The Lactate Threshold Test - Its Importance for Training

http://www.lactate.com/lactate_threshold.html

The reason lactate is different from every other variable a coach and athlete can measure is two fold.

First - there exists an effort level called the maximal lactate steady state (MLSS) that an athlete can continue at for an extended period of time without having to slow down, usually an hour but sometimes longer. As long as the athlete maintains this effort level his or her lactate level will remain constant.

At small effort levels above this point the athlete's lactate level will rise slowly and he or she will be forced to stop, sometimes within a few minutes or sometimes after an extended period of 20-30 minutes. Above this maximal lactate steady state there are no more steady states but an inevitable and frequently rapid progression to exhaustion. This effort level is also often called the lactate threshold (LT) , the anaerobic threshold (AT) or the onset of blood lactate accumulation (OBLA).

Second - the maximal lactate steady state or the lactate threshold is the single best indicator of endurance performance known. Generally the athlete with the maximal lactate steady state at the higher effort level (speed or power) will be faster in an endurance event. Increases in the maximal lactate steady state are almost always accompanied by improvements in race performance for endurance events.

So frequent lactate threshold testing (every 4-6 weeks) is usually the best indicator of potential race performance for endurance events. It is also generally the best measure for improvements due to training or a lack of response to training. For short events such as swimming and rowing the maximal lactate steady state is also highly correlated with performance but anaerobic capacity or the ability to produce lactate and speed will become more important as the event get shorter. This topic is covered in detail on our

Secrets of Lactate CD-ROM

Training to improve the maximal lactate steady state is often called lactate threshold training. However, training intensities at the actual lactate threshold or maximal lactate steady state are not recommend to improve these levels. Why? Because training at these specific effort levels is usually a formula for overtraining.

These intensities are too stressful for most athletes, especially elite athletes. This may sound contradictory but the better the athlete the more dangerous is training near or above the threshold.

Training intensities can be based on the lactate threshold but should either be much higher or at lower intensities. Training at the higher intensities is probably the most valuable training but should be very, very limited since an athlete can quickly overtrain when exercising at the lactate threshold or higher.

Very often endurance athletes do not feel much stress when training at the lactate threshold or higher but this can be deceiving as the stress they are putting on the aerobic system at these high intensities can break down this system too much and result in less aerobic capacity, not more.

The lactate threshold is best used to evaluate the results of a training program. It is the best marker to evaluate whether all those hours of training are paying off.

A very detailed discussion of thresholds, obla and the maximum lactate steady state is on our Thresholds page.

Why Lactate is Unique?

Lactate is the unique metabolic variable that indicates the capability of the muscles for an athletic performance. We emphasize "unique" in the preceding sentence because no other metabolic parameter provides the same information. Lactate is an output of the anaerobic process and a fuel for the aerobic process and levels of it in the blood during exercise is indicative of the strength of each system. No other parameter provides this same information.

The ability of the muscles to reach a peak performance during an athletic event requires that the energy systems providing energy be "fine tuned" or "balanced" properly so the athlete can generate the highest amount of energy per unit of time during a race. Proper training is what accomplishes this fine tuning or optimal balance and it is lactate testing that lets the coach know if the balance has been obtained or how each energy system must be trained in order to obtain the balance.

Coaching is a profession requiring both art and science. The building blocks for an optimal performance are many and must be constructed in a proper sequence and must recognize that each individual is different. Some of these building blocks are correct technique, positive mental attitude and a proper diet. However, the

cornerstone for this building is precise physiological training. That is the main reason an athlete spends so much time in the water, on the bike, on the track or the road, in the weight room or wherever training is best conducted. Ask yourself, do you know if all those miles/hours of training are paying out?

But what is appropriate physiological training? It is not volume or else those who put in the most hours/miles would be the winners. It is not intensity or else those who pushed themselves the hardest would be the winners. It is not someone's favorite workout or else everyone would be copying the magic workout or training pace. It turns out that each individual has their own way of adapting and any smart training plan must recognize this. This is a fact of life. Each has to find his or her own way to the proper balance of the energy systems and peak conditioning on the day that counts, race day.

