An Analysis of Blood Lactate Depletion during Continuous Exercise on Cyclic Ergo Meter

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Abstract

Purpose: - The purpose of the study was to assess the blood lactate depletion response to different duration of exercise on Cyclic Ergo meter on selected male subject. **Methods:-** The subjects were five male, all subjects were perusing BPEd course at Lakshmibai National Institute of Physical Education, North East Regional Center, Guwahati. The age of subject ranged between 18-12 years. All test of blood lactate were administered at Human Performance and Research and Training Laboratory of LNIPE, NERC to obtain the data. The data pertaining blood Lactate were examined by Repeated Measure one way analysis of variance (ANOVA) in order to determine the difference, if any. The level of significant was set at 0.05 levels for testing the hypothesis. **Result:** The selected variable blood Lactate (F ratio 9.43) was significant which was higher than tabulated value 0.05 level of significance. **Conclusion: -** On the basis of the analysis of data and the limitation of the present study the conclusion were drawn as there is significant effect of Blood Lactate depletion response to Cyclic Ergo meter.

KEYWORD: Cyclic Ergo Meter, Blood Lactate, ANOVA and Depletions.

Introduction:

Time over a distance i.e. speeds is the reference for performance for all events whose rules are based on locomotion in different mechanical constraint. A certain power output has to be maintained during a distance or over times. However, despite the complexity of the regulation of lactate metabolism blood lactate measurement can be used by researcher and coaches for prediction of exercise performance **(1)**. The blood lactate level has been used as an indicator of the ability to perform endurance exercise in laboratory and clinical practice. Moreover, during high intensity of exercise, lactate production is higher than its removal from the body. Therefore, the lactate threshold level is an excellent indicator for predicting endurance capacity. Individual with a high LT level have delayed onset of muscles fatigue and are able to exercise for a long duration at high intensity **(2)**. While elevated blood lactate concentration may be indicative of ischemia or hypoxemia, it may also be a “Normal” physiological response to exertion. In the response to “All Out” maximal exertion lasting 130-120 seconds, peak lactate value of approximately 15-22 mM may be observed 3-8 minutes post exercise with incremental, lactate increases gradually at first and then more rapidly as the exercise become more intense **(3).**

To understand what blood lactate is and how it is produced during exercise, it is useful to have a basic understanding of the systems the body uses to produce energy. Whether you're running a marathon or performing an Olympic lift, skeletal muscle is powered by one important compound; adenosine triphosphate (ATP). The body only stores small amounts of ATP in the muscles so it has to replace and resynthesize this energy compound on an ongoing basis. Understanding how it does this is the key to understanding energy systems. There are 3 separate energy systems through which the body produces ATP. Describing each of these systems in detail goes beyond the aim of this article. Instead it is intended that the brief outlines provided will assist in describing the role of blood lactate during energy production for exercise, and how this knowledge can be used to help with training for improved endurance performance.

The ATP-PCr system, this system produces energy during the first 5-8 seconds of exercise using ATP stored in the muscles and through the breakdown of phosphocreatine (PCr). This system can operate with or without the presence of oxygen but since it doesn't rely on oxygen to work it is said to be anaerobic. When activity continues beyond this period the body relies on other ways to produce ATP. The Glycolytic System, this system produces ATP through the breakdown of glucose in a series on enzymatic reactions. The end product of glycolysis is pyruvic acid. This either gets funnelled through a process called the Kreb's cycle (slow glycolysis) or gets converted into lactic acid (fast glycolysis). The fast glycolytic system produces energy more quickly than slow glycolysis but the end product of lactic acid can accumulate and is thought to lead to muscular fatigue. The contribution of the fast glycolytic energy system rapidly increases after the first 10 seconds and activity lasting up to 45 seconds is supplied by energy mainly from this system. Anything longer than this and there is a growing reliance on the Oxidative system.

