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Physiological correlates of simulated sprint-distance triathlon

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Summary

The purpose of this study was to examine the relationship between simulated triathlon performance and physiological variables measured during conventional laboratory tests. Seven non-elite, competitive male triathletes completed incremental cycling and running tests in a random order, in addition to a simulated sprint-distance triathlon trial (750 m swim, 500 kJ bike, 5 km run) using a 25 m pool, an electromagnetically braked cycle ergometer and motorised treadmill. There were no significant correlations between overall performance time and either running or cycling incremental tests, however significant correlations were found between triathlon run time and both running and cycling incremental tests (V_{peak}, $r = -.900$, $p<0.05$; V_{4mmol}, $r = -.822$, $p<0.05$; W_{peak}, $r = -.844$, $p<0.05$). Total simulated triathlon time was highly correlated to cycle time ($r = .930$, $p<0.05$) and mean cycling power output ($r = -.956$, $p<0.05$), whilst there was no significant correlation between either swim time or run time and overall performance time. For non-elite, competitive male triathletes, a performance assessment which better reflects the demands of the cycle phase of triathlon (i.e. a time-trial protocol) may provide a better indication of simulated sprint-distance triathlon performance in comparison to commonly used incremental laboratory tests. Furthermore, cycling performance appears more important to overall performance in simulated sprint-distance triathlon than swimming or running.

Keywords: multisport, transition, constant-distance test, triathlete, incremental test

Resumen

El objetivo de este estudio fue examinar la relación entre el rendimiento en un triatlón simulado y las variables fisiológicas medidas durante pruebas convencionales de laboratorio. Siete triatletas hombres y entrenados realizaron en orden aleatorio pruebas incrementales en ciclismo y carrera. Además, realizaron una simulación de un triatlón sprint (750 m natación, 20 km ciclismo, 5 km carrera) utilizando una piscina de 25 m, un cicloergómetro de freno electromagnético y una cinta mecánica. No hubo correlaciones significativas entre el rendimiento (tiempo) global y las pruebas incrementales. Sin embargo, se encontró una correlación significativa entre el tiempo de carrera en el triatlón y ambas pruebas incrementales en ciclismo y carrera (V_{peak}, $r = -.900$, $p<0.05$; V_{4mmol}, $r = -.822$, $p<0.05$; W_{peak}, $r = -.844$, $p<0.05$). El tiempo total del triatlón simulado mostró una correlación alta con el tiempo ($r = .930$, $p<0.05$) y la potencia media en la fase ciclismo ($r = -.956$, $p<0.05$), mientras que no se encontraron correlaciones entre el rendimiento global y los tiempos en natación o en carrera. En comparación con las pruebas incrementales de laboratorio, una evaluación del rendimiento que refleje mejor las demandas de la fase de ciclismo durante el triatlón (por ejemplo una contrarreloj) puede proporcionar una mejor indicación del rendimiento en un triatlón sprint simulado en triatletas entrenados. Por lo tanto, el rendimiento en ciclismo parece ser más importante que la natación o la carrera para el rendimiento global en un triatlón sprint simulado

Palabras clave: Multideporte, transición, prueba de distancia constante, triatleta, prueba incremental

Introduction

The physiological demands of non-elite, sprint-distance triathlon are considered as unique compared to longer and/or elite event formats, due to differences in distances and tactical considerations (i.e. drafting vs. non-drafting on the bike) (Bentley et al., 2008; Bentley et al., 2002). However, examination of the relationship between triathlon performance and physiological variables measured during laboratory testing has primarily focused on longer events than the sprint-distance format (Schabort et al., 2000; Whyte et al., 2000; Zhou et al., 1997). Those studies which have examined sprint-distance triathlon in this context have only correlated physiological parameters with competitive field-based performance (Bailey et al., 2007; Van Schuylenbergh et al., 2004), with no research to date considering the relationship between simulated triathlon performance and physiological variables measured during conventional laboratory tests. The aim of this study therefore was to investigate the relationship between selected physiological variables and performance in simulated sprint-distance triathlon.

