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COMMENTARY

Response to the commentary on our paper "bioenergetics of the VO_2 slow component between exercise intensity domains"

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In the past 30 years, mathematical modelling of the VO_2 response during metabolic transitions (i.e. VO_2 kinetics) by a sequence of first-order exponential functions has offered a non-invasive means to probe the physiological mechanisms of O_2 delivery and utilization [7, 10]. An alternative second-order exponential fitting has been recently proposed Pereira de Lima et al. [5, 6], with the offered advantage of a better characterization of the possible VO_2 "overshoot" [8]. The model contains two components with simultaneous onset, intended to represent two muscle fibre populations (i.e. slow and fast). In their current commentary, Pereira de Lima et al. propose that our recently published data [3] support their idea, to which we partially agree, yet with the following distinctions.

Based on an innovative bioenergetics approach, our findings [3] suggest that, in the heavy domain, the so-called VO_2 slow component [9] may not be the result of a loss of efficiency manifesting over time; rather, it may represent a delayed shift between anaerobic glycolysis and aerobic metabolism. This observation is compatible with the intuition of Pereira de Lima et al. [5, 6] that the VO_2 profile observed at exercise onset may be the result of the integrated response of the two muscle fibre populations with different kinetics [4, 6]. Our findings also support the idea that, in the heavy domain only, a larger contribution of fast fibres may suffice to explain a slowing of the VO_2 kinetics and, possibly, a concomitant increase in gain, without the need for increased recruitment over time as an explanatory mechanism.

The above does not entail that the second-order model proposed by Pereira de Lima et al. is the only nor the most suited approach to characterize the primary component of VO_2 kinetics. On the contrary, we think it is not, for the following reasons. First, the so-called VO_2 "overshoot", which the new model intends to characterize, is a rare occurrence that is not present in our moderate intensity data [3] (Fig. 1). In fact, the very existence of this phenomenon can be questioned on theoretical grounds [2], while its plausible physiological origin remains elusive [8]. Second, the small improvement of the goodness of fit associated with second-order vs traditional first-order fitting [6] may hardly justify the use of the higher-order model. Moreover, in the severe domain of exercise, our data confirm the existence of a true slow component of VO_2 (i.e. a loss of efficiency over time), which develops in unison with increased muscle activation [3]. Accordingly, the characterization of the VO_2 response in this domain should include a delayed onset term that is ignored in the model proposed by Pereira de Lima et al.

In summary, our findings support the idea that it may be time for a revisitation of the current conception of the slow component of VO_2, interpreted as a loss of efficiency developing over time during constant-load exercises in the heavy and severe domains. A bioenergetics approach [3] and an accurate implementation of loads in each of the exercise intensity domains [1] may contribute to our understanding of the possibly distinct physiological determinants of the adjustment of the oxidative metabolism at exercise onset in the heavy vs the severe domain of exercise. However, we think that the model proposed by Pereira de Lima et al. may, at best, characterize the "heavy domain delayed steady state" but not the "severe domain slow component". A stronger physiological rationale and a better understanding of the VO_2 overshoot's prevalence need to be demonstrated before the proposed

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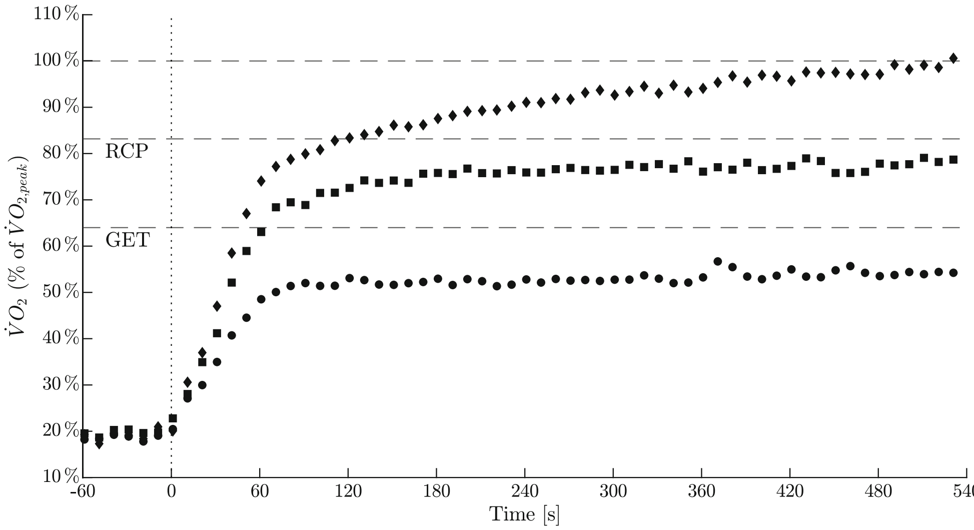

Fig. 1 Group 10-s average values of VO_2 (relative to VO_{2max}) are plotted as a function of time during 9-min constant-load trials in the moderate (black circle), heavy (black square) and severe (black diamond) intensity domains in 8 active young males. The relative intensities corresponding to gas exchange threshold (GET), respiratory compensation point (RCP) and VO_{2max} (upper line) are displayed as dotted horizontal lines (modified from [2])

second-order model can be preferred over the conventional characterization of VO_2 kinetics.

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