Shuttle Training Assessment

Improving Metabolic Flexibility in Soccer

Project Draft for Pre-Test

by

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1 Introduction

Many games in sport are 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 the game 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 a match.

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

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 in games.

“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 give 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. This integration goes straight forward with a flexible loading of a game like soccer.

“…we now know that lactate is formed because it is the product of glycolysis, but lactate is utilised continuously under fully aerobic conditions. Working skeletal muscle simultaneously produces and uses lactate as a fuel, with much of the lactate formed in glycolytic fibres being taken up and oxidised in adjacent oxidative fibres. 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 [s. San-Millán, I.; Brooks, G. A.; 2017].

Then in a second step different training impacts can be tested for this indexing of enhanced metabolic flexibility and compared to improvements in sprint resistance and endurance.

3 Literature

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