SPEED AND PHYSIOLOGIC REPLY IN SWIMMING, CYCLING AND RACING

Benavent, J.[1], Madera, J.[1], Escudero.J.[1], Colado, J.C.[2], Tella, V.[1]

[1]Universitat de València. Spain
[2]Universidad de Alicante. Spain

The triatlon is characterized for being a test of effort of long duration of pace of aerobic and anaerobic intensity. To determine the variations before maximum and submaximum intensities in relation to the speed, it has been studied the behavior of the heart rate and of the lactate accumulation as physiological variables, the effort perceived as psychological variable and the frequency of movements as cinematic variable. The results have showed that the metabolic exigency before maximum intensities of mixed character aerobic/anaerobic in swimming is less than in cycling and in running. The intensity of 90% of the maximum speed, comes closer to the values of the Anaerobic Threshold in the tests of swimming and cycling, being higher in the test of running. In conclusion, the percentage of Speed does not seem to be an equivalent indicator for three disciplines to discriminate the intensity of the effort.

Keywords: Lactate, heart rate, rating of perceived exertion, speed, frequency of cycle y triathlon

INTRODUCTION

The sport of triathlon is characterized for being a test of effort of long duration of very varied nature with changes of pace of aerobic and anaerobic intensity. Three disciplines compose it: swimming, cycling and running. The anaerobic threshold (UA) changes in three disciplines of the triatlón (4 and 5). With relation to the heart rate (HR) as a variable determining the intensity different responses have been studied in each of the disciplines (3). Other authors (1) propose the "Borg scale adapted" to determine "rating of perceived exertion" (RPE) in triathletes. The basic aims of this study has been to analyze and determine the physiological response in triathletes before maximum and submaximum efforts depending on the speed of movement.

METHODS

Sample: eleven of national level amateur triathletes took part in this study with ages included between 18 and 32 years of age. They belong to four representative teams of

the Valencian Community and they were in competitive period. As it is possible to observe in this distribution, there are 6 triathletes subjects that come from the speciality of athletics, 4 of cycling and only one from swimming. The average of age is of 25,6 ± 4,7 years, the level of training is high for most of them, the average of height is 175,7 ± 5,8 cm. and the average corporal weight is 70,4 ± 4,7 kg. Equipment: the materials used for the measurement in the different tests of valuation have been: the lactate tester "LACTATE-PRO" Blood lactate test meter (LT-1710) with test strip only (mark: ARCRAY, lot: L4K05B) to obtain the quantity of lactato in every level of effort and discipline; the POLAR pulsimeter S720i for the determination of the HR. In every level of effort and discipline; chronometers KONUS with laps of 1/100 seg. (Konustart-3) to measure the times in the tests, the frequency of cycle and control of the laps in the application of the 90% the maximum speed tests; and finally the equipment of lights mark Swim Master (2) for the same control of laps in the test of swimming. For the capture of information a few schedules of record were in use. Method: it consists of the application of three field tests, one for every discipline, bearing in mind for its election the similar times of duration of effort, in order that it does not influence the results. Concretly they have been: 300 meters in swimming, freestyle, in swimming pool of 25 m.; 3000 meters in cycling, in bicycle of personal route of similar characteristics with plate of 53 teeth and crown from 23 to 13 teeth, in velodrome of 250m.; and 1500 meters in athletic career, in track of athletics of 400m. The above mentioned tests have been applied in two different forms: 1 º to maximum intensity (100 %), that is to say, in the minor time or maximum speed (better personal mark); and 2 º to submaximum intensity (90 %) of the maximum obtained and applied speed controlled during the whole test with lap times. Protocol: has been taken into account the period of the competition in which the triathletes were, formalizing a short schedule of two weeks in which they did not foresee their participation in sports competitions, so that the study was not affecting in the competitive participation of the triathletes, nor that their competitive participation was affecting in the results of the study. In the first week there three tests of maximum intensity (100 %) have been applied in the alternate days and from 18 to 22h, always after a warming up from 15 to 20 minutes. In the second week and also in the alternate days and in the same conditions the test was applied to submaximum intensity (90 %). Variables: they were obtained from the parameters

