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W. Schänzer
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R. ABELLAN, R. VENTURA, S. PICHINI, R. DI GIOVANNANDREA,
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R. Abellan^{1,2}, R. Ventura^{1,2}, S. Pichini³, R. Di Giovannandrea³, J.A. Pascual^{1,2}, M. Bellver⁴, R. Olive⁴, R. Pacifici³, P. Zuccaro³, J. Segura^{1,2}.

Serum levels of EPO in elite athletes.

¹Unitat de Recerca en Farmacologia, Institut Municipal d'Investigació Mèdica, Barcelona, Spain.

²Departament de Ciències Experimentals i de la Salut, Universitat Pompeu Fabra, Barcelona, Spain.

³Drug Research and Control Department, Istituto Superiore di Sanità, Rome, Italy.

⁴Centre d'Alt Rendiment, Sant Cugat del Vallès, Barcelona, Spain.

Introduction

Erythropoietin (EPO) is the primary regulator of red blood cell production [1]. Its measurement is a useful tool in clinical monitoring of erythropoiesis and in diagnosing different types of anaemia [2]. Serum EPO has also been proposed as one of the indirect biomarkers for the detection of recombinant human EPO misuse in sport [3, 4]. To investigate if physiological conditions or training events (intensity of training, competition stress) could affect the levels of this biomarker, serum EPO was measured in elite athletes, in non-competitive athletes in pre and post-race (10 and 20 km races) conditions, in young non-competitive athletes, and in non-athletic population, free from rhEPO consumption.

Populations and Methodology

Seven different groups of subjects were studied and their characteristics described in Table I.

Serum EPO was measured using a chemiluminescent immunoassay kit (Immulite, DPC, Los Angeles, USA), and by an ELISA assay (Quantikine Human EPO Immunoassay from R&D Systems, Minneapolis, USA) in case of triathlon elite athletes. These immunoassays were selected after an extensive validation aimed to application in doping control. Results obtained with the ELISA assay were transformed using an equation proposed in a previous paper [5].

Table I. Population groups participating in the study.

Population	Non-athletic population (NAP)	Young non-competitive athletes (YNCA)	Non-competitive athletes (NCA10)	Non-competitive athletes (NCA20)	Taekwondo elite athletes (TEA)	Swimming elite athletes (SEA)	Triathlon elite athletes (TrEA)
N (σ^2/σ^-)	17 (6 σ^2 /11 σ^-)	20 (10 σ^2 /10 σ^-)	30 σ^2	33 σ^2	16 (10 σ^2 /6 σ^-)	12 (3 σ^2 /9 σ^-)	16 σ^2
Age range (mean \pm SD)	24-52 years old (33 \pm 8)	19-30 years old (21 \pm 2)	20-32 years old (23 \pm 3)	17-27 years old (21 \pm 4)	17-27 years old (21 \pm 4)	16-21 years old (18 \pm 2)	19-37 years old (27 \pm 6)
Training (h/week)	0 - 5	2 - 8	10 - 40	-	20	35	7 - 25
Samples collection	9 and 17 h in the same day	9 and 17 h in the same day	• Basal • Post-10 km race	• Basal • Post-20 km race	• Basal • Training • Competition	• Basal • Training • Competition	• Basal

Table II. EPO levels in basal conditions (Difference vs Non-Athletic Population (NAP): p<0.05: *; p<0.001: **).

	NAP	YNCA	NCA10	NCA20	TEA	SEA	TrEA
EPO (IU/L) Mean \pm SD	10.2 \pm 3.6	11.1 \pm 4.0	8.0 \pm 3.1 *	14.0 \pm 4.4 **	11.2 \pm 3.7	15.7 \pm 5.2 *	12.6 \pm 4.3
EPO (IU/L) Range	5.5 - 17.7	6.2 - 23.2	3.5 - 15.6	6.1 - 25.8	5.2 - 18.6	10.1 - 22.2	7.9 - 20.2

Values are represented as mean \pm SD. Variance analysis (Student post hoc test and ANOVA) was calculated for within and between groups comparison using the statistical package SPSS 2001 for Windows, version 11.0.1 (SPSS Inc., Chicago, IL, USA).

