Exercise Associated Chronic Fatigue:
The little-understood condition of '*Lactic Acid Poisoning*'

Overview

Fatigue associated symptoms present extremely frequently in many individuals. This article addresses a little-understood cause associated with a physiological imbalance in 'lactic acid' metabolism. It originates primarily from the pursuit of a *disproportionate* amount of 'higher-intensity' exercise, usually over a sustained period of time.

The phenomenon or syndrome is here termed "Lactic Acid Poisoning" or "Anaerobic Shift". In spite of its apparent prevalence, the syndrome has received little attention in the medical literature to date.

The condition may also be affected by suboptimal nutrition, but that is beyond the scope of this article. Affected individuals may exhibit a number of signs and may experience several symptoms that are elaborated below.

"Lactic Acid Poisoning" may affect anyone at any age and is often more pronounced in individuals who have a limited history of 'aerobic' fitness development.

The syndrome may be redressed by appropriate remedial intervention, which is usually individual and case-specific. In most cases this typically involves shifting to a program of higher volumes of 'lower-intensity' exercise.

Exercise Intensity

For the purpose of this discussion the level of exercise 'intensity' reflects the perception of an individual as to how *hard* they feel they are working during exercise. For example, 'low-intensity' exercise should generally feel 'easy' to complete and is usually sustainable for long durations. 'High-intensity' exercise should feel 'hard' to complete and is not usually readily sustainable over long periods.

The actual 'intensity' level during 'low-intensity' exercise will vary with an individual's fitness level. For example, for relatively 'unfit' individuals this may mean walking, while for fitter individuals it may mean jogging or even running (or other commensurate exercise equivalents).

Heavy weight-training almost invariably involves 'high-intensity' exercise. Likewise, activities such as sprinting or many sporting pursuits such as racket sports, martial arts or boxing also usually involve 'high-intensity'.

This article is particularly concerned with the *balance* between the two intensity extremes.

Balanced 'Lactic-Acid' Metabolism

We need some background on energy-producing systems before describing the implications of 'sub-optimal lactic-acid metabolism'.

Energy is produced principally via two pathways, namely 'aerobic' and 'anaerobic' metabolism:

- 'Aerobic' metabolism (requiring oxygen) is the primary mechanism that we use during gentle ('low-intensity') forms of exercise and in resting states.

- 'Anaerobic' metabolism refers to energy production that occurs more predominantly during much harder exertion. It is principally activated in the 'absence of oxygen', a 'debt' that occurs naturally when we exercise with 'high-intensity'. 'Lactic acid' is a metabolic by-product of 'anaerobic' metabolism, usually produced under 'high-intensity' exercise.

- On a relative scale, much more energy can be produced 'aerobically' than 'anaerobically'.

- Both systems co-exist and are active to differing extents at any given time, including resting states; the relative contribution of each differs however as we move from periods of 'gentle' to 'intense' exertion.

- Optimum levels of lactic acid (produced in the *anaerobic* process) are extremely important for cellular function and energy:

    - With 'healthy' metabolism, 'gentle' forms of exertion usually produce lactic acid at, or below, the rate that it can be removed from the blood.

    - Conversely, much harder exercise intensities result in lactic acid accumulating at a much faster rate than the body can clear. The phenomenon known as 'lactic acidosis' ensues. Thereafter capacity to sustain 'hard' exercise continuously is limited (although this is a grossly simplified account).

    - Healthy 'balance' between the production and clearance of lactic acid as a function of increasing exercise intensity provides optimum conditions for ideal energy production.

    - Unfavourable disruption to this 'balance' can be very deleterious to general energy levels and overall health. It is this scenario that drives the syndrome of 'lactic acid poisoning'.

Visual Representation

- The effect of 'Lactic acid poisoning' can be illustrated by reference to the graphs in Figures 1 and 2, where 'lactic acid' (or 'Lactate') concentrations (*y* axis) are plotted against the exercise 'intensity' level on the *x* axis (from very low through to extremely high). These graphs are intended for illustration and are not taken from specific cases.

