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Continuous measures of blood flow during all-out dynamic exercise

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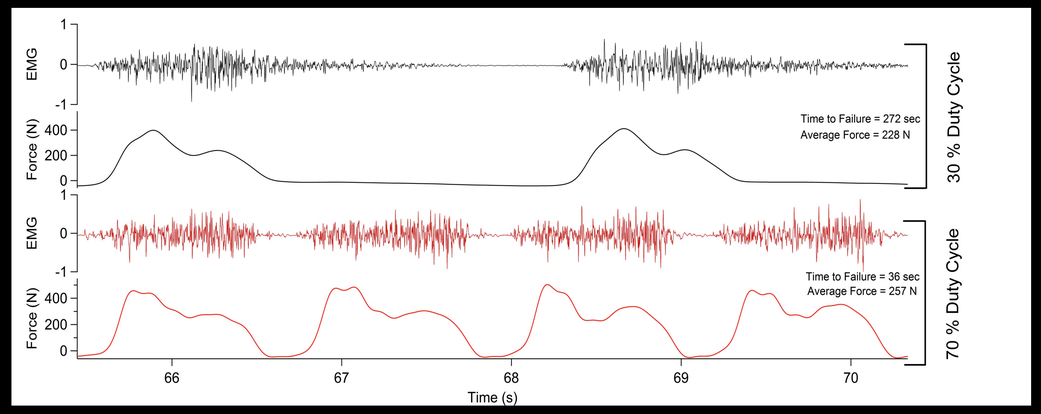
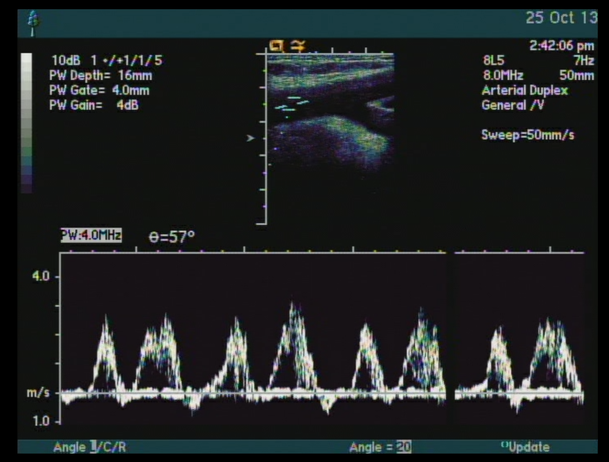
Question:

- **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.**
  Duty Cycle= (time of muscle contraction/ total time of contraction cycle)
- **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.**





1) Materials & Methods:

➢ Four male and four female subjects [Age 2-37 yrs; Mass 65.4 kg (SEM = 2.4)] performed all-out, knee extension exercises

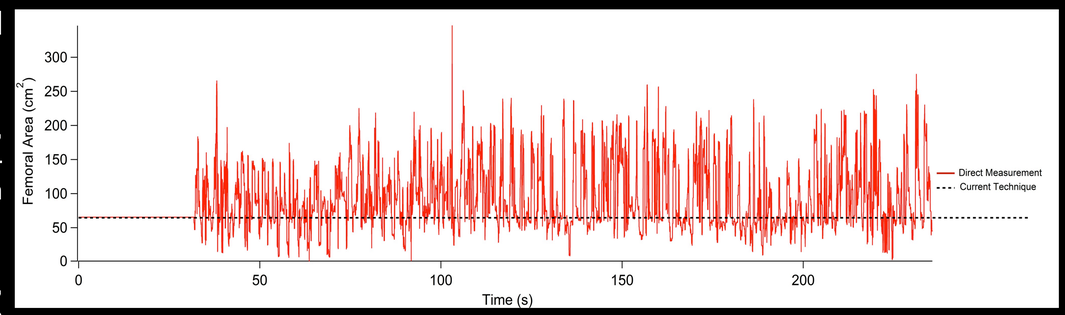
➢ Before experiments were conducted, subjects were familiarized with performing all-out, knee extensions on the knee extension ergometer.

➢ During the 4-8 experimental sessions, subjects were required to complete tests to obtain their $P_{mech\ max}$, P_{aer}, and a minimum of 9 all-out knee extension bouts selected to elicit failure between 3 and 300 seconds at the 30 and/or 70% duty cycles.

➢ Doppler ultrasound to obtain continuous measures of blood flow

➢ Subjects were provided visual feedback with a dual-column LED array.
  - One array displays the selected rate of position change, and the other displays the actual rate of position change performed by the subject.

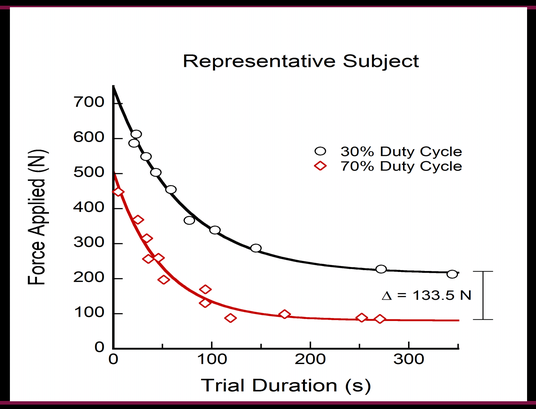
2) Results:



3) Conclusion:

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.



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:

$$P(t) = P_{aer} + (P_{mech\ max} - P_{aer}) \cdot e^{(-k \cdot t)}$$

where, *P(t)* is the muscular performance possible for a duration of *t* between 3 and 300s, $P_{mech\ max}$ is the muscle's maximum mechanical performance, P_{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 VO_2 indirect calorimetry)?***

Literature Cited:

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