PRACTICAL EXPERIENCES FROM MEASURING EXRCISE INTENSITY AND RECOVERY STATE WITH HEART RATE MONITORING IN TEAM SPORT

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INTRODUCTION

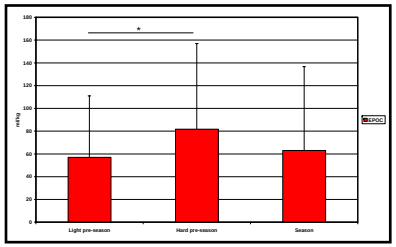
Heart rate (HR) monitoring has been used as a method to analyze an athlete's training program since the validity of the first commercialized heart rate monitor was proven [1]. Monitoring both the exercise bout [2] and the recovery state [3] plays an important part in designing training programs for athletes. The purpose of this study is to introduce a method commonly used in Finnish sport to monitor the exercise intensity and changes in recovery state of athletes by examining their heart rate variability (HRV) responses to training and relaxation stimulus.

METHODS

Elite, national level soccer players (n=24) took part in this study. Total approximately 800 HR measurements (Suunto T6) were taken during three separate weeks selected by the coach of the team to present light pre-season week, hard pre-season week and week during competition season. Exercise intensity was monitored using HR during all sessions, and was quantified using excess post exercise oxygen consumption (EPOC) [4]. Stress-relaxation analysis and recovery state were determined by HRV [5]. Suunto and Firstbeat Pro softwares analyzed the usability of HR and HRV and quantified stress-relaxation, recovery state, and EPOC calculations. The experiences of this study are organized into six examples.

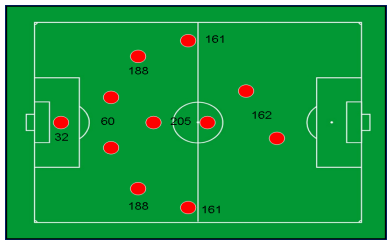
RESULTS

Example 1. *EPOC as a tool for following exercise intensity of the team.*



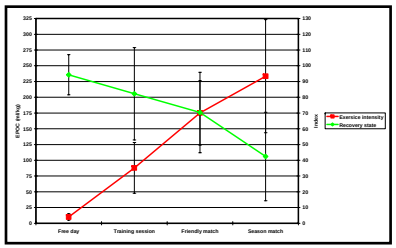
- The team's average training load quantified using EPOC during a team practice was lower in light pres-season than in hard pre-season or during competition season.
- \+ EPOC taking into account exercise duration and intensity provides a useful tool for coaches to plan and follow training programs of the team.

Example 2. *EPOC as a tool for following exercise intensity of individual players.*



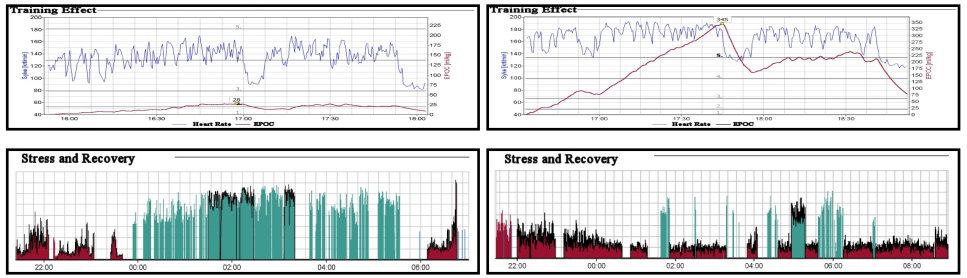
- EPOC of midfield players were more than three times and forward players double that of centre backs in the team which organized itself a tactical formation known as a 4-4-2.
- \+ EPOC as a single value is simple method to determine training load during exercise in team sports since each player's HR can be monitored outside the field in real time via laptop.

Example 3. HRV as a tool for evaluating recovery state.



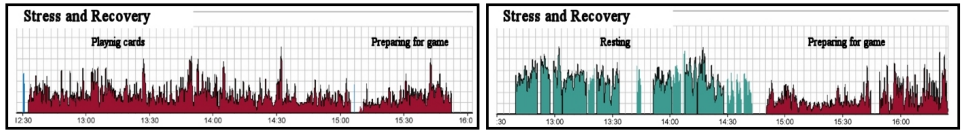
- EPOC and HRV analysis showed that the team's average nocturnal recovery state decreased as the intensity of the exercise increased.
- \+ The recovery index determined from each player's original HRV seems to be valid method to follow player's recovery state.

Example 4. HR and HRV analysis as a tool for detecting individual variations.



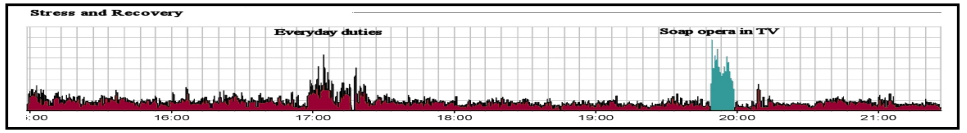
- Based on the analysis of two players who participated in a competitive match:
  - lower exercise intensity → more relaxed sleep
  - higher exercise intensity → more nocturnal stress
- \+ The strength of HR recordings and HRV analysis in team sports lies in possibility to treat players individually.

Example 5. *HRV analysis as a tool for optimisation of preparation*



- HRV analysis of two players (played cards and took a nap) before the game revealed clear difference in arousal state of autonomic nervous system.
- \+ HRV analysis can aid in determining techniques that are beneficial (or harmful) for each individual athlete.

Example 6. *HRV analysis as a tool for overall stress management.*



(blue line = HR; Red line with peak value = EPOC; Red = Stress; Green = Relaxation)

- HRV analysis for a player at day without exercise showed that everyday duties are but watching soap opera isn't stressful for the brains and/or the body.
- \+ HRV recordings can be used to measure overall stress of an individual and determine what everyday activities make the athlete stressed or relaxed

CONCLUSIONS

From the result of this experiment the HR and HRV based methods can be used in team sports to:

- follow the training of a team or an individual
- quantify exercise intensity of games and training sessions in individuals and teams
- quantify recovery states of individuals after games and training sessions
- optimize physical preparation of players for games and training sessions
- teach players how to recognize and control overall stress in their life

References: [1] Karvonen J. & al. (1984) Physician and Sport Med 12(6): 65-69; [2] Reilly, T. (2005). Journal of Sports Sciences, June 23(6): 561 – 572; [3] Hynynen, E. & al. (2006) Med Sci Sports Exerc 38(2): 313-317; [4] Rusko, H.K. & al. (2003). Medicine and Science in Sports and Exercise 35(5): Suppl: S183; [5] Saalasti, S. (2003). Academic Dissertation, University of Jyväskylä, Finland.