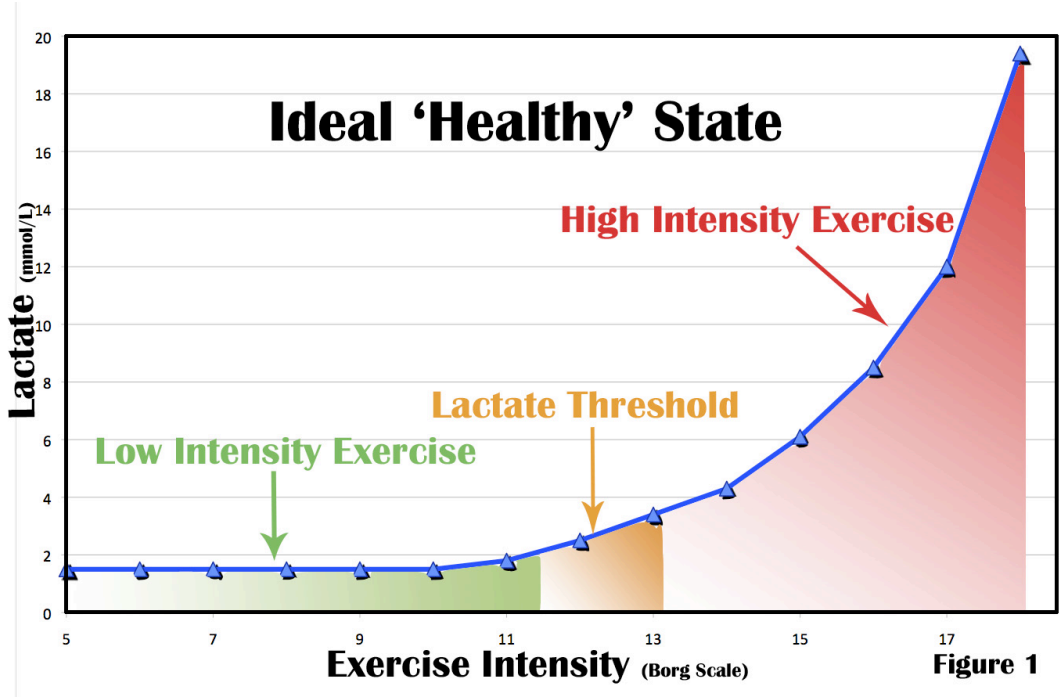

Figure 1

- In an 'ideal' state (Figure 1) low levels of Lactic acid are produced at low exercise intensities and these increase first gradually, then very sharply in medium to high intensity exercise states. Note the units of intensity in the chart are arbitrary, but loosely refer to the 'Borg Scale' of *perceived exercise exertion*, which we have modified a little to include values from 1-20 reflecting sedentary states through to maximal exertion.

- At given point, known as the 'Lactate threshold', lactic acid begins to accumulate faster than the body can clear. This point appears just beyond 'baseline' (flat and low part of graph) readings, where the rate of increase significantly rises.

- Relatively high levels of Lactic acid (well beyond the 'Lactate threshold') are better 'tolerated' in healthily developed 'aerobic' systems as the 'aerobic' system 'buffers' lactic acid. The precise level will depend on many factors including genetic propensity and age.

- In an 'unhealthy' state (Figure 2) there is an 'anaerobic shift' in Lactic acid concentrations against increasing exercise intensity (see causes below). In this state Lactic acid levels can be relatively high, even at low intensities of exercise or movement. The rate of increase in lactic acid concentration is much greater, at a much earlier point, than that in the 'healthy' state, and the body finds it difficult to clear lactic acid effectively. This is the essence of 'lactic acid poisoning'.

