Abstract (Englisch)

Introduction: Compared to the performance development of world class athletes in the last years German athletes have been declining especially in endurance disciplines. A study which investigated the level of endurance performance capacities of German elite youth athletes showed that the level of performance of youth athletes seems to be insufficient. Variables related to the cardiopulmonary capacity (e.g. maximal oxygen consumption [VO_{2peak}]) show that youth athletes achieve significantly lower values when comparable to those of the world class athletes. To connect to world class level new training concepts for youth athletes are highly desirable. As superior indicators for a detailed description and quantification of high intensity interval training (HIT) the quantity (volume) and the quality (intensity) of the stimulus are the most important variables. The aim of this thesis was to generate data regarding the acute responses and chronic adaptations to different training regimes by modulation of specific stimuli. The results should provide information for the composition and where necessary for improvements of training.

Methods: For a better understanding of the mechanism of endurance training metabolic stimuli (pH, O_2-content, et al.) were modulated in several studies. For the modulation of the pH in-vivo two different approaches were used. On the one hand an oral ingestion of bicarbonate was studied to increase pH acutely before a HIT session. On the other hand pH was modulated chronically by different recovery regimes (active vs. passive recovery) over a two week training period. Furthermore the acute hormonal responses of a single HIT session at the beginning and after two weeks of training were compared with regards to familiarization effects.

Results: The modulation of the pH in-vivo by an oral ingestion of bicarbonate increased power output during a HIT session, although the transport of lactate and H^+ in red blood cells remained unaltered. A further in-vivo modulation of the pH by the modification of the recovery mode over a two week training period leads to an increase of time trial performance and peak power output in a ramp test protocol. The hormonal responses at the end of the two week microcycle of HIT compared to the responses at the beginning show, that the training stimulus produced by this training is still great enough to “stress” the athletes, provoke further disturbances of homeostasis and induce positive training adaptations.

Discussion: The results of the present investigations provide important information for the design of future HIT-based training periods. It was shown that during HIT not only the intervals are from interest, but the design of the recovery periods as well. For the acute development of performance in a single HIT session an active recovery might be better to achieve higher power outputs. In contrast, the results of the two week HIT-shockmicrocycle with active vs. passive recovery showed a higher
increase in performance development over a longer period with passive recovery. The results of the investigation of the hormonal responses during the HIT-shockmicrocycle show that blocks of HIT are not necessary from an endocrinological point of view. For the improvements of performance acute responses of the endocrinological system are more important than a longer phase of high hormonal levels.