Using a Periodic Aerobic Threshold Test for Long-Term Performance Tracking and Training Prescription in Male University Rowers

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INTRODUCTION

- Aerobic Threshold (AerT) is the work intensity (wattage) at which an athlete elicits a 2 mM blood lactate concentration (BLa), which is taken to be the first increase in BLa above baseline levels (Faude, Kindermann & Meyer, 2009).
- Training at or above AerT in endurance sports is a widely utilized method of high-volume training in which improvements in cardiorespiratory and neuromuscular systems enhance oxygen delivery to exercising skeletal muscles (Jones & Carter, 2000).
- Currently, most rowing programs prescribe high-volume, low-intensity aerobic training wattage based off of 2000-meter rowing ergometer time trial results, where the average wattage on the time trial is taken to be 100%, and the aerobic training wattage is at about 45-50% of the average time trial wattage (Kleshnev, 2006). This system is widely used and somewhat effective, however it fails to take into account individual differences of fitness at a baseline level, and 45-50% of average time trial wattage is likely sub-AerT.
- By determining an accurate estimate of the average wattage at which rowers maintain a 2 mM BLa, indicative of their AerT, a more precise estimate of the ideal prescribed wattage for steady-state ergometer workouts can be achieved. Further, through analysis of other physiological variables such as heart rate (HR) and rating of perceived exertion (RPE), a model may be developed in order to prescribe and track AerT high-volume training with no need for periodic BLa testing.

METHODS

- 27 male University rowers underwent AerT testing on a monthly basis for 5 months.
- The test involved a standardized warm-up followed by a 20-minute workpiece at a prescribed wattage based on their most recent 2000-meter ergometer performance (for first test) or based on their previous test results from the AerT test the month previous.
- Variables measured included their body weight (Kg), average power output (watts), average stroke rate (strokes/min), average HR (beats/min), rating of perceived exertion (RPE, 7-20 Borg Scale), and BLa immediately post-test (mM).
- Performance variables (body weight, RPE, BLa, average HR and average power output) were analyzed using SPSS statistical software. A linear regression was run to determine which variables best predict 2000-meter ergometer performance.
- The athletes' 2 mM BLa wattage, representing AerT, was estimated and compared to the traditional 2000-meter performance-based prescriptions (Kleshnev, 2006).

RESULTS

Table 1. Correlational data (Pearson r coefficients) between all measured variables. Result is the best 2000 meter performance within the 6 months of testing.

	Result	Watts	HR	MMOL	RPE	KG
Result	1.000	-0.674	0.184	0.093	0.152	-0.522
Watts	-0.674	1.000	0.181	0.172	0.160	0.595
HR	0.184	0.181	1.000	0.575	0.411	0.005
MMOL	0.093	0.172	0.575	1.000	0.354	0.097
RPE	0.152	0.160	0.411	0.354	1.000	-0.38
KG	-0.522	0.595	0.005	0.097	-0.038	1.000

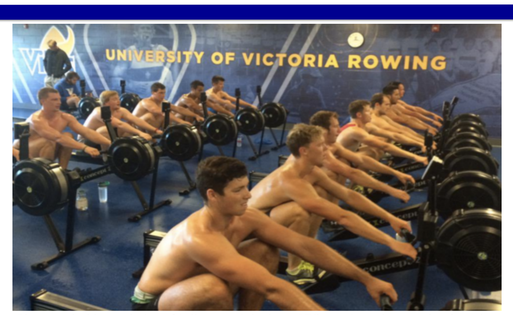

Photo used with permission of Aalbert van Schothorst, UVic men's rowing team head coach.

Table 2. Linear regression analysis results. Result = Watts(-.354) + HR(.263) + MMOL(.404) + RPE(.981) + KG(-.152) + 61.454.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Significance	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1							
(Constant)	61.454	17.690		3.474	0.001	26.263	96.645
Watts	-0.354	0.048	-0.672	-7.303	0.000	-0.450	-0.257
HR	0.263	0.108	0.222	2.426	0.017	0.047	0.478
MMOL	0.404	0.892	0.040	0.453	0.652	-1.371	2.179
RPE	0.981	0.527	0.149	1.859	0.067	-0.069	2.030
KG	-0.152	0.112	-0.122	-1.349	0.181	-0.375	0.072

Table 3. Means (+/- SD) of estimated HR and wattage at 2 mM for the population and Pearson correlations of these estimates to 2000 meter result.

	Estimated 2 mM HR	Estimated 2 mM watts
Mean	155.4	223.1
SD	5.15	23.3
Correlation to 2000 meter average wattage (Pearson r coefficient)	-0.131	0.872

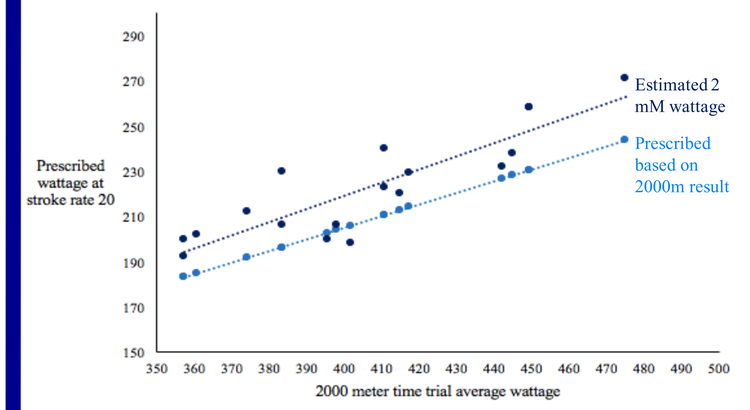

Figure 1. Prescribed wattage at a stroke rate of 20 strokes/minute based off of 2000 meter ergometer time trial wattage (traditional model of prescribed wattage) and participants' estimated 2 mM wattage at a stroke rate of 20 strokes/minute plotted versus their best 2000 meter ergometer time trial average wattage. Estimated 2mM wattage had a strong correlation of 0.872 to 2000 meter ergometer time trial average wattage.

Table 4. T-test results for the difference of means between estimated 2 mM wattage and 2000m-based prescribed splits with a 95% confidence interval (p=0.05).

Estimated 2 mM wattage mean:	Traditional prescribed (20 strokes/min) wattage mean:	Difference of means:	95% Confidence Interval (+/-) (p = 0.05) :
223.1	208.5	14.5	7.04

CONCLUSIONS

- Estimated 2 mM wattage had a strong correlation (r=0.872) to 2000 meter time trial average wattage. This demonstrates the value of using AerT testing to predict performance.
- At 20 strokes/minute, estimated 2 mM wattage was 7% higher (mean = 223.1) than the formerly used prescribed wattages based on 2000 meter test average wattage (mean = 208.5). Difference = 14.5; 95% Confidence Interval = 7.04 (p = 0.05). This indicates that the previous method of prescribing steady-state training intensity based only on 2000 meter test results was inducing sub-AerT training for this population.
- Based on our regression analysis, HR is a powerful indicator of AerT performance and may be used to track training or to potentially estimate athletes' 2 mM wattages without the need for BLa testing.
- The protocol used here may be an effective tool for rowing programs in periodically assessing and tracking their athletes' aerobic fitness, prescribing high-volume training intensity and predicting 2000 meter test performance.
- Further studies to validate these results and enhance the methodology are recommended.

REFERENCES

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