

TRAINING FOR THE LACTATE DYNAMICS

One of the main problems we have to face training middle and long distance runners is about the “Lactate Training”.

We know that lactate can produce new energy, but at the same time becomes a limiting factor looking at the duration of the effort.

Many believe that lactate only forms when you run “out of the oxygen”, and this happens when a fast sprint becomes long, increasing lactate accumulation in the muscle fibers.

Also, many believe that the soreness athletes have the day after a hard training session is caused by lactic acid, and for all these reasons lactic acid in the body is very bad situation.

We can divide coaches in two big branches : the “Aerobic Coaches”, working with long distance runners, who many times look at lactate as an enemy, and the “Anaerobic Coaches”, working with specialists of middle distances (mainly 800m), looking at lactic training as the best way for increasing the performances of their athletes, but thinking a good aerobic level is useless.

Now it's time to understand that the reality is very different.

The old belief, at the base of the methodology for training long distances, that lactic acid was an “enemy”, are now considered to be myths and unfounded. In fact, lactate is not produced just when the body runs “out of oxygen”, but always, in little quantity, for the simple fact we are alive.

When we speak about “lactic acid”, however, we speak about something which doesn't exist in the body, since it splits up, into a “lactate bit” and an “acid bit”.

The LACTATE BIT is a positive and central player in our metabolism, and in how we produce energy. Therefore, we can understand why, in the past, the classic “interval training” worked well for short distances, but not in the same way for long distances, where the aerobic component is more effective.

One thing we have to know is that every measure of lactate we can do, after a test, with our athletes, doesn't represent the ability to “produce” lactate, but the level of “accumulation in the blood”, since lactate has the capacity to be both introduced and removed from the blood.

In 1986, this dynamic movement of lactate around the body and its potential to actually produce more energy in the muscle was given the term “THE LACTATE SHUTTLE” by the American Physiologist, Dr. George Brooks.

But the transfer of these principles to the training became effective only with the explosion of East African athletes, Kenyan and Ethiopian, in long distances, something happening after 1990.

Without having real acculturated coaches, and sometimes training without any training plan, there was, however, a common denominator : the fluctuation of running rhythms.

In 1994, Peter Thompson, coach of many European and American athletes of top level in long distances on track, introduced the term “LACTATE DYNAMICS TRAINING”, to specifically classify the training for the lactate shuttle, the dynamic utilization and clearance of lactate so that lactate is optimally used around the body.

Lactate dynamics training is any form of training where lactate production is increased by the intensity of exercise and then alternated with periods of less intense activity. In this way, the muscle fibers learn how to both use and clear the produced lactate during the less intense recoveries.

The classic “Fartlek”, used by Swedish in the 40th, can be considered a system for training the Lactate Dynamics.

However, the execution was limited to short variations, with little influence on the performances for longer distances (5000m – Marathon). Instead, the current Lactate Dynamics Training is at the base of the improvement in long distances, including marathon, because today we use long intervals, and a fast pace during the recovery periods.

We need to look at what happens in our body, when we increase the running speed.

There is a point, in increasing intensity of running, where individuals may show a rapid increase in the levels of blood lactate. This turning point is referred to as the Onset of Blood Lactate Accumulation (OBLA using the English terminology). The OBLA implies that the dynamic equilibrium which can exist between lactate addition to the blood, and removal from it, has been upset.

“Intense exercise generates big lactate loads, and the body adapts by building up mitochondria to clear lactic acid quickly. If you use it up [as an energy source], it doesn’t accumulate” (George Brooks, UCB press release, 2006).

FROM PHYSIOLOGY TO PRACTICAL TRAINING

In the old methodology, we found two definitions only for training in the lactic zone :

- Lactic Power (LP) (expression of the power of the lactic system, that is the ability to produce the higher quantity of lactate in a determined period of time. As formula, we can say : $\text{Time of the maximal effort} / \text{produced quantity of lactate} = \text{LP}$)
- Lactic Capacity (LC) (how much lactate we are able to produce).

How it's possible to see, in the classic methodology there was not any consideration for the ability to remove lactate.

This produced big mistakes in the training methodology, specifically in the most "scientific" Countries, such as US, Russia, and many other European Nations.

Together with the growing of African runners, we can find a decrease in the quality of European and American runners, because the general new idea was to cut, dramatically, the volume and the intensity of the aerobic training, looking at the increase of intensity in the lactic area, with little volume.