With proper protocols a portable lactate analyzer enables the coach to measure both the aerobic and anaerobic conditioning of each athlete. Information about both is necessary for the coach to optimize the conditioning of each athlete whether they are a 50 meter freestyle swimmer (about 22 seconds plus per race) or an Ironman triathlete (over 8 hours per race for the world's best).

With information on each energy system the coach can plan, control and monitor the training of athletes with a precision not available before. Lactate testing provides the important information that enables the coach to individualize the intensity of each athlete's workout and control their training so they reach performance objectives. No over-training and no surprises come race day.

How Does Lactate Testing do This?

Provides a multi-dimensional profile of conditioning. Because lactate is produced by the anaerobic system and used by the aerobic system it is the only marker available for measuring each system. The amount of energy an athlete can produce per unit of time depends on the development of both systems which is why they have to be balanced. (Essentially this means training the anaerobic system to a level that is appropriate for the athlete's aerobic capacity.)

This balance will depend upon the event for which the athlete is competing and will also depend upon which part of the training cycle the athlete is in. The closer the athlete gets to the "big" event the balance will have to be "fine tuned" for a peak performance.

Show adaptation in each system. Over time changes in blood lactate levels tell the coach what physiological adaptation has taken place in each system. It tells the coach which forms of training are working or not working. Training time becomes much more efficient as the athlete performs only workouts that work.

Your analyzer becomes a "training compass" that "steers" each athlete in the right direction. It is much more relevant than heart rate monitoring which reflects a general overall body response to stress and doesn't necessarily reflect what is happening in the muscles or with the anaerobic system. It is much more versatile than VO2 testing which requires very expensive equipment and requires experts to administrate the test properly.

Teaches coaches and athletes what is required for a peak performance. Lactate testing is also a learning and motivating experience for coaches and athletes as they become much more aware of the interactions of variables and the other nuances that affect workouts as well as performance.

Since the emphasis will be on training energy systems and not the use of very broad training zones, coaches will understand what works best for each energy system and why, what may be counter-productive and when and in what sequence various types of training are appropriate.

The Best Information in the World on Lactate Testing

Lactate Threshold Testing Information for the coach. The Secrets of Lactate CD-ROM was written for the coach and is anything but trivial. There are 16 tutorials on different aspects of lactate testing, metabolism, interpretation with in-depth discussions in three sports (swimming, rowing and triathlon).

In addition there are 8 extensive discussions on various topics such as the lactate threshold and anaerobic threshold, heart rates and lactate, proper lactate test protocols and how to make your lactate testing consistent from test to test.

There is a new interactive module on exercise metabolism which animates how the body's energy systems respond to various races and training exercises. The CD-ROM is the most complete discussion of lactate testing in the world. If you click on the link above or the image below you will see a more detailed discussion that also provides links to sample slides in the tutorials.

Secrets of Lactate CDROM

Training information for the coach. Probably the two best books in the world for explaining the science of training are Jan Olbrecht's The Science of Winning (published October 2000) and Ernie Maglischo's Swimming Fastest (published January 2003). These are two scientists who have spent their lives with athletes as opposed to academia.

Both have Ph.D.'s in exercise science but don't live in academic ivory towers. Jan has worked with top athletes in Europe such as world record holders, triathlete - Luc van Lierde and swimmer - Pieter van den Hoogenband while Ernie has coached several NCAA champion teams and swimmers. Jan helped train 28 medial winners at the Athens Olympics. These two books are wonderfully clear and offer different perspectives from most on what it takes to maximize performance.

Another great book is the Physiological Tests for Elite Athletes written by the Australian Sports Commission. Here is a description of how the most successful sports program in the world is testing their athletes in 17 internationally recognized sports. See all our books (rowing, cycling, swimming)and CD's on training and testing in The Best Sources on Lactate in the World.

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