The Oxidative system, this is where pyruvic acid from slow glycolysis is converted into a substance called acetyl coenzyme A rather than lactic acid. This substance is then used to produce ATP by funnelling it through the Krebs cycle. As it is broken down it produces ATP but also leads to the production of hydrogen and carbon dioxide. This can lead to the blood becoming more acidic. However, when oxygen is present it combines with the hydrogen molecules in series of reactions known as the electron transport chain to form water thus preventing acidification. This chain, which requires the presence oxygen, also leads to the production of ATP. The Krebs cycle and the electron transport chain also metabolise fat for ATP production but this again requires the presence of oxygen so that the fats can be broken down. More ATP can be liberated from the breakdown of fats but because of the increased oxygen demand exercise intensities must be reduced. This is also the most sustainable way of producing ATP. It is important to remember that these systems are all constantly working to produce energy for all bodily functions and one system is never working exclusively over the others. When it comes to energy production for exercise one system will play a more dominant role (this will be dictated by the type of activity being performed) but all 3 systems will still be working to provide adequate amounts of ATP.It is through the Glycolytic System that the role and production of blood lactate becomes apparent. Recall the end product of glycolysis is pyruvic acid. When this is converted into lactic acid it quickly dissociates and releases hydrogen ions. The remaining compound then combines with sodium or potassium ions to form a salt called lactate. Far from being a waste product, the formation of lactate allows for the continued metabolism of glucose through glycolysis. As long as the clearance of lactate is matched by its production it becomes an important source of fuel. Clearance of lactate from the blood can occur either through oxidation within the muscle fibre in which it was produced or it can be transported to other muscle fibres for oxidation. Lactate that is not oxidized in this way diffuses from the exercising muscle into the capillaries and it is transported via the blood to the liver. Lactate can then be converted to pyruvate in the presence of oxygen, which can then be converted into glucose. This glucose can either be metabolized by working muscles (as an additional substrate) or stored in the muscles as glycogen for later use. So lactate should be viewed as a useful form of potential energy. The term 'accumulation' is therefore the key, as an increased production of hydrogen ions (due to an increase production of lactic acid) will have no detrimental effect if clearance is just as fast. During low intensity exercise blood lactate levels will remain at near resting levels as clearance matches production. As exercise intensity increases there comes a break point where blood lactate levels will start to rise (production starts to exceed clearance). This is often referred to as the lactate threshold (LT). If exercise intensity continues to increase a second and often more obvious increase in lactate accumulation is seen. This is referred to as the lactate turn point (LTP).

The physiological processes discussed above can't be over ruled when it comes to the limiting factors of endurance performance i.e. you can't run a marathon once lactate is significantly increasing. An individual's LT and LTP are therefore powerful predictors of endurance performance. Knowing the exercise intensity that represents these two points can prove to be a valuable tool in assessing a person's current performance capabilities. In addition it can also help with the construction of an effective training program. With the right kind of training i.e. appropriate volume, intensity and frequency an individual should see a shift in their LT and LTP, whereby the exercise intensity is higher at these two points. This would then be reflected in improved endurance performance as the limiting effects of lactate accumulation don't occur at the intensity or pace that was observed prior to training. The prescription of training zones to achieve this type of adaptation is based on the heart rate ranges that represent an individual's original LT and LTP.

Materials and Methods:

Five Male undergraduate students of Lakshmibai National Institute of Physical Education, Guwahati were selected as the subjects. All the subjects selected randomly from different games that have at least participated in National level competition, and pursuing BPED course. Age ranges from 19-23 years. On the basis of the available literature, reviewed and in accordance with views of professional educator the blood lactate selected as a variable of the study. The selected variables Blood Lactate were obtained with the help of "Lactate Scout Meter". The subjects were call for the Cyclic Ergomete training for 99 minutes for continuous exercise with standard 6th resistance in Ergometer trainer. Before exercise blood lactate of every subject followed by 4 sample of lactate were measured in interval of 33 minutes each. All 5 subject blood lactate were measured before the treatment. Blood were collected using "Lactate

Scout "from finger tips of subject. Subjects were introduced to Cyclic Ergometer trainer with fixed resistance of 6^{th} in queue of 5 minutes each for feasibility in collecting data. Data were collected in every 33 minutes of subject exposure to exercise up to 99 minutes. Each subject was introduced and explained details about the procedure. "Lactate Scout Meter" was used to analysis of blood lactic measurement. To find out the progressive change in blood lactate between the pre phases to 99 minutes of exercise, a repeated measure "ANOVA" was used between various duration of score and level of significance was set at 0.05.

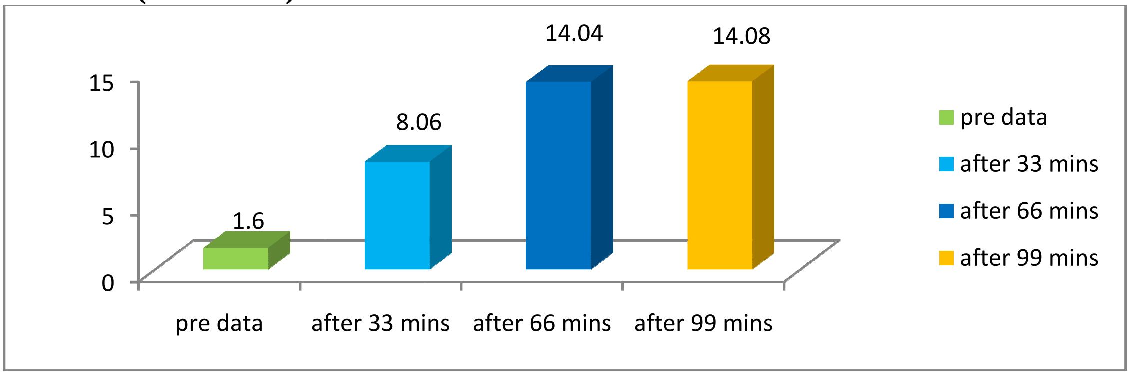
Results:

Various descriptive measure like mean, standard deviation for the selected variable were calculated and presented in **Table -1**.The result pertaining to the analysis of variance for the selected variable is presented from **Table 2 to 4.**

