EMBJ.ORG FOR YOUNG DOCTORS

EUROMEDITERRANEAN BIOMEDICAL JOURNAL
2018,13 (41) 181-184
(*FORMERLY: CAPSULA EBURNEA*)

Original article

SPORT FOR JOB. DIFFERENCES IN CORTISOL LEVELS IN A WATER POLO TEAM AT DIFFERENT TIMES OF WORKOUT

Emanuele Cannizzaro [1], Fabiana Plescia [2], Luigi Cirrincione [3], Emanuele Lo Pinto [4], Fulvio Plescia [1]

1. Department of Sciences for Health Promotion and Mother and Child Care "Giuseppe D'Alessandro", University of Palermo,
2. University of Palermo, Department of Biological, Chemical and Pharmaceutical Sciences and Technologies (STEBICEF), Medicinal Chemistry and Pharmaceutical Technologies
3. Specializing in Occupational Medicine
4. Specialist in Sport Medicine

ARTICLE INFO

Article history:
Received 30 November 2018
Revised 08 December2018
Accepted 13 December 2018

Keywords:
HPA axis activation, water polo team, saliva cortisol

ABSTRACT

Agonistic sport represents a physically stressful situation associated with the release of catecholamine and cortisol that in turn influence the immune system.
This study aimed to investigate the influence, in a team of water polo players, of the emotional processes characterizing the phase of waiting for the race on endocrine changes at the end of an official match.
Thirteen professional water polo players participated in this study. Each player provided two saliva samples before and after three different time phases: (1) rest time, (2) workout and (3) competition.
The results of the present study showed a significant increase in salivary cortisol levels before and after the competition and after workout sections. Our research confirms that the changes observed in athletes after the official competition depend both on the effects of the psycho-physical stress of the race and on other behavioral factors present before the athletic competition.

1. Introduction

Physical and psychic stresses activate different systems of the organism, such as the hypothalamic-pituitary-adrenal (HPA) axis, the sympathetic nervous system and the immune system. The corticotropin releasing hormone (CRF) plays an important role in transmitting the message. While, on one hand, it stimulates the sympathetic nervous system by increasing the secretion of adrenaline, on the other, it accentuates the secretion of cortisol by increasing the release of adrenocorticotropic hormone (ACTH) [1-4].
In humans, exercise stress determines different bio-temporal responses in relation to the intensity and duration of the effort exerted and to the degree of training of the subject. In particular, prolonged physical exertion as well as intense physical work increases the serum cortisol levels, accentuates the release of adrenaline and increases the cytokines serum levels [5-7].
Moreover, as a result of acute physical stress, the central nervous system (CNS), independent from the activation of the HPA axis, is able to influence the activity of the immune system by increasing the release of adrenaline [8].
Several studies have shown a correlation between testosterone levels and the different agonistic activity performed, indicating how, during official competitions, there is a positive correlation between athletes' offensive / aggressive behavior and the increase in serum testosterone concentration [9-11]. The correlation between hormones and psychophysical stress has therefore been widely studied in athletes who practice individual sports as compared to athletes who practice team sports in which the outcome of the game depends on the commitment of all athletes [12].
The aim of this study was to investigate, in a team of water polo players, the influence exerted by the emotional processes, that characterize the phase of waiting for the race on endocrine and immune changes, found at the end of an official match, comparing them with the variations observed before and after a normal training session, similar in intensity and duration.

* Corresponding author: Fulvio Plescia, fulvio.plescia@unipa.it
DOI: 10.3269/1970-5492.2018.13.41
 ISSN: 2279-7165 - Available on-line at www.embj.org

To this end, a non-invasive technique for the determination of activation of the HPA axis has been applied by usingcardiovascular parameters such as heart rate, blood pressure and salivary cortisol levels, before and after the various workout sessions.

2. Methods

Subjects

Players of an agonistic "male water polo team" (N=13) gave their written consent to participate in this study after they had been made acutely aware of the experimental procedure. All participants trained three to four times a week for 2 hours, and had a water polo match on the weekend. Basic anthropometric data of players are shown in (Table1). In April, all players participated in three different experimental sessions: rest time (t_{rt}), workout (t_{wo})and competition (t_c). Each single session has been carried out in different days but at the same time points, with the scope to better monitor the circadian rhythm.

	Water Polo Players
n	13
Age (years)	24,75 ± 3,86
Height (cm)	182,17 ± 8,86
Body weight (Kg)	85,58 ± 9,30
BMI (KG/m^2)	22,17 ± 2,27

Table 1 - Basic anthropometric data. Value are shown as mean.

Sample collection and analyses

Before (t_0) and after (t_1) every experimental section, salivary cortisol samples were always collected in the afternoon on test tube wipes (Sarsted, Germania). The concentration of salivary cortisol was measured using the ELISA Competitive Immunoassay (Enzyme Linked Immunoassorbent Assay) method provided by the company DRG Diagnostics. The samples treated in this way were analyzed with Sorin Biomedica's Eti-System Fast Reader S800 reader.

