The Dark Side
Lactate Tolerance Training
by Richard Diaz

The Secret to High-Intensity Performance
I like to refer to Lactate Tolerance Training as “The Dark Side”. Lactate Tolerance Training is a very important component of every endurance athlete’s training, however, often times it is grossly misunderstood. I think the basis of this misconception in training is due in great part to the mystery of accurately identifying one’s “AT” or “LT” (anaerobic threshold or lactate threshold). Further simplified by referring to this consequence as “AT”.

For the sake of clarity, when we exercise below our “AT” (anaerobic threshold), the preferred and most dominant energy source is fat (oxidative metabolism). When we exercise above this threshold the energy source is sugar (glycolytic metabolism). Without the advantage of a clinical evaluation (VO2max test), everything else you do to arrive at this metabolic turn point is nothing more than guess work.

Having said that; the real problem lies in our perception of our efforts, most people who track heart rate while training, tend to overestimate their ability to exercise aerobically. Intuitively, once they begin to sense fatigue, they tend to cut short their exercise bout. In most cases, even while exercising above threshold, there is adequate energy available to produce work for as much as 2 hours depending on the level of intensity. This freedom to exercise unabated for this length of time lends people to believe that their ability to operate at higher heart rates is well within their aerobic capacities.

Under this misconception, even at low anaerobic efforts, the training stimulus is still anaerobic, thus, for the most part, is contrary to improving aerobic functionality. In my experience, I find that the majority of people (for the sake of this article I am referring to runners) train at around 70% or greater of their max heart rate. In all of the years I have tested athletes, most novice athlete’s thresholds are commonly much lower than 70%. In fact, novices tend to spend most all of their training in an anaerobic state. If you are a sprinter, this conversation ends here; however if you hope to perform well in events in excess of 800 meters, I advise you to keep reading.

WHAT IS LACTATE TOLERANCE AND WHY IS IT SO IMPORTANT?

Lactate production is a normal function of our metabolic system. It is estimated that about half of the lactate we produce during intense exercise is used to form muscle glycogen (energy). Some lactate is held in surrounding muscle tissue until energy is needed and some is converted to water and carbon dioxide, the rest is released from our bodies through respiration. During intense exercise, we breakdown glucose for energy, as this happens, we create lactate and hydrogen ions. As hydrogen ion concentrations increase, our blood and muscles become acidic.

Overly acidic muscles, due to high hydrogen ion concentration, aggravates local nerve endings which is what causes the burning sensation and increased irritation of the central nervous system. So in fact, lactate itself is a useful adjunct to our energy demands under intense exercise conditions. If we are able to improve our ability to process this precious energy source before its acidic partner (H+) plays havoc on our muscle function, we will gain access to more energy when we need it most. Have you ever participated in a race where
it seemed “your mind was writing checks that your body could not cash”? Your mental drive and desire is intact, but your legs just don’t seem to want to cooperate? A time when it seems that the only plausible solution to the dilemma is to slow down, walk or crawl? Have you ever witnessed someone mid race, start walking and begin pounding on their legs as if they hope to wake them up and get them back into the race?

Welcome to fatigue; a term that broadly paints a picture of temporary failure, the inability to perform as a result of a variety of culprits. We may reflect and try and cast blame on a hot day, energy debt, cramping, GI issues, or too aggressive a pace as the reasons for our fatigue. Ideally, we hope to cover all of the bases, feed well, hydrate well, possibly put in the required amount of training and yet, in many cases, we are still left wanting. “If I could have…” “I should have…” are conversation starters that really suggest that we did something wrong leading up to our race.

My favorite motivational phrase is: “Chance favors the prepared mind”, which simply means, if you are well prepared you will have already determined the outcome.

More often than not, there are more than one thing that fails us, but where performance is concerned, rather than simple completion of a race, it is our inability to cope with the acidic environment in our muscles from improper training that is the root cause of our failure.

**LACTIC ACID AND DELAYED ONSET MUSCLE SORENESS**

Lactic acid has long received a bad rap in that it has been blamed for post workout discomfort for which it is not at fault, namely “delayed onset muscle soreness” or the acronym DOMS. The truth is, lactic acid has nothing to do with the discomfort we experience typically at its peak 2 days post workout. This discomfort is more likely a result of microscopic tears and muscle damage caused by the eccentric phase (deceleration) of exercise.

