lactate levels of two groups. The EA and SEA lactate levels of two groups have showed a significant increase in comparison to the EB and SEB levels ($p<0.05$). This increase results from exercise and is identified in the literature.

When examined the difference between both groups (C,S), the lactate level of C group before exercise (EB) is higher than S group ($p<0.05$), there is no difference on SEB. The lactate level of C group (EA) after exercise was found to be significantly high in comparison to S group ($p<0.05$). Since S group consists of elite sportsmen, their anaerobic thresholds become high. It supports this conclusion. Although there are not any statistical differences between SEA levels of two groups (C,S), the lactate level of C group is numerically higher than S group, for C group consists of sedentary individuals.

When the EB and SEA lactate levels of both groups are examined, a significant increase is seen in the lactate levels after two exercises ($p<0.05$). But the SEA lactate level of C group is significantly lower than the EB level, a numerical decrease is seen in S group although there is no statistical difference in this group. Based on the positive effect of glyserol on MAX VO_2, it is especially stated that the effect of glyserol on lactate is a challenging one, and so the researches should be made in detail and developed about this field.

CONCLUSION AND SUGGESTIONS

In addition to studies, for having clear results and identifying them in literatures the results should be stated in numbers and evaluated on the performance by increasing the amount of kg/gr glyserol for body, subjecting to different tests for the persons, and even giving them glyserol suplementatıon before races and competitions.

When the lactate levels of subjects are studied, a significant increase is seen in EA and SEA lactate levels of two groups ($p<0.05$). But the SEB lactate level of C group is lower than the EA level, although there are not any statistical differences in S group, a numerical decrease is seen in the group. Based on the positive effect of glyserol on MAX VO_2, it is especially stated that the effect of glyserol on lactate is a challenging one, and so the researches should be made in detail and developed about this field.

In this study, body kg/gr 1 glyserol was added. But in other studies glyserol amounts of 1.5 kg/gr, 2 kg/gr, 2.5 kg/gr were given. The lactate level achieved in parallel with MaxVO_2 indicates that glyserol rate used in studies should not be lower than the amount (1kg/gr) applied in our study. Because the result can be expected that glyserol increases MaxVO_2 and decreases the lactate level especially after exercise.

In conclusion; it can be reported that glyserol suplementatıon applied orally has important effects on MaxVO_2 level but it does not show any effects on the lactate levels at least at this amount and in this period.

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