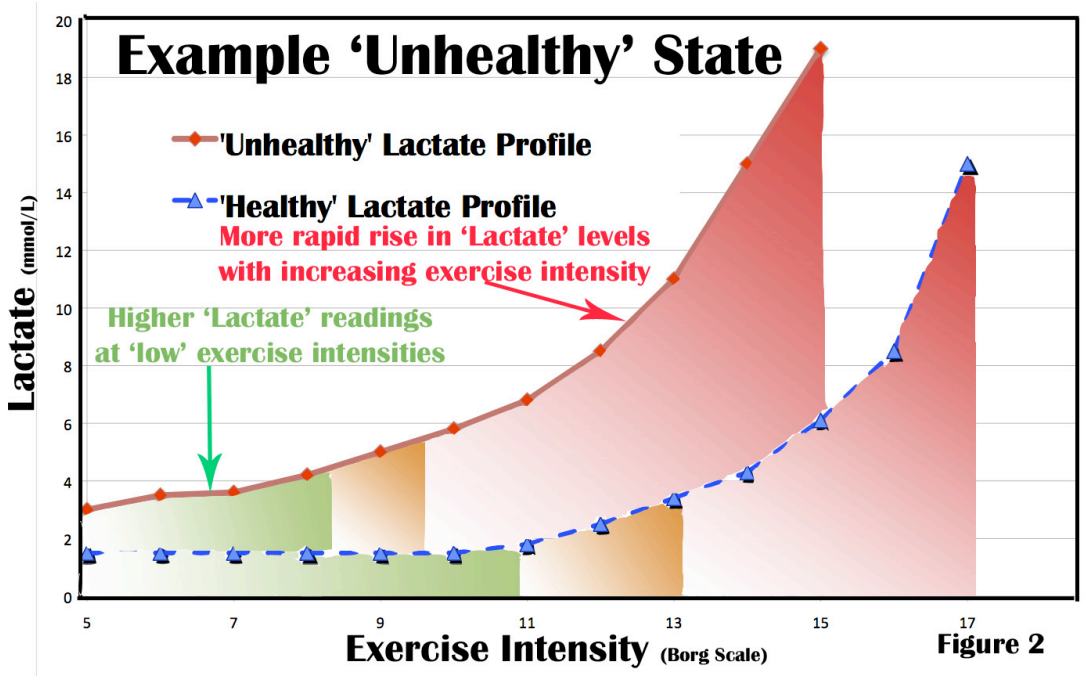

Figure 2

Causes of 'Lactic Acid Poisoning'

- The principle cause appears to be the pursuit of a *disproportionately* excessive amount of 'high' relative to 'low intensity exercise, where the net result is the overdevelopment of the 'anaerobic' energy system versus 'aerobic' capacity, i.e. there has been an 'anaerobic shift'.
    - This can occur in all individuals irrespective of background, including *extremely fit* athletes.
- In such instances, the 'aerobic' system is usually not properly developed, or has not been well enough *maintained*.
- Fortunately the 'aerobic', more so than the 'anaerobic', system has much more propensity to be improved or repaired *but this can take a considerable period of time*. Usually genetic predisposition more limits the development of the 'anaerobic' system.
- 'Anaerobic shift' ('lactic acid poisoning') usually happens following very *extended* periods of 'high-intensity' training. Depending on the individual this can vary from several weeks to many months; i.e. it does not happen in one week!
- The problem lies not solely in the amount of 'high-intensity' exercise pursued but in that there has been an insufficient amount of 'low-intensity' exercise to yield favourable physiological balancing.
- The situation can be illustrated by a few examples:

1. The 'anaerobic' system will usually peak at a relatively *earlier* age in individuals performing extremely 'high-intensity' pursuits over a short duration (e.g. sprint to middle-distance track athletes). Like fast cars, the anaerobic energy system cannot be thrashed forever!