measured in every test, discipline and the form of application has been: on, the one hand, the independent one or speed in m/s (S) in every tests and discipline to 100 % of intensity, and on the other hand the dependents, both to maxim (100 %) and submaximum intensity (90 %), the frequency of cycle in cycles/minute (CF), the maximum lactate in mM/l (LA), the pulsations per minute on having finished the test (HR) and the subjective value of the physical effort done according to Borj's Scale on having finished every test (RPE). All the variables were registered at the conclusion of each of the test. Extractions performed in case of LA from the minute 1 until the value was getting down were done every 2' to obtain the maximum value. Analysis of results: first it was done in a description of the statistical values of all the dependent and independent variables as well as the percentage value of the independent variables in the test of 90% in relation to the values obtained in the test of 100% to maximum speed. Later, the statistical differences were calculated according to the test "t" of student for related samples of dependent and independent variables among three disciplines of the triathlon: the swimming, the cycling and the running with the statistical package SPSS v.11,5 for Windows.

RESULTS

In swimming at 100% 12,8 LA, 173,1 HR, 18,1 EPE, in cycling 14,4 LA, 179,4 HR, 18,2 EPE and in race 14,2 LA, 186,3 HR, 18,3 RPE show statistically significant differences between three disciplines ($p < 0,01$) to 100 % except in RPE in swimming, running and cycling. In cycling and running significant differences do not show in LA. In swimming 5,1 LA, 152,6 HR, 13,4 RPE, in cycling 5,9 LA, 158,3 HR, 13,5 RPE and in career 7,2 LA, 176,5 HR, 14,7 RPE show statistically significant differences between three disciplines to 90% ($p < 0,01$), except in swimming and cycling. In running and cycling it does not show significant differences (table 1). The percentage values of all the variables in V to 90% in relation to the values obtained in V to 100% (table 4) only find significant differences ($p < 0,01$) in swimming (39,9 % LA), 87,5 % HR, 74,1 % RPE) and in running (51,3, % of LA), 95,4 % HR, 80,8 % REP)

Table 1. Statistics of related samples and mean of differences between swimming variables and R, S and C, R and C, in triathletes

S & R	N	mean	sd	p	S & C	N	mean	sd	p	R & C	N	mean	sd	p
CF100% S	8	38,127	4,762	,00	CF100% S	7	38,161	5,143	,00	CF100% R	10	94,153	5,847	,31
CF100% R	8	95,536	5,470		CF100% C	7	97,738	7,259		CF100% C	10	97,317	6,123	
CF90% S	11	31,º888	3,963	,00	CF90% S	9	31,904	4,345	,00	CF90% R	9	87,891	3,624	,31
CF90% R	11	88,111	3,692		CF90% C	9	91,055	9,373		CF90% C	9	91,055	9,373	
Rpe100% S	11	18,090	1,300	,68	Rpe100% S	11	18,090	1,300	,81	Rpe100% R	11	18,272	1,348	,82
Rpe100% R	11	18,272	1,348		Rpe100%C	11	18,181	,873		Rpe100%C	11	18,181	,873	
Rpe90% S	11	13,363	1,206	,00	Rpe90% S	11	13,363	1,206	,85	Rpe90% R	11	14,727	1,190	,01
Rpe90% R	11	14,727	1,190		Rpe90% C	11	13,454	1,293		Rpe90%C	11	13,454	1,293	
La100% S	11	12,790	1,788	,03	La100% S	11	12,790	1,788	,02	La100% R	11	14,190	2,236	,78
La100% R	11	14,190	2,236		La100% C	11	14,418	2,459		La100% C	11	14,418	2,459	
La90% S	11	5,109	1,167	,00	La90% S	11	5,109	1,167	,33	La90% R	11	7,200	1,140	,23
La90% R	11	7,200	1,140		La90% C	11	5,936	3,067		La90% C	11	5,936	3,067	
Hr100% S	7	175,571	8,734	,00	Hr100% S	7	175,571	8,734	,00	Hr100%R	10	186,300	10,122	,00
Hr100%R	7	189,285	8,616		Hr100% C	7	181,714	7,587		Hr100%C	10	179,400	9,617	
Hr90% S	10	152,600	10,123	,00	Hr90% S	8	155,625	7,327	,21	Hr90% R	9	177,111	8,447	,00
Hr90% R	10	178,000	7,257		Hr90% C	8	162,250	15,663		Hr90% C	9	158,333	18,781	

Table 2. Mean and descriptive estatistics of independent variable (v) of swimming (SW), running (R) and cycling (C) in triathletes, obtained directly from the time (t) in test of maximum intensity.