Even though lactic acid is not the perpetrator of DOMS, it is the culprit behind performance impairment. Lactic acid production left unchecked in muscle, causes a temporary debilitating effect on the ability of our muscles to contract.

**THE BENEFITS OF AEROBIC CONDITIONING**

Aerobic conditioning allows us to perform at increasingly greater rates of speed with lesser lactate production. Aerobic conditioning is commonly conducted for long steady bouts below lactate threshold, which promotes capillarization (formation of more small blood vessels, thus enhancing oxygen transport to the muscles). It also increases the fat burning enzymes in our muscles. An enhanced aerobic capacity, results in more oxygen availability to the working muscles which delays the onset of lactic acid at higher workloads.

Aerobic conditioning is how we enhance our endurance, the ability to sustain low intensity efforts for great lengths of time. We are able to do this because we function in an oxidative state, “in the presence of oxygen” fat is liberated as the primary fuel source. Even the leanest runners are able to store in excess of 50,000 available calories of energy from fat. The number of calories burned for exercise on average at a moderate aerobic pace is between 500-800 calories per hour, depending on the weight of the athlete and intensity.

On the other hand, even a well-trained runner can only store as many as 2,000 calories from usable sugar for energy. Again, depending on weight and intensity, being anaerobic suggests that a greater number of calories are being burned. For the sake of argument, let’s say between 650-1,000 calories per hour (almost exclusively from our
If a runner were to attempt a marathon and is running anaerobically from the start, the odds of completion without having to walk, crawl or fail are stacked against him, of course, the shorter the event the greater likelihood of survival. What most people fail to realize is that the greater the intensity of effort, the more difficult it is for the body to process or evacuate the ensuing lactic acid production and heat that are byproducts of this anaerobic environment. As a result of the inability to neutralize this toxic environment in the working muscles, your performance suffers. Your pace will slow and fatigue will ultimately consume you.

THE ROLE OF OUR CENTRAL NERVOUS SYSTEM.

Our Central Nervous Systems primary function is to protect us from ourselves. As athletes, at any level, we are capable of causing great harm to our bodies and to our health. We can strain ligaments and tendons, we can rupture muscle and we can even overload our hearts which of course, is potentially fatal.

Dr. Timothy Noakes of South Africa is a globally respected exercise scientist who has developed one of the most unique theories on fatigue termed “The Central Governor Theory.” Noakes believes that the key to unlocking performance lies within our ability to understand how to placate our minds while training and racing. He suggests that whenever we expose ourselves to potential dangers through our efforts, our CNS begins introducing road blocks to keep us from continuing to cause harm. I agree and firmly believe that one of the principle triggers used to abate our intense efforts is lactic acid production. There are others but in the case of our trying to physically force our bodies beyond our current limits, this is one of the most likely perpetrators.

If you pause to think about the ramifications of our efforts and how many times we were incapable of producing more effort despite our ambition or determination, you can come to quickly appreciate Dr. Noakes proposition.

Now begs the question: How can we cause our bodies to adapt to greater intensity and faster finish times without breaking down or being limited by fatigue?

Before I begin with an in-depth explanation of my approach to lactate tolerance training, I want to preface this next segment by saying: The most effective way to encourage an increase in your aerobic potential is to train aerobically. Aerobic training holds a dominant influence over your ability to move your metabolic threshold “AT” up into higher intensities than almost anything else you can do. On the other hand, the shorter the event the more critical it is to adapt to an anaerobic environment. Because the focus of this article is to share this latter influence, this is where I will focus on causation.

WHAT WE KNOW SO FAR:

- Aerobic training improves our endurance and the energy source (fat) is almost limitless.
- There is a limit to the amount of work we can perform when we are anaerobic.
- The greater the intensity, the sooner the acidic effect of lactic acid will hamper our ability to perform.
- The Central Nervous is believed to be the culprit behind our perception of fatigue.

My best analogy for training anaerobically is like getting a FLU shot. An inoculation which is no more than a low dose of the virus you hope to become immune to. Lactate tolerance is much like trying to develop our immunity to this potentially toxic substance. Yet, with proper training, we can turn this potential stumbling block to our performance into an incredible ally.
To look at this analogy with a bit of humor, if you are concerned about contracting the flu, having a double dose of the flu shot will actually give you the flu, not safeguard you from it.