    - In individuals who are not genetically or naturally suited to this 'high-intensity' activity, 'overtraining' of this anaerobic system can easily induce an 'anaerobic shift'. Here, unacceptably high levels of lactic acid begin to accumulate at resting and gentle exertion states.

2. The 'aerobic' system usually peaks at a much later age than the 'anaerobic'. Many *elite* marathon runners don't peak until well into their thirties.

    - This is a succinct illustration of the time needed to properly develop 'aerobic' capacity. Rushed 'aerobic' development limits performance, and can cause many physiological problems.

    - While the above illustrations refer to athletes, ordinary exercising individuals should be acutely aware that the principles are equally and more so applicable to them. While exercise can generally be considered as healthy, this only prevails when it is *healthily pursued*.

Possible causes for our increased observation of 'anaerobic shift' patterns:*

- Over several decades there has been a radical shift in the pursuit of activities that heretofore promoted 'aerobic' development. Nowadays activities such as walking, physical education, and recreational sport frequently give way to more sedentary pursuits. E.g. driving rather than walking *even short distances* and spending long hours in front of computer screens and televisions. This has especially impacted children where previously *normal physical activity* provided a perfect foundation for 'aerobic' development.

- Experience, and educated wisdom, suggests that an 'aerobic' system firmly established by the age of maturation stands the individual in good stead to buffer against, and to recover faster from, 'anaerobic shifts' caused by inappropriate training. *The importance of this point cannot be overstressed!*

- We thus find many of today's training programs for junior athletes to be inappropriate. If training programs *assume* an 'aerobic' system is established when it is not, then the propensity for deleterious shift patterns is high. A lack of 'aerobic' development may therefore significantly shorten the career length of an athlete.

- Even athletes from 'anaerobically' demanding sports ***must*** have good 'aerobic' development to serve as a base for their 'anaerobic' training. Good 'aerobic' development' gives such athletes the ability to absorb larger quantities of 'anaerobic' training and to recover quickly from one day to the next and from one game/competition to the next. This is especially critical in tournament situations where the athlete may have to compete several times in

one day. E.g. heats in the morning and finals at night. This point pivots on the need to tailor 'aerobic' development to the individual sport. Different sports have very different requirements (although this is beyond the scope of this article).

Signs and Symptoms

Individuals afflicted with an 'anaerobic shift' ('lactic acid poisoning') may exhibit various signs and experience a range of symptoms. The extent of these is very individual specific and may be linked to other factors.

Signs and symptoms can include:

- Lack of energy: feelings of fatigue at rest and/or after moderate exercise.
- Insomnia: including broken sleep and difficulty getting to sleep.
- Depression
- Failure to respond favourably to progressive exercise regimes
- Elevated resting and maximum heart rate
- Ectopic heart beats at rest (we have also seen more elaborated forms of 'arrhythmias' in some afflicted patients)
- Feelings of, or actual, nausea following intense exercise (this is *usually* never a healthy sign)
- Poor recovery capacity from high intensity exercise
- Propensity toward recurrent injury
- Relatively poor immunity
- Loss of motivation
- May experience difficulty in losing excessive body fat

Treatment

Experience indicates that the 'anaerobic shift' ('lactic acid poisoning') can usually be corrected by following a *balanced* program of restorative 'aerobic' exercise.

The corrective program is *individual and age specific* and is related to their current and past exercise history.

The severity of the 'anaerobic shift' can usually be readily seen from a 'Lactate Test' profile. Such Lactate profiles taken at various points in the restorative process show how quickly and how much the individual's 'aerobic' system is improving.

The restorative program can take weeks to (many) months to complete. The essence of remedial training is that the individual should follow a program where 'low-intensity' exercise constitutes, at first, about two-thirds to three-quarters of the total training program. Most of this 'low-intensity' exercise should be done at a 'perceived' level of exertion that feels at the upper end of 'gentle/easy' exercise. This will vary extensively for many individuals and may include purely walking based exercise for some, through to gentle jogging or even running based paces or equivalents. The intensity is much more important than the type of exercise, whether walking, cycling, swimming or running etc.