Results

EPO levels in basal conditions are shown in Table II. No differences were observed between sample collection times (studied in NAP and YNCA) or gender (studied in YNCA).

Serum levels of EPO in non-competitive athletes (NCA10 and NCA20) in pre and post-race conditions are represented in Figure 1. Levels of EPO were significantly increased after a 20 Km race.

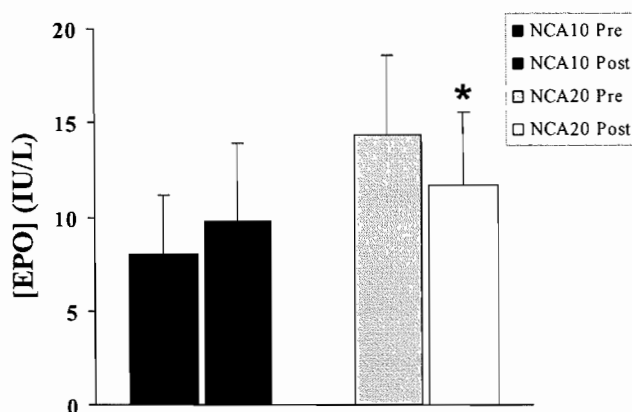


Figure 1. EPO levels in pre and post-race conditions in non-competitive athletes (NCA10 and NCA20).

Basal, training and post-competition levels of EPO in athletes from Taekwondo, Swimming and Triathlon were similar to levels in youth non-competitive athletes, and only statistically higher for the Swimming elite athletes if compared to non-athletic population. No statistical differences between training status were observed in Taekwondo or Swimming elite athletes (Figure 2).

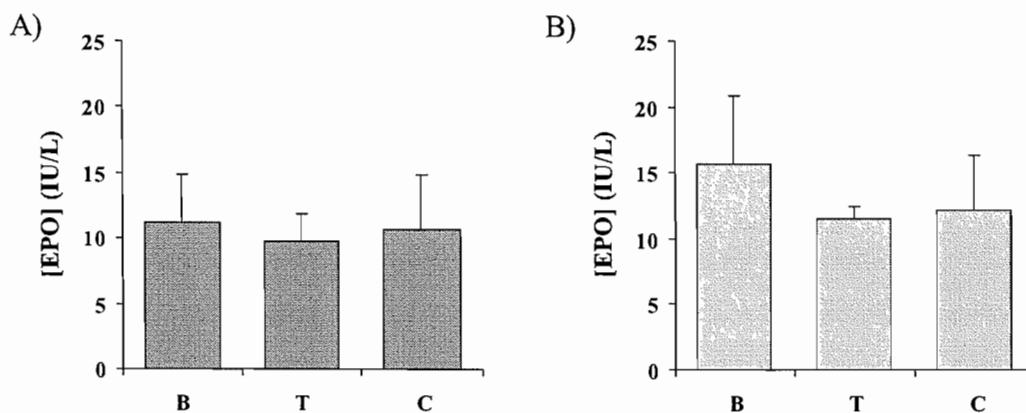


Figure 2. EPO levels in basal (B), training (T) and competition (C) conditions in elite athletes (A: TEA group; B: SEA group).

Discussion and conclusions

Levels found in all groups were consistent with those described in previous studies (4-35 IU/L EPO) regarding different population groups (age, gender, physical activity) [3, 6-8].

Although circadian rhythm has been described for EPO concentrations in human serum [9, 10], no significant differences were observed between sample collection times. Moreover, no gender differences were observed, as described in previous studies [7].

Conversely, significant differences were found in the basal levels among some of the groups studied (i.e. NCA10, NCA20 and SEA). However, no clear trend was observed with age or physical fitness. Differences between pre and post-race values were only observed for the NCA20 group, with lower values obtained after the effort. On the other hand, regarding elite athletes, no statistical differences in EPO values were observed between conditions.

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