All subjects were asked not to practice physical activity within 24 hours prior to each test session and to consume a light lunch 3 hours beforethe session. The t_{rt}session was conducted to inform the athletes of the objectives of the study and to plan the research. During the t_{rt} session, an additional two samples of saliva were taken. One week after the t_{rt}session, the training session was held, during which a physical effort similar to that of the official meeting was reproduced by the water polo players. Finally, after an additional 10 days, the official $t_c$took place.

Statistical Analysis

Data on salivary cortisol levels, expressed in µg/L were analyzed by a two-way analysis of variance for repeated measures (RM two-way ANOVA), considering "salivary cortisol plasma levels during different training sessions" as the subject factor in between, and "time" before and after as the repeated measure factor followed by a Bonferroni post-hoc test (α= 0.05). Data of the salivary cortisol, before and after different training sections were analyzed by separate students' t-tests for two tailed unpaired measures. Data are reported as ± SEM. Statistical significance was set at p-value<0.05.

3. Results

Salivary Cortisol Levels

Salivary Cortisol levels expressed in µg/L were analyzed by a RM two-way ANOVA, that indicated significant effects of different trainingsession [$F_{(2.36)}$=433.95; p<0.0001], time [$F_{(2.36)}$=421.45; p<0.0001] and their interaction [$F_{(1.36)}$=1002.13; p<0.0001]. Results by Bonferroni post-hoc test showed an increase in salivary cortisol levels during the t_c at both points, t_0 (t=13.21, p<0.001; t=13.67, p<0.001) and t_1 (t=36.36, p<0.001; t=29.29, p<0.001), respective to t_{rt} and t_{wo}sections. Furthermore, an increase in salivary cortisol levels was also detected at time $t_1$in t_{wo} session (t=13.21, p<0.01) compared to the t_{rt}session (Figure 1).

Statistical analysis from the mean of salivary cortisol, at time$t_0$and $t_1$the different training sections, showed a significant increase of salivary cortisol levels after the t_{wo} and t_c (t=8.179, df=24, p<0.001; t=24.54, df=24, p<0.001) respective to cortisol levels detected att$_0$starting t_{wo} or $t_c$sections (Figure 2).

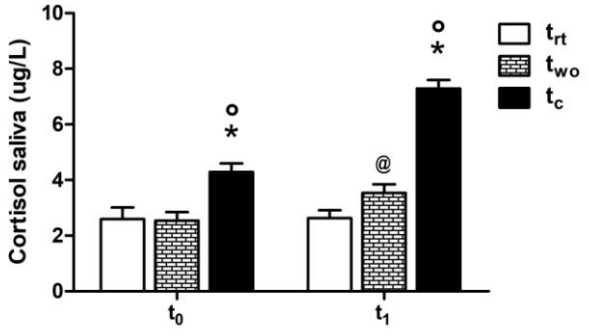

Figure 1 - Comparison of the differences in salivary cortisol levels (ug/L) in water polo team during three different training sessions: rest time (trt), workout (two) and competition (tc).Each value represents the mean ± S.D. of thirteen players. *p<0.001 vs. t_{rt}; °p<0.001 vs. t_{wo}; @p<0.01 vs. t_{rt}.

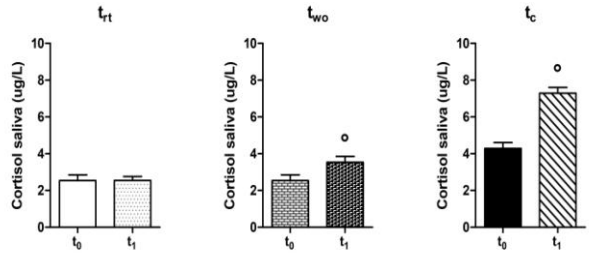

Figure 2 - Comparison of the differences in salivary cortisol levels (ug/L) in water polo team before (t_0) and after (t_1) different training sessions. Each value represents the mean ± S.D. of thirteen players. °p<0.001 vs. t_0.

4. Discussion

Many researches have revealed that people with different job-related problems such as unemployment, low salary, shift work or particularly laborious jobs, have a significant risk of health problems, such as depression, alcohol use disorders and sleep disorders [13-14]. Furthermore, different studies indicate that prolonged physical exertion like the this induced by official sport competitions differently influence the immune responses of athletes, as compared to uncompetitive sports activities, confirming the correlation between hormonal and immune changes and aggressive offensive behavior expressed during the game [15-17].

This research has investigated the influence of the emotional processes that characterize the waiting phase of the competition on specific hormonal responses that occur during the game in a team of professional water polo players. Before the competition, salivary cortisol levels increased as compared to those observed before the training session. These results agree with various studies that indicate that psychic stress before the competition induces cortisol secretion [18]. The increase in cortisol levels in the period preceding the competition plays an important role for the activation of competitive behavior and the mobilization of the physiological resources necessary to prepare the athlete for the race. Cortisol levels are also increased at the end of the competition compared to the training session. Furthermore, an increase in cortisol levels was observed at the end of training, compared to the period of rest. A significant variation in cortisol levels was also reported both before and after training and on the day of the competition.