In some cases ongoing 'high-intensity' exercise just needs to be reduced in conjunction with increased volumes of low intensity exercise. The high-intensity work can usually be very gradually increased as the Lactate profile begins to improve.

Once (re)-established, the 'aerobic' capacity can be easily maintained by following a healthily balanced exercise regime. Some individuals may require a 'cyclical' approach (phase of aerobic 'maintenance' followed by aerobic 'development').

Whilst rest or 'calming' forms of exercise such as Yoga or T'ai Chi may alleviate stress, and are recommended in many ordinary fatigued states, they will in this instance generally not fix the problem of 'anaerobic shift' ('lactic acid poisoning'). The reason is that the intensity level is generally far too low for restoring diminished / damaged aerobic capacity.

High-Intensity Training – The Need for Balance:

High-intensity exercise has its place. It is not however the 'be-all and end-all'!

Many 'high-intensity' training studies have been published leading to advocation that 'high-intensity' work alone provides an Elysium of health. For example, some health practitioners advocate that a mere three minutes of high-intensity 'interval training' is better than, or can achieve the same benefits as, three-times twenty minutes moderate intensity exercise per week. Moreover there are a number of internet reports implying that all forms of 'aerobic' exercise may even be detrimental, claiming it causes an unfavourable shift in hormonal balance.

We consider this to be misguided and ultimately dangerous to health. In most instances, opinion is extrapolated beyond the bounds and scope of the original research. Most research is conducted over a finite and usually relatively short period and usually involves a limited cross-section study group (often involving 'untrained' college-aged males with limited history of 'aerobic' development). From our observations, taken across a wide cross-section of capabilities and over periods of months to years, 'anaerobic shift' usually takes extended times to develop. These times are generally longer than the aforementioned studies whereby the deleterious effect of 'anaerobic shift' has either not had enough time to manifest itself, or for the individual to be afflicted with the negative signs and symptoms.

Nonetheless, 'high-intensity' training can (and in most instances should) certainly have its place as part of a *balanced* exercise routine. The reader is directed to the excellent writings of Joel Jamieson for a more in-depth discussion of this subject.

The influence of 'aerobic' exercise on 'stress' hormones

'Cortisol' is a stress hormone released by the adrenal glands and is essential for survival. Too high a level causes undue hormonal stress and too low a level is implicated in *fatigue*. 'Cortisol' is released in a diurnal pattern where the 'high' levels of early morning ready the body for action and the 'low' levels at night prepare the body for sleep.

Reports that 'aerobic' exercise induces excessive and damaging 'cortisol' levels may be misleading. In our experience we have rarely seen high 'cortisol' levels expressed in individuals who have well developed, *and managed*, 'aerobic' systems. [Cortisol output monitored from saliva/urine samples taken over a 24-hour period]

Indeed, depressed levels of 'cortisol' in 'adrenally-*fatigued*' individuals may be redressed by appropriate 'aerobic' exercise, usually best performed in the early morning (daylight). A twenty-minute daily *easy* 'aerobic' exercise routine can greatly help achieve the correct balance for many individuals.

Summary:

'Aerobic' and 'anaerobic' energy systems exist in a continuum. It can be very easy to overdevelop the 'anaerobic' side at the expense of *healthy* 'aerobic' metabolism. This is usually a function of age and genetic propensity. *Certain* individuals can be very negatively afflicted with many deleterious symptoms, often over a sustained period of time. By contrast it is usually relatively *more* difficult to 'overdevelop' the 'aerobic' side to the same detriment of health. **Both** are equally important for health and fitness. It is *critical* that *balanced* exercise programs are followed to ensure that negative aspects do not impact vitality.

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* Communication from Chris Maund, BSc acknowledged with thanks.