PERFORMANCE DIAGNOSIS IN SWIMMING

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INTRODUCTION

Energy expenditure as a function of swimming velocity is one of the major topics of interest in swimming science. Understanding the mechanisms behind swimming performance and training need new scientific approaches, while most of the existing knowledge on the bioenergetics of the four swimming strokes has already a number of years. The purpose of this presentation is to synthesize the most recent contributions of our research group in the domain of bioenergetic evaluation of the swimming strokes.

METHODS

Assessment of physiological and biomechanical variables was conducted over different samples of low level swimmers, high level swimmers, and elite swimmers. The parameters used were: (i) $\dot{V}$O2 kinetics (COSMED K4 b^2), including $\dot{V}$O2max, slow component (SC), and time limit at $\dot{V}$O2max. (TLimv$\dot{V}$O2max); (ii) capillary blood lactate concentrations ([La-]) (Yellow Springs); (iii) heart rate (POLAR); (iv) mean velocity (v) (paced by a GBK Pacer); (v) energy cost of swimming ($\dot{C}$); (vi) (intra-cyclic horizontal speed fluctuations (dv) (dual-media videogrametry through APAS); (vii) stroke parameters such as stroke length (SL), rate (SR), and stroke index (SI). The experimental protocol contained two phases (24h rest): (i) an intermittent incremental test for v$\dot{V}$O2max assessment and; (ii) an all-out test at v$\dot{V}$O2max to assess TLim-v$\dot{V}$O2max.

RESULTS AND FINDINGS

We compared the actual relative economy profile of the four competitive strokes with one published in the seventies. A reduction in $\dot{C}$; was noted, especially in butterfly. Probably due to rules restrictions, a breaststroke bioenergetic evolution was not so noticeable. $\dot{C}$ was compared between swimming strokes. Front and back crawl where more economic than simultaneous techniques, due to the association of this parameter with the dv: 0.38<R<0.79. An overall positive linear relationship was observed between total energy expenditure and v, as well as a tendency to a polynomial relationship between v and dv (0.47<R<0.65). The relationships between stroke parameters and $\dot{C}$ showed that SR was the major determinant of $\dot{C}$ in all swimming strokes (0.14<R^2<0.25), and that increases in SL tended to reduce $\dot{C}$, especially in breaststroke (R^2=0.24, P=0.02) and butterfly.

Results also pointed out that TLim-v$\dot{V}$O2max values ranged from 215 to 260 s (elite swimmers), 230 to 260 s (trained – high level swimmers) and 310 to 325 s (low level – university swimmers). No differences were observed between genders. TLim-v$\dot{V}$O2max main determinants were swimming economy, oxygen slow component, SL and SI (direct relationship) and v$\dot{V}$O2max, velocity corresponding to anaerobic threshold, lactate production and SR (inverse relationship). In general, TLim-v$\dot{V}$O2max was not related to $\dot{V}$O2max. It seems that the higher v$\dot{V}$O2max values achieved by elite and high level swimmers impose also higher $\dot{C}$ for this exercise, and higher recruitment of the anaerobic energy system, which leads to earlier fatigue stages and consequently lower TLim-v$\dot{V}$O2max.

Keywords: Swimming, VO2 Kinetics, Energy Expenditure