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The Bike Doc: Lactate threshold – VeloNews.com

By Shannon Sovndal, M.D. and Owen Murphy, M.S.

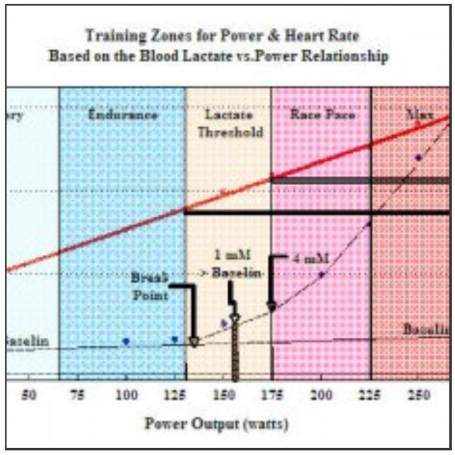

Figure 1- Courtesy Dr. Allen Lim

Everyone wants to ride faster. Last week wediscussed VO2max and natural ability. Now we get to the good stuff – lactate threshold (LT). The burn.

The reason we enjoy talking about LT is because it is highly trainable.Don't get us wrong, natural ability still plays a huge role, both withVO2max and LT, but for almost every individual, training properly willramp up LT.

Lactate Threshold?

Lactate is a by-product of anaerobic metabolism that, despite common misconception, is produced across all exercise intensities. In fact, even when you stand up from sitting in a chair, lactate acid is produced.

The key in sport is the balance between the rate of lactate production and lactate absorption. During light and moderate-intensity exercise, the blood concentration of lactate remains low.

The body is able to absorb lactate faster than the muscle cells are producing it.

However, as exercise intensity increases, there comes a point at which lactate removal fails to keep up with the rate of lactate production. This point is referred to as the lactate threshold (LT) and spells the beginning of the end of high intensity exercise. Excessive blood lactate and hydrogen ion concentrations combine to interfere with efficient and proper muscle contraction, and as a result, power output drops, suffering increases and you are forced to slow down.

LT represents the highest steady-state exercising intensity an athlete can maintain for prolonged periods of time (> 30 minutes). Most coaches and sport scientists today recognize LT, or a derivative thereof, as one of the strongest predictors of endurance performance. LT also serves as a very useful measure for the determination of training zones and the overall effectiveness of training programs.

How is it measured?

LT tests typically are performed on a treadmill or bicycle ergometer. After an adequate warm-up period, the test starts at an exercise intensity corresponding to 50-60 percent of the test subject's VO_2MAX. Each stage lasts 2-6 minutes, allowing sufficient time for the subject to achieve steady-state heart rate, VO2, and lactate production. Blood samples taken towards the end of each stage determine blood lactate concentration (a simple finger prick does the trick). The workload increases in steps and the process is repeated until an obvious spike in lactate concentration occurs. Heart rate, power output or speed, and/or VO2 are recorded at each stage. I have included a diagram of the data obtained from a sample LT test.

We measure blood lactate concentration in millimoles (mM) of

lactate per liter of blood (mmol/L). LT typically is expressed as a percentage of one's VO_2MAX or maximal heart rate. With the advent of power meters, various power outputs identify a riders LT and training zones. By evaluating a riders power output at LT, we can determine the potential for success. To be competitive in a race like the Tour de France, a male professional must be able to maintain 5-6 watts/kg at lactate threshold. This means if the rider weighs 68 kg (150 lbs) he must produce 350-400 watts while riding up the Col du Galibier in Stage Eleven this year.

Remember the example of the two cyclists Bill and Tom from last week.Bill had a high VO_2max but a moderate LT, and Tom had a moderate VO_2max but a ridiculously high LT. Being the same size and weight, Tom would likely find himself victorious in a head to head race up L'Alpe d'Huez.

It is possible to find your LT without going to a laboratory. A majority of athletes could care less what their actual LT number is.What is important is how fast and long can they ride at a given workload.

