

## Determination of Anaerobic Threshold by Heart Rate or Heart Rate Variability using Discontinuous Cycle Ergometry

SUNG W. PARK, MICHAEL T. BRENNEMAN, WILLIAM H. COOKE, ALBERTO CORDOVA, and DONOVAN L. FOGT

Exercise Biochemistry and Metabolism Laboratory; Department of Health and Kinesiology; The University of Texas at San Antonio; San Antonio, TX

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Category: Masters

### ABSTRACT

We evaluated whether changes in heart rate (HR) and/or heart rate variability (HRV) would reflect anaerobic threshold (AT) using a discontinuous, incremental, cycle test. To accomplish this, exercise thresholds were determined for HR and HRV metrics and compared with AT via ventilatory threshold. Experienced cyclists ( $30.6 \pm 5.9$  y; 7 males, 8 females) completed a discontinuous cycle test consisting of 7 stages (6 min each with 3 min of rest between). Three stages were performed at W below AT, one at AT, and 3 above AT. The averaged stage data for  $V_e$ , HR and time- and frequency-domain HRV metrics were plotted versus W. Trend lines were identified for data from stages known to be below and at AT, and another for data collected at and above AT. The W at the intersection of the trend lines was considered each metric's "threshold" W. Significant correlations ( $p \leq 0.05$ ) were observed between AT and HR, mean RR interval (MRR), low and high frequency spectral energy (LF and HF, respectively), high frequency peak (fHF), and HFxfHF metrics' threshold W (i.e., MRRTW, etc.) when all participants' data were compared. However, relationships were less robust for male and female when analyzed separately. Correlations between MRRTW and AT for males and females were not significant ( $p=0.117$  and  $p=0.734$ , respectively). The correlation between LFTW and AT was not significant for males ( $p=0.278$ ) while the HFTW and AT did not correlate for females ( $p=0.069$ ). AT and HFxfHFTW did not correlate for males or females ( $p=0.062$  and  $p=0.083$ , respectively). HR or HRV metric threshold W and AT for all subjects were less than 14 W. Statistical differences ( $p < 0.05$ ) were not observed for differences between AT W and HRTW ( $2.0 \pm 13.4$ W), MRRTW ( $10.0 \pm 26.4$ W), HFTW ( $7.3 \pm 19.0$ W), and HFxfHFTW ( $-2.4 \pm 23.1$ W). However, the  $11.3 \pm 17.8$ W difference for LFTW and  $-13.9 \pm 18.7$ W difference for fHFTW were significantly different ( $p=0.028$  and  $p=0.015$ , respectively). The male HR and HRV metric threshold W were less than 16 W different from AT with no statistically significant differences observed (all  $p > 0.05$ ). Female HR and HRV metrics' threshold W were all less than 15 W different from AT. In this subject group the LFTW  $13.6 \pm 12.1$ W difference from AT was statistically significant ( $p=0.016$ ). In all, several heart rate-related parameters accurately reflect AT as determined using a discontinuous, incremental, cycle test in experienced cyclists.