The decline of American and European long distance runners mainly depends on this technical choice.

If we think that, 30 years ago, UK could produce in 1500m athletes under or around 3'30" such as Steve Cram, Sebastian Coe and Steve Ovett, and today (Mo Farah apart), nobody is able to run under 3'36" ; Portugal had athletes as Carlos Lopes and Fernando Mamede, running WR in 10000m in 27'12" and winning OG in Marathon, and today the best specialist is not able to run under 28'30" ; that in the European Championships in Prague (1078, 37 years ago), the 9th classified in 10000m ran 27'41" ; that today the best Russian athlete in 5000m and 10000m (Rybakov) runs 13'35" (such as Vladimir Kuts 58 years ago) and 28'22" (Pyotr Bolotinikov ran 28'18" in 1962...), we well understand that the "new way" of training produced wrong effects.

The main question is : "Knowing that lactate can be partially used as energy, but at the same time its accumulation in the muscle fibers reduces the biomechanical possibility to work, what we have to do in order to use the benefits and reduce the limiting factor ?".

It's clear that the priority is to INCREASE THE ABILITY TO REMOVE LACTATE FROM THE MUSCLE FIBERS. If we can remove lactate more quickly, we can tolerate a higher accumulation, and of course we can produce more lactate without limiting the action of the muscles.

This means that now we add a third definition to the training in the lactic zone :

- Lactic Resistance (or Tolerance) (how much lactate we are able to tolerate maintaining a good level of exercise)

We can see how all the physiological actions are connected, and depends one from another :

- 1- Athletes need to increase the ability to produce lactate, because, in theory, more lactate = more energy
- 2- Athletes need to increase the ability to remove lactate very quickly, because fastest they are able to remove lactate, more lactate they can use in the same period of time, so they can have the disposal of more energy
- 3- Athletes need to become able to tolerate more quantity of lactate, because, due to a faster removal from the fibers, the same quantity of lactate that before went to create a defined level of accumulation, now is equivalent to a lower level.

For reaching the above goals, it's very important to understand one essential point :

Faster is the test, slower and longer is the recovery. This means that we rarely use running during recovery among very fast lactic tests, while we use to run at good intensity preparing long distances.

In this case, we speak of "Floating" during the recovery. Floating means the ability to maintain a good speed, drastically reducing the voluntary action, becoming able to use the force of inertia previously accumulated.

Float recoveries improve your ability to transport waste products from the cell (lactate, hydrogen ions, etc.), enhance efficiency at rate pace, and prepare the athlete for specific demands of competitions. In this way, athletes work for improving their body's "lactate shuttle system" from cell to bloodstream with each repetition.

The cell becomes somewhat saturated with lactate during the fast running segments and is then forced to remove the waste during the float recovery.

This training, which has the physiological target to increase the permeability of the cell membrane, favoring the ability to remove lactate faster, is quite challenging at first, and it will take a few workouts to keep from panicking mid-run and slowing either the fast rep or recovery interval (or both).

DESIGNING A LACTATE DYNAMICS TRAINING (LDT) SESSION

Like any repetition-based workout, lactate dynamics must follow several rules and include a few standard variables to be effective. Once established, these variables can be manipulated to suit your needs and goals any way you like.

Which are the variables we have to look for ?

- 1- Global workout volume
- 2- Workout purpose
- 3- Speed and duration of Fast segments
- 4- Speed and duration of Float segments
- 5- Recovery time between lactic sets
- 6- How often to use a LDT session

THE COMPLETE TRAINING PHYLOSOPHY

FOR MIDDLE AND LONG DISTANCES

How explained above, it's not possible to look at one part of training only, since every type of training **MUST** be connected with the others, in order to produce results.

Remember that a good training has to be not only hard, but essentially **SMART**. We have many athletes training hard, but they are not able to improve because their training is not smart. Training smart means training hard, too, but training hard doesn't mean always training smart.

For that reason, we need to look at the complete training philosophy.

We can classify the type of training we have to use in very simple way, looking at the speed, the duration and the goals :

- **REGENERATION**, with the goal to better and faster recover the real training
- **FUNDAMENTAL**, having the goal to create the aerobic base for putting in training workouts of higher intensity
- **SPECIAL**, being the direct support of the Specific Training
- **SPECIFIC**, which has direct influence on the performance.