Our results, therefore, suggest that the high level of emotion reached by athletes before the race plays a fundamental role in enhancing the stimulating effects of the psycho-physical stress of the game on the release of cortisol. In conclusion, the results of our research confirm that the changes observed in athletes after the official competition depend both on the effects of the psycho-physical stress of the game and on other behavioral factors present before the competition.

In particular, the emotional tone of the period preceding the official competition represents an important factor of modulation of the hypothalamic-pituitary-adrenal axis, which is fundamental in determining the physical performance of the athlete during sports performance. Finally, in consideration of the limited number of subjects submitted to our study, further experimental research are needed to elucidated and confirm the results of the present study.

Study supported by a grant from FFABR 2017

References

1. Zipes Miller DB, O'Callaghan JP: Neuroendocrine aspects of the response to stress. Metabolism 2002; 51(6Suppl 1): 5-10.
2. Cannizzaro C, Plescia F, Martire M, Gagliano M, Cannizzaro G, Mantia G, Cannizzaro E: Single, intense prenatal stress decreases emotionality and enhances learning performance in the adolescent rat offspring: interaction with a brief, daily maternal separation. Behav Brain Res 2006;169(1): 128-36.
3. Papadimitriou A, Priftis KN: Regulation of the hypothalamic-pituitary-adrenal axis. Neuroimmunomodulation 2009; 16(5): 265-71.
4. Martines F, Salvago P, Ferrara S, Messina G, Mucia M, Plescia F, Sireci F. Factors influencing the development of otitis media among Sicilian children affected by upper respiratory tract infections. Braz J Otorhinolaryngol 2016;82(2):215-2
5. Ballacchino A, Salvago P, Cannizzaro E, Costanzo R, Di Marzo M, Ferrara S, La Mattina E, Messina G, Mucia M, Mulè A, Plescia F, Sireci F, Rizzo S, Martines F: Association between sleep-disordered breathing and hearing disorders: Clinical observation in Sicilian patients. Acta Medica Mediterranea 2015; 31(3):607-14
6. Dhabhar FS, McEwen BS: Acute stress enhances while chronic stress suppresses cell-mediated immunity in vivo: a potential role for leukocyte trafficking. Brain Behav Immun. 1997;11(4):286-306.
7. Besedovsky HO, del Rey A: The cytokine-HPA axis feed-back circuit. Z Rheumatol 2000;59(2):II/26-30
8. Le Panse B, Labsy Z, Baillot A, Vibarel-Rebot N, Parage G, Albrings D, Lasne F, Collomp K. Changes in steroid hormones during an international power lifting competition. Steroids 2012;77(13):1339-44.
9. Sinnott-O'Connor C, Comyns TM, Nevill AM, Warrington GD: Salivary Biomarkers and Training Load During Training and Competition in Paralympic Swimmers. Int J Sports Physiol Perform 2018;13(7):839-43.
10. Bermon S, Garnier PY: Serum androgen levels and their relation to performance in track and field: mass spectrometry results from 2127 observations in male and female elite athletes. Br J Sports Med 2017;51(17):1309-14
11. Casto KV, Rivell A, Edwards DA: Competition-related testosterone, cortisol, and perceived personal success in recreational women athletes. Horm Behav 2017;92:29-36.
12. Arruda AFS, Aoki MS, Paludo AC, Moreira A: Salivary steroid response and competitive anxiety in elite basketball players: Effect of opponent level. Physiol Behav 2017;177:291-296.

13. Cannizzaro E, Cannizzaro C, Martorana D, Moscadini S, Coco DL: Effects of shift work on cardiovascular activity, serum cortisol and white blood cell count in a group of Italian fishermen. EuroMediterranean Biomedical Journal 2012;7(23):109-113
14. Verso MG, Picciotto D: Effects of the global economic and job crisis on the health status of the Italian and Sicilian populations: from the Occupational Medicine to not Occupational Medicine? Acta Medica Mediterranea 2014;30:1129-36
15. Keaney LC, Kilding AE, Merien F, Dulson DK: The impact of sport related stressors on immunity and illness risk in team-sport athletes. J Sci Med Sport 2018;21(12):1192-99
16. Henry A, Sattizahn JR, Norman GJ, Beilock SL, Maestripieri D: Performance during competition and competition outcome in relation to testosterone and cortisol among women. HormBehav. 2017;92:82-92.
17. Oxford JK, Tiedtke JM, Ossmann A, Özbe D, Schultheiss OC: Endocrine and aggressive responses to competition are moderated by contest outcome, gender, individual versus team competition, and implicit motives. PLoS One. 2017 27;12(7):e018161
18. Stelzer I, Kröpfl JM, Fuchs R, Pekovits K, Mangge H, Raggam RB, Gruber HJ, Prüller F, Hofmann P, Truschnig-Wilders M, Obermayer-Pietsch B, Haushofer AC, Kessler HH, Mächler P: Ultra-endurance exercise induces stress and inflammation and affects circulating hematopoietic progenitor cell function. Scand J Med Sci Sports 2015;25(5):e442-50