Aerobic Training Development for Rugby

By Frederick Claro

Aerobic endurance (where the energy necessary for muscular contraction relies on an oxidative metabolism as opposed to anaerobic, where the energy is produced without the presence of oxygen) is the foundation of most sports. Why, because as soon as a physical effort is lasting more than roughly a minute, the aerobic pathway will steadily take over the energy production for the contracting muscles. Very few sport activities are 100% anaerobic (effort produced without the need for oxygen), and these sports are explosive and not lasting more than a few seconds such as Olympic weight lifting, diving, and some track & field disciplines like the 100m sprint, and most throwing disciplines. Even though these sports are purely from an alactic built range of efforts, some good aerobic capacity will help these athletes to recover faster between bouts and between training sessions.

All team sports heavily rely on a strong aerobic base for the players to perform at their optimum potential. In most instances, team sports will proceed through bursts of high intensity muscular activity very specific to each of the sports, with the game being intermittently stopped mainly when the ball is out of play or players are requiring medical attention. Rugby is the typical example of a power sport played intermittently and where an increased level of fatigue will affect the players technically, tactically and psychologically. For those who still didn't really realize it: your "enemy" is not the opposition but…the fatigue induced by high intensity play, which being mostly anaerobically developed will leave muscles and blood flooded with excess lactic acid, the inevitable byproduct of prolonged and/or repetitive anaerobic efforts.

As mentioned in another fact sheet in this section about endurance training, rugby players must be able to sustain repetitively during 80 minutes, bouts of sub-maximal and maximal intensity efforts. If anaerobic endurance is paramount, aerobic endurance will help players to last the full game in minimizing the negative effects of fatigue as it is known that all factor being equal, the last experiencing the least fatigue specifically at the end of the game, has the greater chances of winning the game…

If we categorize rugby through the "work it physiologically generates" or its ergo-genesis in an 80 minutes format, we find that motion analysis studies have shown rugby to be:

- 60% aerobic
- 30% anaerobic lactic
- 10% anaerobic alactic

In extensio a high aerobic endurance will:

- Help players repay the oxygen debt which occurred after high intensity efforts during resting times

- Help players to recover quicker during shorter recovery time through an increased volume of O2 brought to the blood and the muscles' cells
- Help players to recover faster between training session and games

How do players develop their aerobic capacity?

By training smartly to increase their maximum O2 uptake also called VO2max. It is expressed in ml/kg/min (milliliters of O2 per kg of body weight and per minute). It is a very good idea for a player or a coach to know individual VO2max as it will help as a reference to develop it further. A normal, non trained male adult has a VO2max between 36 and 40 ml/kg/min. It is considered today that rugby players should have a VO2max comprised between 56 and 60 ml/kg/min or more. Some differences being made between the different players' positions as the physiological demand of the game will be different for a prop, a flanker or a winger.

It is generally admitted that the best way to develop VO2max is through interval training, but when looking into the procedures of these commonly standardized training where athletes/players are asked to run specific distances a certain amount of time with a set rest interval, it is obvious that these training protocols lack one of the most important variable to take into consideration: individualization, or to be player specific in training development. To avoid any confusion, we must state that rugby players need to develop specifically their VO2max and not their Lactate Threshold (LT) running capacity, which would be more typical of endurance athletes. Most of the action time in rugby will induce either beyond LT running bouts through repetition (where lactic acid will accumulate) or will involve pure strength/power alactic bouts such in rucks/mauls and ball contest in the tackle area. In the light of these elements, players need to develop their VO2max through quality, personalized interval bouts run at maximum velocity sustainable at VO2max. How?

The very first step would be to assess and estimate the player's actual VO2max, which will be the base for further development. This can of course be done with accuracy in a laboratory but could be costly and logistically unpractical if the facilities are not nearby. Self assessment of VO2max can still be made accurately through tests such as the test of Luc Leger (1984), or the Cooper test (originally designed in 1961 and tested in the USAF). Tests protocols are as follow:

- Leger formula for VO2max calculation: For rugby purposes, the distance of 3,000m will be the most convenient and realistic for testing. After a good warm up, players run 3,000m on a track all out. Players must finish the run exhausted. Time is recorded per individual. By dividing the distance in meters by the time converted in second, the vVO2max or velocity at VO2max of each individual will be determined (in m/s) on that particular run, multiply then the result by 3,600 and we obtain the vVO2max of the player in km/h. From there the formula goes as follows: VO2max (ml/kg/min) = 3,5 x vVO2max (km/h)