HOW IS IT POSSIBLE TO BETTER SUPPORT THE SPECIFIC TRAINING ?

REGENERATION TRAINING

Regeneration has the goal to better and faster recover the effects of fatigue after tough training.

If the normal basic level of lactate in athletes and normal people is 1.2 / 1.5 mmol/l, after a hard workout (especially in the lactic zone) the level remains higher for 2-3 days, if the athlete goes to rest. Instead, after an **EASY RUN**, he's able to remove the residual lactate, and his lactic level can decrease under 1.0 mmol/l, with a feeling of wellbeing.

For every event, we have different speeds of **REGENERATION**, but normally the right speed is about 60-70% of the speed of **OBLA**. For example, in the case of a marathon runner with OBLA of 2'48" per km, we can speak of Regeneration when he runs slower than 3'40" / 3'45". In this case, 3'45" or 5' per km have the same effect, but many times running too slowly provokes mechanical problems.

Instead, for a good 800m runner (1'44") coming from shorter distances (400m), having OBLA of 18 km/h (3'20" per km), Regeneration happens when running slower than 4'10" / 4'20" per km, but. Because the biomechanical difference between the speed of the race (13" every 100m) and the speed of regeneration is very wide, sometimes can be better to use other systems (pool, sauna or any other situation not involving wrong running technique).

FUNDAMENTAL TRAINING

We call it **BASIC AEROBIC TRAINING**. The goal is to create the right support, at organical and metabolic level, for every workout of higher intensity.

For achieving this goal, we use mainly **CONTINUE RUN**, at even pace or with some variable (easy variations of speed and/or progressive run).

It's possible to see in the slides examples regarding duration and speed of the Continue Run during the Fundamental Period, referred to the different distances, for men and women.

In order to understand the system of calculation of the percentages pointed out as an example, we explain how it works.

- a) We calculate the pace of the race (RP) for every 100m. For example, 1'44" for 800m is 14", and this value is 100% of the RP.

- b) We calculate the percentage of RP : for example, 10% is 1"4, 50% is 7".
- c) We add the time corresponding to the proposed percentage to the value of the RP, in case of slower pace, or subtract in case of faster pace. For example, if we speak of 80% of speed with reference to a RP of 3' per km (= 18" every 100m), the calculation is : $100\% (18'') + 20\% (3''6) = 21''6$ (80% of RP). If we speak of 110% of speed, the calculation is : $100\% (18'') - 10\% (1''8) = 16''2$ (110% of RP).

HOW TO INCREASE LACTATE DYNAMIC

When we have a good aerobic base, we can start to use special sessions for LDT.

For increasing the ability to remove lactate from the muscle fibers very quick, we have to use different philosophy according to the athlete's event.

When we speak of MIDDLE DISTANCES (800m – 1500m), the preferred system is to use SETS of test, not very long, alternating for every set speed of tests, and recovery times.

For example, this is a LDT for a 800m specialist with a PB of 1'44" :

3 x 300m in 42" (recovery 30") - Rest 3'
 3 x 300m in 40" (recovery 45") - Rest 3'
 3 x 300m in 38"5 (recovery 2') - Rest 4'
 3 x 300m in 37"5 (recovery 4') - Rest 6'
 1 x 300m Max Speed

Another system is to use sets of 3 different short distances (for example, 200m + 300m + 250m), with short recovery (less than 1 minute), with different level of the effort : for example, easy-hard-medium (in this case, 26" – 38" – 32"5).

But when we speak about short distances, the improvement of Lactate Dynamic is not the main goal, since it's very much more important to train the ability to recruit a high level of fast fibers when already there is a high percentage of lactate inside the muscle fibers.

This is the specific **STRENGTH ENDURANCE TRAINING**, and for a specialist of 800m becomes one of the most important type of workouts.

For example, the WR holder David Rudisha uses, sometimes, to carry out 4 repetitions of 500m built in the following way : first 200m under 25" (like in the race), 100m bounding very fast in about 16" – 17", and again 200m at the max possible speed, for a final time of 1'06" – 1'08". The 3rd 100m bounding, after 200m in 25" or faster, contributes to train the

ability to use maximal strength when already the athlete is in a lactic zone, and after 300m the lactate in the legs is very high. This means that, trying to run very fast the last 200m, we are in a situation very similar to the race, requiring the athlete to recruit all the possible fast fibers in order to develop speed when the lactate saturation is already very high.

