Background to the system

The origins of the heart rate interval-monitoring test (HIMS) began in the late 1990's when we were approached by the conditioning coach of a professional rugby team. This was a few years after rugby became a professional sport and the physical and mental demands on the players were increasing[1]. The consequence was that players were over-exposed to rugby and some players developed symptoms of chronic fatigue during the season with obvious detrimental effects on their playing performance. He requested that we develop a test to monitor and predict chronic fatigue in his players. The test had to fulfill certain characteristics;

a) be non-aversive to the players to enable the test to be conducted frequently
b) be less than 15 minutes duration, including warm-up
c) require minimal equipment (to enable the test to be portable and used while the team traveled)
d) have outcome measures which were sensitive to change and could predict imminent player fatigue

With these guidelines we designed the Heart rate interval monitoring system (HIMS). In response to the requirements defined by the conditioning coach we designed a test which;

a) elicits an intensity of about 90% of maximum heart rate for about 2 minutes.
b) lasts 12 minutes
c) requires cones, a 20 m measuring tape, heart rate monitors and an audio pacing tape
d) measures recovery heart rate which is sensitive marker of training status

Brief description of the HIMS test

The HIMS consists of 4 running stages of increasing intensity interspersed with recovery periods. The players run back and forth between two lines drawn 20 meters apart. The pace of each of the 4 running stages (8.4 $km \cdot h^{-1}$, 9.6 $km \cdot h^{-1}$, 10.8 $km \cdot h^{-1}$ and 12.0 $km \cdot h^{-1}$ respectively) is set by a pre-recorded auditory signal. Each running stage lasts two minutes and is separated by one-minute rest periods in which the players stand upright and motionless with their hands by their sides. The players stand for two minutes after the fourth stage. Therefore the intensity of the HIMS is controlled and constant for each test. Heart rate is recorded continuously during and after the test and stored in a heart rate monitor for downloading after the test. The intra-class correlation coefficient of the heart rate on a day-to-day basis during the four stages and recovery periods ranged between R = 0.94 and 0.99 in a group of subjects who maintained their training load[2]. This equates to a day-to-day variation in heart rate (during exercise and in recovery) of about 6-8 $beats.min^{-1}$.

We have used the test on a daily basis for 5 consecutive days in a repeatability trial with 45 subjects. None of the subjects reported any negative effects.[2] We also tested a half marathon runner 2 days before he set a personal best time (61 min 30 s) using a similar test. The runner did not report any symptoms of fatigue resulting from the test,

Principles of heart rate recovery after exercise

The autonomic nervous, consisting of the parasympathetic and sympathetic systems, is linked to virtually all the organs in the body which are associated with exercise performance. The parasympathetic system dominates during rest and the sympathetic system dominates more as the exercise intensity increases. When exercise stops there is increased parasympathetic activity and reduced sympathetic activity. This is reflected in the heart rate which decreases after exercise stops. The heart rate recovery is defined as the rate at which heart rate decreases in the first minute after moderate exercise and is a consequence of parasympathetic re-activation and sympathetic withdrawal[3-5]. Cross-sectional studies have shown that trained athletes have a faster recovery of heart rate than untrained subjects[6;7]. There is a disturbance in the autonomic nervous with overtraining[8] and this is reflected in a slower heart rate recovery after exercise.

Interpretation of the heart rate recovery

Measuring heart rate recovery only once provides limited information. Once a profile has been established for a player the interpretative information increases exponentially with each subsequent test and when this is related to training load and subjective symptoms of fatigue. For this reason we recommend that the test is done weekly at the same time of day. If the training load is adjusted following a slower heart rate recovery the risk of developing serious symptoms of player fatigue are reduced.

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