SYMPATHO-VAGAL INTERACTION AT THE DIFFERENT PHASES OF ACUTE EXERCISE

Tulppo Mikko
(Verne, Finland)

The interplay between the sympathetic and vagal regulation of heart rate (HR) is organized usually in a reciprocal fashion, i.e. increased activity in one system is accompanied by decreased activity in another. At the beginning of low intensity exercise, HR increases due to inhibition of vagal tone. As work load increases, HR increases due to further vagal withdrawal and concomitant sympathetic activation. These changes have been documented by pharmacological and non-invasive HR variability techniques. The cold face immersion is the only known intervention where malfunction of autonomic regulation is observed expressed as simultaneous sympathetic and vagal outflow. The sudden termination of exercise may results in similar co-activation of vagal and sympathetic outflow since the potential differences in vagal and sympathetic activation/deactivation after exercise.

HR variability methods based on nonlinear system theory have been developed to evaluate cardiac regulation and to characterize the features of HR dynamics that may not be easily detectable by traditional analysis methods. Analysis of fractal scaling exponents by Detrended Fluctuation Analysis (DFA) is one such method, which describes the fractal correlation properties of R-R interval data. Breakdown of short-term fractal organization in human HR dynamics, derived from DFA and expressed as a reduced scaling exponent (alpha-1), has been observed in various disease states, such as heart failure and preceding the onset of atrial fibrillation, and it indicates an increased risk of mortality and life-threatening arrhythmias in patients with and without structural heart disease. In our recent paper, we have shown that the breakdown of fractal HR behavior toward more random dynamics occurs during co-activation of sympathetic and vagal outflow caused by cold face immersion in healthy subjects (1).

A delayed decrease in the HR during the firsts minute after exercise is an independent predictor of sudden cardiac death in general population (2). However, the interaction between sympathetic and vagal outflow after exercise is not well know. This lecture will discuss the interpretation of sympatho-vagal interaction in humans during different phases of acute exercise including recovery. The chances in vagally mediated HR variability index (SD1), fractal scaling exponent (alpha-1), and muscle sympathetic nervous activity measured from peroneus nerve by microneurography technique during different phases of exercise and recovery will be presented.

References:

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