Given what I said in the last paragraph, the key to developing a greater resistance to fatigue or the debilitating effects of lactic acid is to expose yourself to this environment carefully. Too great a dose too soon in training will not help you become immune to the toxic effect of over exposure to lactic acid. What it will do is shut you down.

The best immunity and “adaptation” to high rates of lactic acid production is achieved through progressive intervals. You want to tip toe over into the “Dark Side” and return to an aerobic, waste and heat liberating environment, keeping track of how well your body responds from each and every bout.

One of the most effective means of identifying progress is by monitoring your training heart rate.

Keep in mind that a heart is nothing more than a pump, that’s sole purpose is to deliver oxygen and nutrient rich blood to our working muscles and cycling the metabolic byproducts of energy combustion and heat away from the working muscles. When this work is done, the heart rate (pumping action) retires to a more rested state. The hallmark of an efficient cardiovascular system is powerful cardiac output (delivery) and an extensive network of arterial and venous (reception and evacuation) throughout our working muscles.

HERE ARE THE STEPS TO TRAINING THE DARK SIDE:

First, you must identify your Anaerobic Threshold in order to effectively produce the correct intensities. In the absence of a clinical test, I suggest you subtract your age from 180 and add 10 bpm and use this number for your threshold.

(Refer to the graphs on the final page of this text for details of heart rate intensity vs. recovery)

You need benchmarks to quantify your progress. To do this, perform some periodic time trials set at your threshold heart rate. In the beginning, a 1 mile time trial is a good place to start. Run 1 mile without exceeding your threshold heart rate while staying as close to it as possible. Log your results and save them for future comparison.

I further suggest performing a follow up time trial at progressive distances, 5k, 10k and as much as 20k (depending on the distance event you are training for) at the conclusion of each phase of training. Again, the first time trial (1 mile) conducted as first order of business, than a follow up 1 mile at the end of phase one, a 5k at the beginning of phase two and 10k at the beginning of phase three and a 20k at the end of phase three. Each time trial tells a tale.

If you are improving, the time to completion will drop. Keep in mind the intervals are constructed in such a way that you will begin to realize what you are capable of at the varying distances from a standpoint of sustainable intensity. It is important that while training you mimic the feeding and hydration strategies you would follow while racing. If you feed and hydrate well while training and don’t follow this practice while racing, you are not going to perform as well as you had hoped.

PHASE ONE

THE FIRST 3 WEEKS - the focus of phase one is to power up your VO2 max and get your pump working optimally. These efforts are not going to be easy, if you have any per-existing health concerns, you need to be cleared by your doctor before
attempting this workout. Your intervals will be governed by your LOW INTENSITY recovery heart rate (see graph). If you find it difficult to recover within 2 minutes after the first 2 weeks, use your MODERATE INTENSITY recovery heart rate.

Perform 30 second repeats on a relatively steep incline about 8% grade; If you are forced up onto your toes without your heels touching down, the grade is too steep. Run at a pace that is near max effort yet sustainable for the 30 second repeats.

A treadmill is best for this exercise. With a treadmill you can simply jump to the outside rails of the treadmill at the conclusion of each repetition. Wait there or walk away until your heart rate recovers to the target recovery rate. If you are performing these drills outdoors, use the same training hill each time you do these intervals and walk down the hill, don’t run. In either case, repeat the repetitions as many times as you can within 45 minutes.

Perform these intervals every other day for 3 training sessions per week followed by an aerobic steady state workout on the opposing days for anywhere between 60 and 90 minutes, dependent upon your fitness.

You must record your training with a heart monitor (and GPS for outdoor applications) while downloading your workouts for later recall. With time you will notice that the recovery times grow shorter and the intensity during the reps will become more aggressive. That’s a good sign. Do not exceed the 30 second work time. Doing so will have contrary influences.

Follow this training paradigm for 2-3 weeks. (Longer if you are not seeing results and or you have missed sessions.) If the 45 minutes is too strenuous, cut it to 30 minutes until you can complete 45. Perform a 1 mile Time Trial at the beginning and end of this phase.

The outcome will be an increase in your VO2max and improvements in your recovery times.

PHASE TWO

Perform a 5k time trial at your aerobic threshold heart rate. Recall, in the absence of a test, subtract your age from 180 and add 10 bpm. Warm up-run until you achieve your target heart rate and begin tracking the time it takes to accomplish 5k, record the result.