Materials and methodology

Seven non-elite, competitive male triathletes (mean ± SD: age 32.6 ± 6.2 yrs, body mass 76.9 ± 6.0 kg) completed two incremental exercise tests in a random order, either on an electromagnetically braked cycle ergometer (SRM, Germany) or motorised treadmill (LifeFitness 93T, USA). V,O_{2peak}, peak aerobic power (W_{peak}) and power output at a fixed blood lactate concentration of 4 mmol·L^{-1} (W_{4mmol}) were measured during cycling, whilst V,O_{2peak}, peak running velocity (V_{peak}) and speed at a fixed blood lactate concentration of 4 mmol·L^{-1} (V_{4mmol}) were measured during running. Within ten days of laboratory testing participants completed a simulated sprint-distance triathlon trial (750 m swim, 500 kJ bike, 5 km run), using a 25 m pool, cycle ergometer and motorised treadmill. In addition to overall performance time and sub-discipline splits, power output (W) was measured during the cycle phase.

Results

Physiological values obtained for the triathletes during incremental cycle ergometry and treadmill running are shown in Table 1. There were no significant correlations between total performance time (h, min and s) for simulated triathlon (01:18:15 ± 0:08:24) and either running or cycling incremental tests ($V_{peak,}$ r = -.437, p = 0.327; $V_{4mmol,}$ r = -.417, p = 0.353; $VO_{2peak\ (run),}$ r = -.341, p<0.455; $W_{peak,}$ r = -.687, p = 0.08; $W_{4mmol,}$ r = .020, p = 0.966; $VO_{2peak\ (cycle),}$ r = -.082, p = 0.861). Significant correlations were found between triathlon run time (0:21:59 ± 0:02:19) and both running and cycling incremental tests ($V_{peak,}$ r = -.900, p<0.05; $V_{4mmol,}$ r = -.822, p<0.05; $W_{peak,}$ r = -.844, p<0.05). Total performance time was highly correlated to cycle time (0:39:34 ± 0:04:54) ($r = .930$, $p<0.05$) and mean power output (212.8 ± 25.7 W) ($r = -.956$, $p<0.05$), whilst there was no significant correlation between either swim time (0:12:24 ± 0:01:22) ($r = 0.558$, $p = 0.193$) or run time ($r = 0.521$, $p = 0.230$) and overall performance time.

Table 1 Peak and submaximal physiological variables obtained from cycling and running tests.

Peak cycling values	
$\dot{V}O_{2peak}$ ($l \cdot min^{-1}$)	4.2 ± 0.4
$\dot{V}O_{2peak}$ ($ml \cdot min^{-1} kg^{-1}$)	54.1 ± 6.0
W_{peak} (W)	307.0 ± 19.5
W_{peak} ($W \cdot kg^{-1}$)	4.0 ± 0.4
W_{4mmol} (W)	241.0 ± 15.3
HR_{peak} ($b \cdot min^{-1}$)	175 ± 6
Peak running values	
$\dot{V}O_{2peak}$ ($l \cdot min^{-1}$)	4.3 ± 0.5
$\dot{V}O_{2peak}$ ($ml \cdot min^{-1} kg^{-1}$)	55.5 ± 3.9
V_{peak} ($km \cdot h^{-1}$)	15.9 ± 1.2
V_{4mmol} ($km \cdot h^{-1}$)	13.6 ± 1.0
HR_{peak} ($b \cdot min^{-1}$)	182 ± 6

Values are mean ± SD

Discussion and conclusions

To our knowledge this is the first study to have examined the relationship between simulated triathlon performance and physiological variables measured during conventional laboratory tests. The results suggest that using a performance assessment which reflects the demands of the cycle phase of triathlon (i.e. a time-trial protocol) may provide a better indication of simulated sprint-distance triathlon performance, in comparison to commonly used incremental laboratory tests. Furthermore for non-elite, competitive male triathletes, cycling performance appears more important to overall performance in simulated sprint-distance triathlon than swimming or running. Although performance intensities observed during simulated triathlon were comparable to higher calibre triathletes performing in similar sprint-distance performance tests (>80% V,O_{2peak}, >70 % W_{peak}) (Hausswirth et al., 2001), it is important for future research to establish whether these findings are an artefact of the protocol used, or whether they reflect the genuine importance of the cycle phase to sprint-distance triathlon performance.

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