ILSA

Integrated Lactate Shuttle Assessment

Project Draft for Pre-Test

by

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1 Introduction

Performance in sport is often a combination of different physical skills towards endurance and sprint. Traditional training plans are based on the dichotomy of aerob and anerob energy metabolisms and focus these different skills in separated realms. Metabolic thresholds operationalize the training impacts for different physical skills by separating the physical requirements of sports into aspects of sprint and endurance. The energy-based dichotomy of aerob and anerob enhances the separation in physical skills and training impacts with the underling marginal condition of energy conservation of separated systems. Training then is a zero-sum game of sprint and endurance towards an entity of performance.

The lactate shuttle theory shows that energy metabolisms are closer to an integrated system than to a dichotomy towards physical skills [s. Brooks, G. A.; 2020]. Training in sport with a combination of different skills, can benefit by an integrated training with an integrated theory that refers to the entity of performance as well as metabolisms.

If you are a sprinter, then you have to focus on the skills of sprint with these special metabolic pathways, keeping in mind that metabolisms are integrated. With marathon it's vice versa. For players in soccer or other games, the integration of different physical skills and the focus on the integrated pathways of metabolisms are crucial.

„Because lactate, the product of glycogenolysis and glycolysis, is disposed of by oxidative metabolism, lactate shuttling unites the two major processes of cellular energy transduction" [Brooks, G. A.; 2007; 341-343].

2 Draft

This project takes the numerous scientific insights and papers of lactate shuttle (for a first glance into the literature s. [Deuker, C.; 2017a; 2017b]) as a starting point and not only as a hypothesis. The idea is to operationalize this theory for training sessions.

“Time is overdue to turn the page on understanding lactate metabolism and consider lactate shuttling as an important component of intermediary metabolism in vivo” [Brooks, G. A., et al.; 2021; 15].

Lactate shuttle gives a new and different view on metabolisms and in a second step in principles of training. As a bridge between different cellular energy sources, lactate stands in the center of an integrated metabolic system.

From a system theoretical viewpoint, the integration of different metabolic pathways into an energy supply system is crucial. Different metabolic pathways - or the structure of processes - still exist, like aerob and anaerob ones, but this dichotomy is dominated by the integration into the metabolic system. ILSA is not about finding new metabolic pathways or physiological insights, but to look at them from a different perspective of an integrated system. Integration dominates the differentiation into the dichotomy of aerob and anaerob.

This integration goes straight forward with a flexible loading in sportive execution, especially in games.

“…we now know that lactate is formed because it is the product of glycolysis, but lactate is utilized continuously under fully aerobic conditions. Working skeletal muscle simultaneously produces and uses lactate as a fuel, with much of the lactate formed in glycolytic fibers being taken up and oxidized in adjacent oxidative fibers. Lactate disposal is mainly through oxidation, especially during exercise when oxidation accounts for 70–75% of removal and gluconeogenesis the remainder" [Brooks, G. A.; 2007; 343].

Measures of lactate shuttle are only feasible with latest lab technology and not practicable in the field. But the insight that blood lactate is the sum of all active shuttles holds the opportunity of guessing the premises [s. Deuker, C.; 2017b].

"Recognizing that lactate, particularly rising blood lactate concentration, is a biomarker for an imbalance between lactate production and removal provides practitioners in diverse fields with important information on the physiological status of athletes and the ill and injured" [Brooks, G. A.; 2021; 1095].

With the lactate shuttle theory, it is possible to analyze the central parameter of an integrated metabolic system and draw conclusions for special, but integrated skills. This is especially interesting for tasks with flexible loads and the capabilities of an integrated metabolic system to cope with it in a non-zero-sum attitude.

"The results obtained here clearly show that PAs {rem.: professional endurance athletes} demonstrate superior capabilities to oxidize lactate, as well as CHO- and lipid-derived fuel energy sources, and also retain capacity for lipid oxidation at different exercise intensities where MAs {rem.: moderately active individuals} and MtS {rem.: metabolic syndrome} patients are completely CHO-dependent, which is also expected as, especially for the MtS group, even the initial lower absolute intensities were metabolically tasking" [San-Millán, I.; Brooks, G. A.; 2017].

In first step some pre testing will be necessary for categorizing different exercise intensities and typical reaction of different metabolic dispositions. Here the research of San-Millán and Brooks can serve as starting point for indexing metabolic flexibility and integration [s. San-Millán, I.; Brooks, G. A.; 2017].

In a second step the individual indexing as an expression of metabolic integration could serve for the planning of the impact of different training sessions.

The idea of lactateguided threshold interval training (LGTIT) is not new [s. Casado, A., et al.; 2023; 1] and well established. ILSA wants to take the lactate shuttle as an internal index for the integration of the metabolic system instead of setting external distributions of training impacts. No doubt the idea of 80% in zone 2 is reasonable, but why not 79% or 81%?

In a third step the development of the lactate shuttle index could serve for the training planning in longer terms.

3 Literature

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