Table -1
Descriptive Statistics of Blood Lactate Response

Duration	Mean	Std. Deviation	N
Pre data	1.6000	.30822	5
After 33 mins	8.0600	2.90482	5
After 66 mins	14.0400	4.36898	5
After 99 mins	14.0800	6.82766	5

Figure -1
Graphical representation of blood lactate response to different duration (in minutes) of Exercise. Blood lactate measurement is in Mmol/l



Sphericity is an important assumption of repeated-measures ANOVA. The effect of violating sphericity is a loss of power (i.e., increased probability of a Type II error) and a test statistic (F ratio) that simply cannot be compared to tabulated values of the

F-distribution. Table 2, represents the Mauchly's test to assess the severity of sphericity which is as follows:

Table 2
Mauchly's test of Sphericity for subject wise comparison of Blood Lactate Response

Measure: Temporal Variable

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	Df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Apparatus	.246	3.808	5	.599	.596	1.000	.333

*** p-value < 0.05 is significant.**

The result of Mauchly's test in table 2 was found insignificant as the above table shown the p value was more than the significance value ($p > .05$) so assumption of sphericity has not been violated. In that case one way repeated measure ANOVA was proved as valid to apply for the analysis.As the same subjects was used to test in four different duration of time and there was only one factor (blood lactate) used for analysis so one way repeated measure ANOVA was applied to find out the difference among the subjects. The result is presented in table 3

The results of the one-way repeated-measures ANOVA in table 3, showed that there was a significant difference in main effect ($p < .05$) while performing exercise in Cyclic Ergo meter trainer on different duration of time.

The Partial Eta Square is also reported in the above table to find out the total strength of the main effect (Effect Size) was showed large in magnitude.

Table 3
Subject Wise Comparison of Temporal Variable of the Blood Lactate

Source		Type III Sum of Squares	Df	Mean Square	F	p-value	Partial Eta Squared
Respose lactate	Sphericity Assumed	530.29	3	176.76			
Error(lactate)	Sphericity Assumed	224.89	12	18.74	9.43	.037	.702

*** p-value < 0.05 is significant.**

As the results of repeated measure ANOVA was significant at the level of 0.05, in that case Bonferroni Post Hoc Test was used to pair wise comparison of each subject The finding of post hoc test is presented in table 4.

Table 4
Pair wise comparison of the Lactate Effect on each Duration of Time

(I) Effect_lactate	(J) Effect_lactate	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-6.460*	1.401	.010	-10.349	-2.571
	3	-12.440*	1.950	.003	-17.853	-7.027
	4	-12.480*	3.063	.015	-20.983	-3.977
2	1	6.460*	1.401	.010	2.571	10.349
	3	-5.980	2.566	.080	-13.104	1.144
	4	-6.020	3.810	.189	-16.598	4.558
3	1	12.440*	1.950	.003	7.027	17.853
	2	5.980	2.566	.080	-1.144	13.104
	4	-.040	2.956	.990	-8.247	8.167
4	1	12.480*	3.063	.015	3.977	20.983
	2	6.020	3.810	.189	-4.558	16.598
	3	.040	2.956	.990	-8.167	8.247

*** p-value < 0.05 is significant.**

The bonferroni post hoc test showed significant difference in comparing duration 1 with 2, 1 with 3 and 1 with 4 while comparing separately at 0.05 level of significance in case of temporal variable. The results also showed no any significant difference while comparing duration 2 with 3, 2 with 4 and 3 with 4. Duration 2, 3 and 4 showed an equal response than duration 1.

Discussion

On the basis of the data revealed and statistically evaluation, it was evident that there was significant effect of Blood Lactate depilation response to cyclic ergo meter training. The finding of the study satisfied the objective and vary purpose of the on which the study was conceptualized, the result also thrown light on the various duration of exercise and its effect on lactate depletion. The finding of the study clearly indicates that there was a significant effect of 99 minutes of cyclic ergo meter training on blood lactate. A muscle is the site of lactate production and utilization with shutting and oxidation occurring both among and within muscles. The blood lactate production in muscles increased continuously with increased workload. The level at which abrupt increase in blood lactate is observed has been described as individual lactate threshold. The rise in blood lactate may not necessarily indicate the abrupt increased in lactate production by exercise muscles, due to simultaneous removal of process. Increased lactate production could have occurred much earlier but may not have increased the blood lactate concentration because of increased removal. It is well known that non exercise muscles, liver, the kidney and the heart can mobilize lactate from the main stream for further biochemical degradation. The sum of the entire discussion of findings, it can be stated that the observation made in the study is quite rational. Total 4 times blood sample has been collected i.e. Pre, 33 Min, 66 Min and After 99 Minutes of exercise. After analyzing the data through statistical technique , the repeated measure it was found significant effect of 99 minutes of training on Cyclic Ergo meter trainer in blood lactate. But at the end of the exercise the blood lactate was not elevated as expected , this may be increased in hydrogen ions, leading to an increased acidity of the intercellular environment.

Conclusion

On the basis of the analysis of data and the limitation of the present study, the following conclusion may be drawn that there was significant effect of Blood Lactate depletion response to cyclic ergo meter training.

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