When we look at longer distances, like 3000m steeple or 5000m, we prefer to use sets including different distances, normally the first longer, producing lactate accumulation, and the second shorter but very fast, for training the speed when already muscles are full of lactate.

For example, with Saaed Saif Shaheen, WR holder of 3000m steeple, we used sometimes couples of 1000m + 300m, for 4 times, with short recovery between the tests (2'), and long recovery among every couple (6'). The times average was 2'22" and 39", and this was also the system I used with Mo Farah during the period he was in training with my group (October 2009 – August 2010), with the difference that the first test was 1600m (his average : 4'08" and 39").

However, we can find the best improvement in the performances, using LDT, for long distances events, especially Marathon.

One of the reasons is that the higher level of lactate, reachable racing those distances, is very much lower than in middle distances events.

Another reason is that the period dedicated to train a Marathon, or a top competition of 10000m, is more "exclusive", and athletes preparing those events have time and concentration for long periods of training, that can allow to build the performance using a "mathematical approach".

For example, for preparing a Marathon with the modern system, we have two well identified speeds : the Marathon Speed or Marathon Pace (MP), and the speed of the recovery, normally about 85% of MP.

In this way, it's easy to create a progressive adaptation to the MP, both about rhythm and extension, always working with these two speeds.

If we want to prepare a Marathon at 3'20" per km with one woman (final goal 2:20'40"), we can start with 7 times 2 km in 6'40", alternated with 1 km in 4' (which is 80% MP).

Having time, the following step is to enhance the speed of the km of recovery, moving from 4' to 3'50" (85% MP), maintaining the same speed for the tests.

We can use a combination of many variables for building the specific marathon endurance looking at the final planned time :

- 1- Increasing the total volume, for example adding one or two tests of 2 km
- 2- Running longer tests at the same speed (for example, 2 km in 6'40" become 3 km in 10', then 4 km in 13'20", then 5 km in 16'40")
- 3- Running faster the recovery, till the percentage of 90% MP
- 4- Running long and mixed test, increasing the speed from 96% MP till 105% MP, such as 7 km + 6 km + 5 km + 4 km + 3 km + 2 km, for a total distance of 32 km (including the km of recovery), which can replace the normal long run.

INTERACTION BETWEEN VOLUME AND INTENSITY

In order to have a well balanced training system, it's important to understand the interaction between volume and intensity.

In the most part of cases, coaches, after few year of training, maintain with their athletes same volume, same tests, same recovery, only requesting to run faster.

This is not a correct approach. In fact, we need to combine, using a continuous manipulation, all the variables of training when we speak about running : length of tests, recovery time, speed and total volume.

We need to remember that during the first period of preparation, the **FUNDAMENTAL**, training must be connected with the **INTERNAL LOAD**, which is the level of effort used for doing it. If the training is productive, with the same "Internal Load" the objective level of performances becomes better, also if for the body there is not more effort.

This means that, following a correct training philosophy, the first step is to **EXTEND** the ability of any athlete to run longer distance at the same speed, at the same Internal Load, and when they achieve this goal, the ability running, faster than before, a shorter distance, is something usually happening.

Of course, this philosophy regards the **BIOENERGETIC** and **METABOLIC** side of the preparation : never we have to neglect the **BIOMECHANICAL** training, with the goal to increase strength, coordination and technique.

However, the main goal is always to increase the **SPECIFIC SPEED ENDURANCE**, in order to run faster.

The development of a career goes through the increase of the **VOLUME OF INTENSITY** :

not the volume of training at the same intensity , and not the grow of intensity maintaining the same volume.

We need to remember that the **SPECIFIC TRAINING** only has a direct influence on the performance, so **ALL THE NOT SPECIFIC TRAINING** (General and Fundamental) has the only goal to support what is specific.

We have, of course, several ways for increasing the Specific Endurance : every coach must be able to use what there is, and a magic system doesn't exist.

Athletes can be the best in the World thank to their talent and their proper training, but the talent of top champions of the same event is not superimposable.

Each top class athlete has some characteristics which make him different from the average, and his qualities found right development in his environment : so, if **Yuriy Borzakovskiy** can win Olympics after a long and winning indoor season, **David Rudisha** wins and runs WR without never competing in any indoor race.

Respecting the principle of **INDIVIDUALISATION** is one of the most difficult points for a coach, but it's also the only way for building athletes able to win the most important competitions.

RENATO CANOVA