Teaching Support Pack

Graphs for Exercise Physiology

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Lecture Notes

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Introduction

Graphs, such as those presented here, are the simplest way of summarising the complex interactions between body systems during varying levels of activity. They allow a clear visualisation of rates of change in the activity of these systems with differing demands.

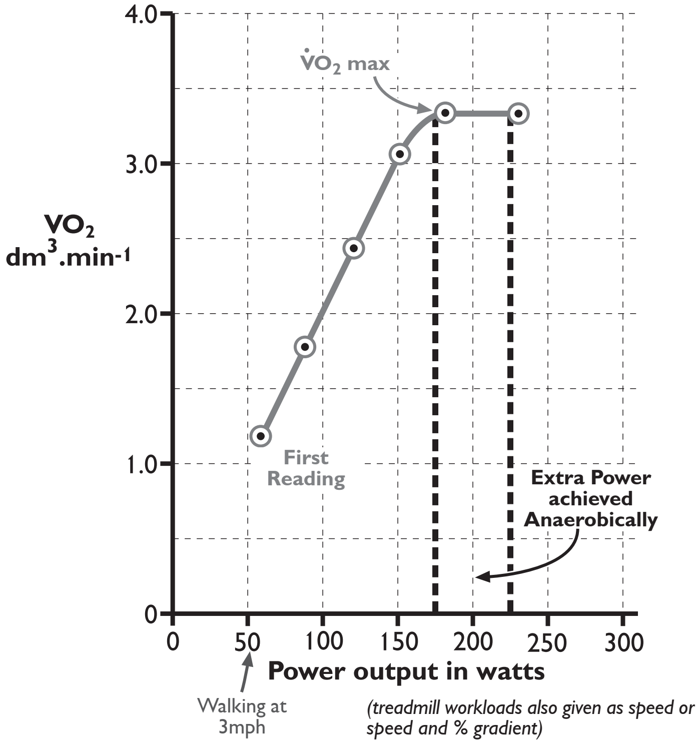
They can thus serve as excellent focus points for lectures. A consideration of the trends shown in the graphs leads naturally to a discussion of the actual physiological events underlying these trends.

The metabolic demands of the tissues, predominately the skeletal muscles in exercise physiology, stimulate corresponding changes in activity of the body systems that supply those tissues. It is important to realise and adopt this ‘demand led’ approach to the subject, which is also the basis of the performance based approach. By asking questions about the demands of performance, there is a natural progression to explaining the functioning of the various systems.

Exercise physiology is definitely a study of demand and supply.

Oxygen uptake in relation to work output in a progressive maximal test

Graph 4



2 minutes at 60 watts and then increments of 30 watts every 2 minutes.
A watt is the unit of rate of work or power 1w = $1J.s^{-1}$.
A reasonably fit person could maintain about 200 watts for an hour.
Tour de France riders maintain about 250 watts for seven hours.
Peak power outputs are as high as 1500 watts.

At sub-maximal work rates oxygen uptake is proportional to work rate. As the work rate goes up, the demands of the active muscle tissue goes up, and the increased demand is met by a proportional increase in supply of oxygen via an increase in heart rate and cardiac output.

However, at high work rates, the work rate continues to increase without a proportional rise in oxygen uptake; in other words the curve 'flattens out'.