The next 3-5 weeks
In the first phase of training your work to recovery ratio was set to about 1 to 3 (work time 30 seconds and average recovery 90 seconds). The intensity was high and short in duration, the recovery was low and long in duration. These efforts were seperated with long duration aerobic runs to further condition your aerobic pathways.

Now the intensity is not as great but the time at work is extended and the recovery is near equal duration and moderate.

In PHASE TWO the recovery is shorter, 1-1 (90 seconds work- 90 seconds recovery). The same schedule applies (M, W, F- Intervals, T, TH, Sat, Aerobic base runs).

In order to gain the most benefit from this training, heart rate is the most effective indicator of intensity and recovery. Pay close attention to the metrics you collect from your workouts. What you should be looking for is the relative pace to heart rate improvements during the work phase of the intervals and how quickly you are able to bring your heart rate back to a recovery state. Early on, you may not be capable of recovering to the prescribed “AR” heart rate. In which case, I recommend waiting until you do. As you progress over the coming weeks, you will find your recovery times dropping. All of these markers point to your progress.
At this juncture I think it’s important to point out that in the absence of your ability to track heart rate (you simply don’t own a monitor) I am referring to time lines of work/recovery.

At the conclusion of this phase, perform another 5k time trial.

**PHASE THREE**

The next 5-7 weeks
In PHASE THREE, we now shorten the duration and increase intensity while further decreasing recovery. The work to recovery ratio is now 2 to 1 (60 seconds at high intensity, 30 seconds at high AR recovery). This is as extensive an exposure to lactic acid production I recommend for the first cycle of the phase progressions. The aerobic base component of this phase is shorter (60 minutes vs. 60-90 minutes) due to the increased intensity of the intervals. It may be prudent to cut the interval sessions to only 2 sessions per week initially if undue soreness exists. It is better to sacrifice a day of intervals than it is to sacrifice the aerobic bas runs. Depending on your race goals, you may wish to check your endurance by performing another time trial, this time at 10k or even 20k. I would even recommend some race pace time trials to check your race capacity to build confidence.

At the conclusion of these three phases you will have gained a far greater capacity to function above your anaerobic threshold. Your metabolic system will have been adapted to process a greater share of the lactate produced into usable energy. You should also have improved your resistance to the toxic effects of lactic acid build up which will provide you with greater capacity to sustain race pace.

**Your training, like everything in life is cyclical. We cannot continue to press harder and harder without facing eminent failure.**

Our training plans should undulate in a progressive/regressive fashion. At the end of these 3 phases, it may be a good idea to take a week off from running, allow your body to repair and begin again. For those who have a hard time taking time off, think in terms of active recovery, try running aerobically for an hour every other day for a week or two before beginning your LT workouts again. When you do return to your second cycle “Phase One” you should notice your peak velocities are far greater than they were initially, as will be your recovery rates.

Information is power! As I suggested earlier, it is critical that you collect the data from your efforts so that post workouts; from day to day, time trial to time trial and phase to phase, you are able to see the trends in your adaptations. You will become intuitive in respect to how much time you need in each phase to encourage even greater improvements in your training and racing. Training “The Dark Side” is best suited for high intensity events where it is nearly impossible to rely on fat utilization for energy as is the case in longer events such a marathon.

Consider this warning: if you approach this training with the hope of improving your marathon times, it is quite likely you will end up running too hard for the first few hours and suffer for the final miles of your race.

Obstacle Racing is a perfect example of where this type of training program is best suited. If you follow these guidelines while running as an adjunct to your typical strength workouts, I predict you will greatly improve your finish times.

Richard Diaz is the founder of diaz human performance LLC. He has over 18 years of clinical experience and field testing of endurance athletes from novice to world class professionals. He is available for coaching both online or by appointment to conduct VO2 max tests, gait analysis and correction. visit [www.diazhumanperformance.com](http://www.diazhumanperformance.com)
Establish your threshold: subtract your age from 180, add 10 bpm.

**Lactate Tolerance**
- High Intensity - add 25
- Moderate Intensity - add 20
- Low Intensity - add 10

**Threshold**
- High Intensity - minus 0
- Moderate Intensity - minus 5
- Low Intensity - minus 10