Let's take an example: A player is running 3,000m in 12min10sec or 730sec, his/her velocity is: 3,000 / 730 = 4.10m/s → vVO2max = 4.10 x 3,600 = 14.76 km/h
From there his / her VO2max = 3.5 x 14.76 = 51.66 ml/kg/min

- The Cooper test involves players to run on a track as far as they can during 12 minutes. Formula to calculate VO2max from the test is:
  VO2max = 22.351d – 11.288
  Where d is the distance run in km
  Let's take again our above example: the player run say 3km in 12 min
  → VO2max = (22.351 x 3) – 11.288 = 55.76 ml/kg/min

As we can see there is a difference between the two, mainly due to the fact that the coefficient used by Leger takes into account more physiological parameters than the Cooper formula, and is therefore probably more accurate.

One important consideration must be brought to view here: Any one who already tried to run as far as possible, all out for 12 minutes will agree that it is merely impossible and that indeed VO2max will not be triggered constantly during the run and therefore there might be an underestimation of the real VO2max and vVO2max. This was taken as the basis for the work of world endurance expert Professor Veronique Billat from the University of Lille in France in 1994 through 1998. After numerous studies and field tests, she determined following the work of Astrand and Rodhal (1986) that trained athletes will be able to sustain an average of 6 minutes maximum time running at vVO2max. She then induced the check on vVO2max on a 6 minutes (360 seconds) test rather than the too long 12 minutes where runners will not achieve VO2max 50% of the time. From there her research has shown that the actual running at vVO2max was the best way to develop VO2max in trained athletes, and that one session of interval training based on individual vVO2max per week was enough to increase the vVO2max and therefore the VO2max significantly in just 4 weeks (Billat, 1998).

Based on the work of Professor Billat, and considering the fact that training for intervals at vVO2max will be beyond LT training and develop VO2max, it is definitively an asset to develop VO2max for rugby players, using individualization and high intensity bouts customized for each player.

Protocol for Billat training sessions:

- Each player runs all out for 6 minutes on a track, distance is recorded
- Divide distance by 360 to get the speed
- Multiply result by 3600 to get vVO2max in km/h

Let's take an example: a player is running 1,650m in 6 minutes, what is his/her vVO2max?

vVO2max = 1,650m / 360s = 4.58m/s x 3,600 = 16.49 km/h
This will be the minimum speed inducing a maximum O2 intake with the player.

From there interval sessions will be elaborated as follows:

- 30-30: 30s run at vVO2max and 30s recovery at 50% vVO2max

From our previous example: 4.58m/s x 30s = 137m in 30s with 68m recovery run in 30s. Player runs this pattern until he/she can't complete it any longer (being 5m from the mark twice in a row on the vVO2max bout)
Once the player is familiar and has adapted to this 30-30, he/she can move to:

- 60-60: same protocol but based on 60s
- Once easy on this and used on interval training, player can move to a longer interval pattern: 5 x 3 min at vVO2max with 3min recovery at 50% vVO2max

From our previous example: vVO2max = 4.58m/s x 180s = 824m in 3 minutes with 422m in 3 minutes recovery run. Once it becomes easy, keep the bouts unchanged, don't increase, but decrease the recovery time to 2min30s and then 2min.

Advantage of the method:

- It is 100% individualized as no one runs at the same speed
- It maximizes the time spend to run at actual vVO2max
- It is easy to re-assess the process. Players must do so every 4 weeks, retest on a 6 min run, which should show an improvement as the player should run further, recalculate vVO2max and adapt the intervals to the new developed vVO2max
- It can easily apply for cross-training activities, such as biking, swimming or rowing

Training frequency: 1 to 2 sessions per week.

I believe this is the best protocol to noticeably develop players VO2max. Retest players on a new 3,000m at the end of the aerobic endurance development phase and each player or coaches will recalculate his/her the new VO2max.

What about the traditional long steady runs? These are ok during the Transition and early Preparatory phases to burn excess fat for weight control and maintain the blood vessels network necessary to bring O2 to the muscles when needed. It is now widely admitted that long slow runs don't have much to do with the specificity of rugby.

Aerobic endurance is also developed through team and units technical and tactical sessions arranged to tax the aerobic system primarily and preferably in alternation with anaerobic training.

Keep your training sessions smart and sharp for best results!

References: "Physiologie et Methodologie de l'Entrainement", V. Billat, DeBoeck ed, 2003