A case study assessing the effectiveness of measuring and using cardiac vagal tone (CVT) as a coaching tool with elite athletes

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Abstract

Background and Purpose

If we can reliably monitor the 'stress' load of an athlete at rest over a period of time we can make adjustments to the training loads in accordance to these fluctuations and help prevent over reaching in athletes. Thus reducing the chances of sickness or injury in a proactive rather than reactive manner. Ultimately, improving the effectiveness of the training programme. However, reliable monitoring of athlete health and wellbeing has been challenging. Coaches typically rely on subjective measures of well-being and readiness to train scores, with no direct measure of the athletes' underlying physiology. Developments in technology have led to the ability to directly measure Cardiac Vagal Tone (CVT) (parasympathetic control on the heart via the Vagus nerve). The purpose of this case study is to investigate the use of the Pro-biometric CVT measuring device to monitor an athlete's health and well-being. Further to, assess the device, as a tool to enhance understanding of training volume and intensity and it impact on recovery or capacity to train.

What was done?

Participants: The participant was chosen based on two criteria: 1) Elite level athletic performance; 2) Non-centralised or limited daily contact with coaching staff. The participant was a 17-year old male sprint canoeist.

Process: The participant was asked to complete a daily 'at rest' 5 min CVT reading and also record a log containing of hours and quality of sleep, any illness symptoms, muscle soreness, energy levels, stress levels, fatigue levels. This was recorded via the 'Smartabase' phone app, currently in use throughout out centralised training squads. There were also periodic unstructured interviews with the participant to discover any contextual information which might be relevant to further understand the CVT score.

A daily fatigue score (CVT score) is calculated by the software of the Pro-biometric CVT measuring device. The CVT score can be interpreted as a measure of the capacity to train. Therefore, a low score suggests fatigue and a reduced capacity to train and a high CVT score suggests an increased capacity to train.

Key findings

Compliance was better with the CVT device compared with the current Smartabase app system. The participant followed the protocol for 94 days. During this period, he missed completing the protocol on 3 occasions giving 96.8% compliance. In comparison, over the same testing period he completed 50 subjective health records in the Smartabase app system (53.19% compliance rate).

The CVT score for the duration of the case study is below. There appears to be a link between external factors and changes in CVT scores. For examples, there was a drop in CVT scores: 1) during the Christmas break where the participant was engaged in 'social activities', disruption in normal sleep patterns, poor dietary choices; 2) after an 'arduous' flight; 3) just prior to reporting of mild illness symptoms (indicated by the short vertical red lines); 4) during strength training block). There was an increase in CVT scores during high volume aerobic training.
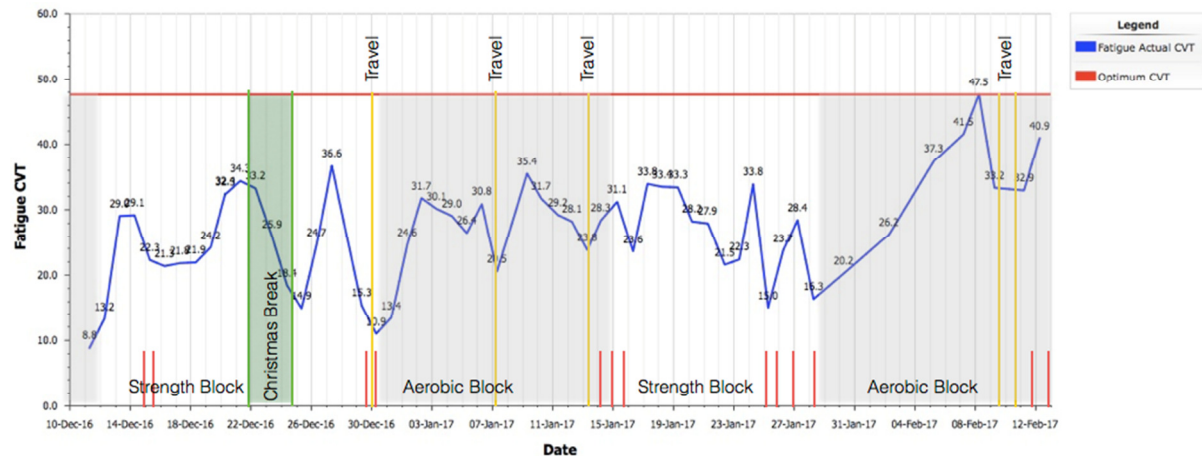
Points of interest for coaches

Accepting that this is a time limited, n=1 case study, I am optimistic that the technology can offer valuable insights into the athlete's state (psychological and physical). I would be confident adapting the daily training plan based on the CVT score. For example:

- A drop below an established baseline for illness prediction or a prescribed percentage drop across any two days could be used to advise the athlete to alter the loading with the aim to recover the score to an 'optimal zone.'
- Training block length could be altered to avoid persistent illness symptoms seen at the end of each block.
- Planning travel arrangements to minimise stress vulnerability pre-travel and ensuring enough time for rebound post-travel prior to competing.
- Lifestyle education for the athlete, such as highlighting the negative impact of a change in routine and the introduction of reduced sleep patterns.

Conclusion

The technology appears to be simple to use and the information generated provides coaches with valuable objective measures of athletes' capacity to train, health and well-being. It should enable coaches to further individualise, monitor, and adapt training programmes to maximise the effectiveness for each athlete. In addition, the ability to accurately monitor an athlete's capacity, in the preparation phase leading into a major competition, adds huge value to the coaching team when designing the final training period. This adds a level of objectivity to the coaching 'art' in those final weeks never before seen.

If you would like further information on the research or to receive a copy of the full project please contact: ian.wynne@britishcanoeing.org.uk