

心拍変動モニタリングによる一流スポーツ競技者の 疲労評価に関する研究

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Evaluating Physical Fatigue in Elite Athletes by Monitoring Heart Rate Variability

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ABSTRACT

Since it has been considered that prolonged fatigue has negative influence on sports performance, it would be essential for athletes to continuously monitor day-by-day stress of training. In this study, we examined the relationships between training load and heart rate variability (HRV) indices, salivary cortisol concentration, salivary immunoglobulin A (SIgA) secretion rate, and subjective feeling of fatigue in elite athletes. Eleven Japanese national badminton team players (22.5 ± 3.0 yrs) participated in the study. Data were collected during an 8-day badminton national team training camp. As it was immediately followed by a major international competition, the focus of the training camp was to make the players in good form for the competition.

Every morning, beat-to-beat heart rate (HR) was recorded. Spectral analysis was used to calculate spectral power in the high-frequency (HF: 0.15-0.40Hz) band which represents parasympathetic autonomic activity. Saliva samples were collected to measure salivary cortisol concentration and SIgA secretion rate. The subjects were also asked to estimate subjectively perceived fatigue on a visual analogue scale. Training load was quantified by Training Impulse (TRIMPs). As training intensity and duration both decreased in the course of the training camp, TRIMPs in the second half (Day5-8) significantly decreased from that in the first half (Day1-4). In response to the decrease in TRIMPs, mean HR and salivary cortisol concentration significantly decreased in the second half. In contrast, HF significantly increased from the first to the second half. During the training camp, only daily values in HF had significant correlation with daily values in TRIMPs. These results suggest that measuring HRV indices such as HF would be an efficient tool for elite athletes to monitor day-by-day stress of training.

要 旨

バドミントン日本代表選手を対象に、強化合宿中のトレーニング負荷の推移を定量的に評価し、心拍変動から算出される自律神経活動指標、内分泌指標、免疫指標及び主観的コンディション指標の推移との関係性について検証した。直後に行われる国際大会へのコンディショニングを目的とした8日間の合宿の中で、トレーニング負荷は前半 (Day1 - 4) と比べて後半 (Day5 - 8) に有意に低下した。それと対応して、起床時心拍数は合宿後半に有意に低下し、心拍変動から算出される副交感神経活動指標 HF は有意に増加した。また、唾液コルチゾール濃度についても、合宿後半で有意な低下がみられた。一方で、合宿を通じた一日ごとのデータ間関係性でみたとき、トレーニング負荷と有意な相関を示したのは翌朝起床時の HF のみであった。これらの結果から、一流スポーツ競技者において、トレーニングによってもたらされる身体的な疲労を評価するうえで心拍変動モニタリングが有用であることが示唆された。