	SW					R					C				
v	N	M	sd.	Min.	Max	N	M	sd	Min	Max.	N	M	sd	Min.	Max.
T-100%	11	253,5	18,3	201,2	271,5	11	276,3	11,7	261,6	297,9	11	267,2	13,1	242,9	287,0
S-100%	11	1,2	0,1	1,1	1,5	11	5,4	0,2	5,0	5,7	11	11,3	0,6	10,5	12,4
T-90%	11	281,6	20,4	223,2	301,2	11	307,5	13,4	291,0	331,5	11	296,3	13,6	270,0	310,8
S-90%	11	1,1	0,1	1,0	1,3	11	4,9	0,2	4,5	5,2	11	10,1	0,5	9,7	11,1
S-90% of S-100%	11	90,0	0,1	89,8	90,1	11	89,9	0,7	87,8	90,4	11	90,2	0,7	89,9	92,4

Table 3. Mean and descriptive statistics of % of the dependent variables of swimming, running and cycling in triathletes, depending on the results of tests to 90% of intensity..

	SW					R					C				
v	N	M	sd	Min.	Max.	N	M	sd.	Min.	Max.	N	M	sd.	Min.	Max.
CF-90%	8	85,3	4,6	80,6	94,1	11	93,3	3,1	89,1	99,1	9	93,7	10,0	82,7	113,4
REP-90%	11	74,1	6,8	61,1	82,4	11	80,8	6,6	72,2	93,8	11	74,0	6,5	61,1	83,3
LA-90%	11	39,9	7,9	30,1	50,9	11	51,3	8,3	38,5	68,6	11	41,3	21,9	21,0	98,5
HR-90%	8	87,5	3,2	84,0	94,3	10	95,4	3,6	90,2	101,6	9	88,1	6,4	79,9	102,1

DISCUSSION

In the table 2 we can observe the times of effort done in three tests applied by disciplines, which show a few maximum differences of 23 seg. equivalently to a low percentage (8,6 %), understanding that the right election of the tests applied by their similarity in the duration of physical effort to maximum intensity (100%). This allows to compare the results of the dependent variables among the disciplines.

As for the use of the REP proposed by other authors (1) to determine the intensity of the effort done, the results show the efficiency of this tool since the information that contributes to discriminate with the differences obtained between disciplines both to 100% and to 90%. Thus, the athletic running is the discipline that needs a physiological higher response, followed by cycling and by swimming. The level of lactate (LA) obtained in the three specialities to 90% is over the anaerobic threshold theoretically of 4 mMl/l. The values obtained in the athletic running indicate that the intensity of the effort to speeds of 90% are over the UA. Contrary to this, in swimming and cycling 90% of the maximum speed comes closer to the values that represent an accumulation of LA related one to the UA. These results coincide with the contributed ones with other studies (4 and 5). Moreover, it is important that at maximum intensities of mixed character aerobic/anaerobic like these in the present study swimming has a metabolic lower response that in cycling and running.

As for the heart rate (HR) our observations coincide with other authors (3) in that swimming is the one that supposes an average lower HR, possibly due to a minor muscular implied mass, to the horizontal position or to the minor effect of the gravity, followed by cycling with higher results, being the highest those of running.

The order observed of lower to higher physiological exigency can justify the sequential order in which the triathlon develops: swimming, cycling and athletics.

Another outstanding aspect is the analysis on the differences between the percentage values of the independent variables LA, CF, REP and HR. From the results one distinguishes that to submaximum efforts (90% of the speed) the CF and the HR have similar percentage values in relation to their maximum responses (table 3).

The intensity of 90% of the maximum speed aproaches to UA's values in the tests of swimming and cycling (5,1 and 5,9 LA), being superior to the UA in the test of running

(7,2 LA). These results seem to indicate a major muscular effort in the discipline of running.

CONCLUSION

We can say that: 1º- All the variables show a behavior different at 100% and at 90% of the speed in three disciplines, for what the percentage of speed does not seem to be an equivalent indicator for three disciplines discriminating the intensity of the effort. 2º- The discipline of major physical effort is the athletic running; secondly, cycling and finally, swimming. Considering very suitably, according to the exigency of the physical effort, in the established order in the triathlon (swimming-cycling-running). 3º- The percentage responses of the CF and HR are those which come closer to the submaximum intensities (90%) depending on the maximum speed.

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