Many applied exercise physiologists believe that finding your LT in the field is actually more applicable than finding it in the lab. What you can do while on a ride is a pretty good indicator of what you'll be able to do on a ride. Sounds so simple you may think that last sentence was a mistake. No mistake, just simple common sense. There are a variety of techniques for finding your LT on the road.

It seems that each coaching system or training book has its own specific method. Although they vary a bit, most will give you an effective idea of your LT. Some are more complicated than others. For the sake of time and simplicity, one of the easiest techniques for finding LT in the field is to use the following approach, using a heart rate monitor or power meter. It is

possible to find an estimation of LT without these tools, but due to limited space, we'll have to pass on an explanation here. (So much to talk about but such limited time!)

Finding your LT• Find a flat or slightly uphill stretch of road (avoid undulations or hills)- you may also use a trainer (but this is mentally tough)

• Warm up for at least 10-15 minutes

• Ride a thirty-minute time trial with your best possible time

• If using a heart rate (HR) monitor, record the last twenty minutes of your ride. – Your average heart rate over this period will estimate your HR at LT

• If using a power meter, record the last twenty minutes of your ride – Your average power over this period will estimate your power output at LT.

Where do you stand?

To put things in perspective, untrained individuals usually reach LT at about 60 percent of their VO_2MAX. Moderately trained athletes reach LT at 65-80 percent VO_2MAX. Elite endurance athletes have a very high LT relative to their VO_2MAX . They are able to ride at 85-95 percent VO_2MAX, and it is this ability that allows them to making a living riding bikes.

I went to a spin class with my wife a few weeks back. I was minding my own business, suffering as I always do when riding an indoor trainer.The instructor told the class to "really work for this interval."

She told the class to "be right at 90-95 percent of your max." So I'm busting my butt trying to comply. Then she says, "Okay, now we really need to work. Let's bring it up to lactate threshold." I had to take a quick look around. Scanning the other participants, none looked like professional cyclists. Many looked as though they might be sick.

I realized the instructor didn't know what she was talking about. Only the best could be riding at 90-95 percent of their maximum heart rate and still be within their LT.

The key point in all this is the numbers change. LT is not as fixed as VO_2max. Through proper training and commitment, a rider can increase the percentage of VO_2max at which LT occurs. What fantastic news! Finally, something an individual can control.

Through years of hard work and training, a person can become a rider who is able to perform at near maximum for extended periods of time.

Factors that affect the rate of lactate accumulation
There are numerous factors that change the rate at which lactate is produced. Each of these could be an article unto itself, so we will have to keep the discussion brief.

• **Exercise intensity**. The harder you work, the more lactate youractive muscles produce.
• Diet. If you don't have good stores of glycogen, your high intensity training will be short lived.
• **Training status**. Proper training develops four primary mechanisms to slow the rate of lactate accumulation:Higher mitochondrial density allows for greater lactate resynthesis.Superior fatty acid oxidation prevents lactate production at submaximal exercise intensities. Your body will preferably burn fat over glycogen and this will preserve your glycogen as a fuel source for continued exercise.Greater capillary density improves both oxygen delivery to and lactate removal from the active muscles.
• **Muscle fiber type composition**. Slow twitch (Type I) muscle fibers produce less lactate at a given workload than fast twitch (Type II) muscle fibers. Although there is a big genetic component, proper training can influence the proportion of slow

vs. fast twitch muscle fibers.

• **Distribution of workload**. A large muscle mass working at a moderate intensity will produce less excess lactate that a small muscle mass working at a high intensity. Certain cycling techniques will slow the overall accumulation of lactate by using different muscles.

What does it all mean?

We have said that LT is one of the strongest predictors of endurance performance. So, if you increase your LT, you will be able to ride faster and put the hurt on your friends and fellow competitors. To take an analogy from one of our fellow coaches at Thrive HFM, Allen Lim, “It’s not only the size of your magic wand (VO_2max), but how your wield it (LT).” If you train properly, you can have dramatic increases in you LT.

So, how do we train properly to increase LT? Well, that’s a whole other story…

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