Standard Operating Procedure for Maximal Anaerobic Running Test (MART)

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Maximal Anaerobic Running Test (MART)

Introduction:

Exhaustive high-intensity exercise is common in many sporting activities and depends heavily on ATP resynthesis from substrate level phosphorylation (i.e. anaerobic metabolism). To quantify anaerobic energy turnover during intense dynamic exercise, muscle biopsies have to be obtained before and after muscle contraction. Furthermore, the energy turnover related to the release of lactate to the blood has to be taken into account, usually by sampling blood from an artery and the vein that drains the exercising muscle. Clearly this is a very invasive procedure and there are only a few laboratories in the world that can do it. Therefore an indirect determination of anaerobic energy turnover would be useful.

Since the 1920’s the oxygen deficit concept has frequently been used as an indirect determination of anaerobic energy turnover. In 1988 Medbo et al. described a method of estimating ATP re-synthesis from anaerobic processes by predicting the energy requirement during ‘supra-maximal’ exercise (i.e. at work rates greater than those which would elicit VO$_{2\text{max}}$) from a linear extrapolation of the oxygen cost of sub-maximal running. This is known as the Maximally Accumulated Oxygen Deficit (MAOD). However, this test is very time consuming and, more importantly, there has been considerable debate over the validity of its estimation of anaerobic energy turnover (Medbo, 1996; Bangsbo, 1996).

Because of the complexity of the MAOD test another indirect determination of anaerobic energy turnover has been developed. The so-called maximum anaerobic running test (MART) (Rusko et al. 1993) consists of performing repeated short-duration runs (at approximately 110 – 190% VO$_{2\text{max}}$) with periods of passive recovery.

Protocol:

Complete a series of repeated 20 second runs on the treadmill, each at increasing intensities at a gradient of 10.5% with a passive recovery of 100 seconds between runs. The starting speed of the treadmill should be 14.3 kph (3.97 m s$^{-1}$) and increase by 1.2 kph (0.35 m s$^{-1}$) on each progressive run until exhaustion.

Hold on to the handrails whilst stepping on and off the treadmill (great caution is required here and some practising of this should be carried out prior to the actual test). The 20 second count should only begin when in the full running action. Perform the MART on at least 3 participants. Ensure an adequate warm-up is performed before completing the test.

Calculations:

Anaerobic running capacity is calculated from the speed of the last completed 20 second run and the exhaustion time of the subsequent sprint according to the formula (ACSM, 1986):

\[ \text{Anaerobic running capacity} = \text{speed of last completed run} \times \text{exhaustion time} \]
3.5 + 12v + 54gv

Where:

'v' is treadmill speed (m s\(^{-1}\))

'g' is gradient of treadmill (tangent of the angle with horizontal)

(The units are expressed as \(\text{ml } O_2 \text{ kg}^{-1} \text{ min}^{-1}\))

If, in the final run, the participant was able to complete 10 second anaerobic capacity was modified by adding 1 ml \(O_2 \text{ kg}^{-1} \text{ min}^{-1}\) to the calculated value. Each additional 2 second increased the value by a similar amount.

References


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