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Pupillometry: Detection of variations in autonomic nervous system activity in high level young athlete.

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INTRODUCTION:
The pupil light reflex (PLR) is a reliable physiological mechanism which lasts 3.5 seconds [1]. It's based on a strength equilibrium mathematical model whose fitting with real data is almost perfect. These components are viscous, elastic, sympathetic and parasympathetic [2]. The autonomic nervous system (ANS) activity is commonly modulated with clinostatism and orthostatism positions. These ones are used to appreciate activity variations through the monitoring of heart rate variability (HRV) in elite sport [3]. We assume the PLR which reports the ANS activity is susceptible to being impacted by these positions and could complete HRV analysis.
METHODS:
Seventeen subjects, handball and basketball players (respectively n=10, n=7), aged 16±0.87, who were in a pathway to high level access were exposed to light flashes which were produced using a screen (Samsung QB50R LED, 50 inchs - Vietnam). Subjects wore glasses equipped with two cameras (Pupil core by Pupil Labs – Berlin, Germany) to record PLR at 120hz sampling frequency. Ten flashes lasting 200ms, interspaced by 30 seconds, were produced in each position with a 2 minute rest period before the beginning of each analysis. Throughout the whole protocol, athletes wore a cardiofrequencemeter (Polar H9 by Polar - Malaysia) to collect HRV data. A principal component analysis was done to characterize the nature of the data given by pupillometry and HRV respectively. Student paired T tests were done after application conditions were verified to appreciate the PLR sensitivity and its model of the study [2] at changing positions. Significance was set at $P<0.05$.
RESULTS:
The model showed a high quality degree of fit with the measured PLR ($r2=0.99±0.01$). In clinostatic condition, the basal pupil diameter was significantly smaller than in orthostatic condition ($p=0.002$). The constriction has a shorter duration and the parasympathetic strength was reduced (respectively $p=1.25*10-11$, $p=0.03$) in clinostatic condition compared to in orthostatic. The redilation and the concomitant impulse of both sympathetic and parasympathetic systems were significantly higher compared to in clinostatic condition (respectively $p = 1.03*10-7$, $p = 0.03$). The principal component analysis showed that information given by pupillometry and HRV analysis were distinct and complementary.
CONCLUSION:
Raw pupillometric data and those from the tested model appears sensitive to the changing position. Pupillary and cardiovascular responses do not seem redundant but can give complementary information about ANS. The HRV provides information transmitted by baroreceptors while pupillometry would deliver more general indications about ANS state. The pupillometry could constitute a complement to appreciate the ANS state in regard to training load in high level athletes.

1.Wang et al. (2018) 2. Yan et al. (2021) 3. Schmitt et al. (2015)

Topic: Statistics and Analyses

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