Continuous measures of blood flow during all-out dynamic exercise

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Continuous measures of blood flow during all-out dynamic exercise

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Question:
- Is the onset of muscle fatigue caused by inadequate oxygen delivery to muscle tissues or failure to clear metabolic byproducts from the muscle bed?

Purpose:
- Through this study we aim to investigate whether higher rates of blood flow occur with greater relative periods of muscle inactivity.
- The measures of flow will let us know whether or not that accounts in the differences for mechanical performance.
- The implications of this study could lead to vast gains in the exercise science community through implementation of new workout regimes or novel supplementation to improve performance.

Background & Introduction:
- As the duration of an all-out muscular effort extends from seconds to minutes, the performance of the muscle declines exponentially.
- The exponential decline for an individual’s performance-duration relationship (Fig. 1) is accurately described by the following equation:

\[ P(t) = P_{\text{aer}} + \left( P_{\text{mech max}} - P_{\text{aer}} \right) \cdot e^{-k \cdot t} \]

where, \( P(t) \) is the muscular performance possible for a duration of \( t \) between 3 and 300s, \( P_{\text{mech max}} \) is the muscle’s maximum mechanical performance, \( P_{\text{aer}} \) is the sustainable performance supported by aerobic metabolism, \( e \) is the base of the natural logarithm, and the exponent \( k \) describes the decrements in performance that occur as the duration of activity is increased.

- This exponential decline, in and of itself is expected. The unknown here is the main contribution to this decline.

- Are the differences in fatigue onset in .3 and .7 duty cycles caused by decreased clearance of metabolic byproducts from blood and/or the \( O_2 \) delivery (measured with \( \text{VO}_2 \) indirect calorimetry)?

Conclusions:
- The current method of calculating blood flow to active tissue is inaccurate and through the progress of this study, we have shown that the arterial diameter is not constant throughout exercise. The increased diameter thus affects flow and the measurements included in investigation of the onset of fatigue.
- Our hypothesis that Percent of oxygen delivery to muscles remains consistent is nearly supported and will allow us to surmise that fatigue is due to the inadequate clearance of metabolic byproducts and not inadequate delivery of oxygen.

Literature Cited:

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