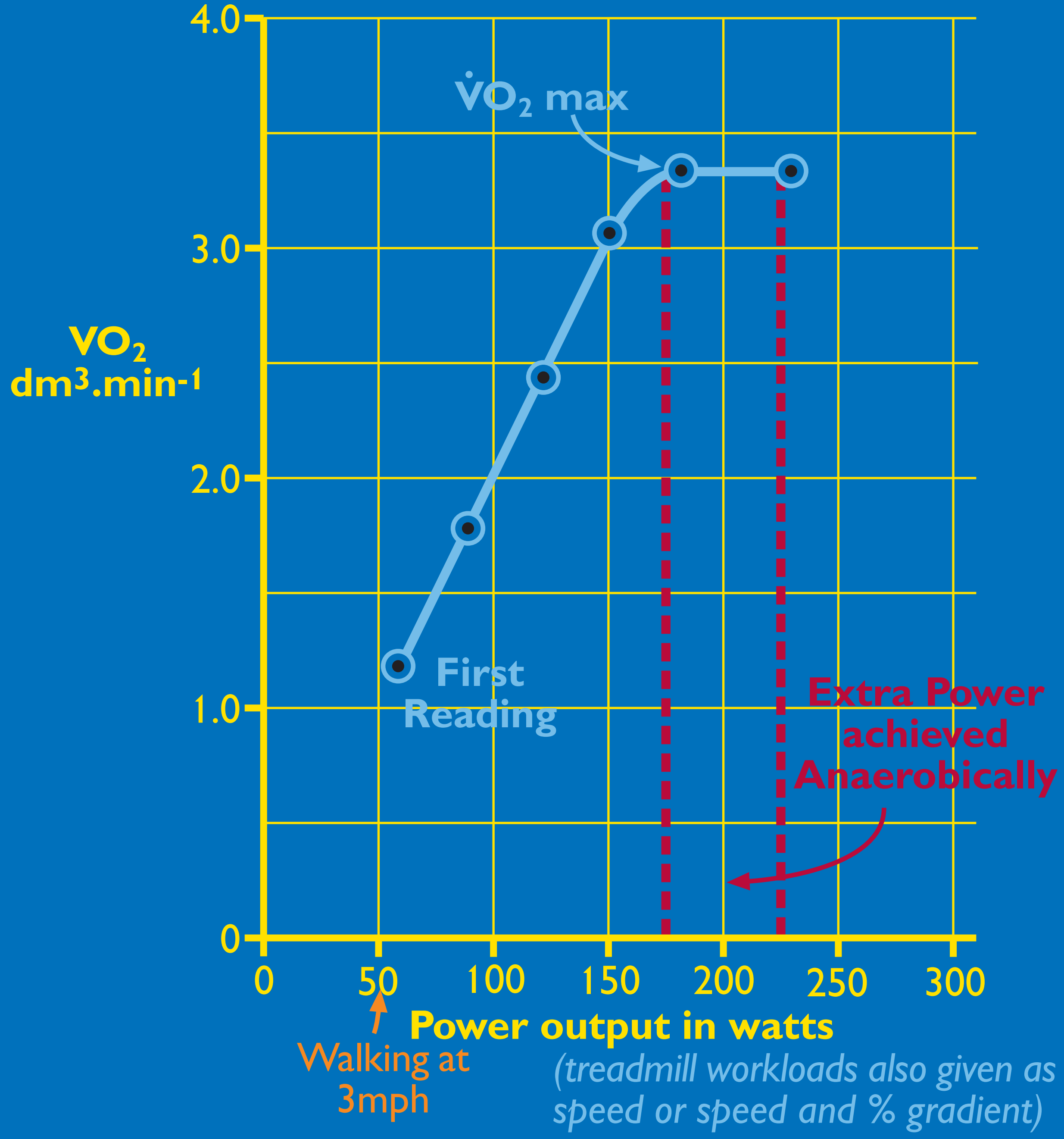
The additional energy for these very high work rates is supplied independently of that supplied aerobically using the oxygen taken up at the lungs, eg by an increase in the rate of anaerobic respiration.

It is interesting to note from this graph that a maximal test is not necessary for the assessment of maximum aerobic power or VO_2 max, only the achievement of a 'plateau' of readings of oxygen uptake, which as is seen in the graph may occur below the maximum work rate.

In practice, subjects usually work to volitional exhaustion, as the plateau may be more a decline in the rate of increase of VO_2 and quite difficult to spot during the test.

Oxygen uptake in relation to work output in a progressive incremental treadmill test.

4



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Determination of Lactate Threshold in a progressive incremental test by projection.