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A new, non-invasive, non-laboratory device to assess personalized anaerobic threshold during exercise training

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The anaerobic threshold (AT) is a fundamental physiologic measure to assess the cardio respiratory fitness of health and diseased individuals. Currently, the principal method for the detection of AT is performed in the laboratory and is limited for blood sampling (lactate measurement) or non-invasively using cardio-pulmonary exercise testing (CPET).

Aim: To develop a new, non-invasive, non-laboratory device for the detection of the AT during exercise.

Methods: A prototype made of a stretch sensor, vertical accelerometer, and heart rate monitoring was built as a chest belt to measure exercise intensity and the equivalent of pulmonary ventilation. All sensors were connected to a data processing and logging unit. The stretch sensor was characterized by changes in breathing interval (corresponding to breathing frequency) and changes in the equivalent of tidal volume (TV, driven by thorax expansion), both generating pulmonary ventilation (VE). CPET (ZAN 600) were conducted using the AT-strap to compare between the two methods. RR and AT results were compared using Bland-Altman Analysis.

Results: Initial AT-strap optimal length has been determined at 16 cm stretching up to 20 cm, using 3 stretch sensors in parallel for signal stabilization. RR tests (N=74) results have show high agreement between methods (mean difference: 0.2 [1/min], limits of agreement 95% (LoA): -2.7 - 3.2 [1/min]). Increase in amplitude of AT-strap signal has been noted with the linear thorax expansion in the breath simulation. Results were consistent in all RRs tested (0.2-1 Hz). Comparative experiments of AT determination have been tested in N=10 normal healthy volunteers showing mean difference of 1.5 [watt], LoA: (-14) - (17) [1/min]).

Conclusions: The new AT-strap stretch sensor successfully detects pulmonary attributes (RR, relative TV, and equivalent of VE) relevant for the detection of AT non-invasively, in the field. High agreement was found between AT-strap and CPET results. Additional tests should be taken to successfully validate the agreement between both devices under a larger and more diverse individuals, athletes, and patients.

Biography

Mickey Scheinowitz, Ph.D., Fellow of the American College of Sports Medicine. He is Faculty member of the Department of Biomedical Engineering, Faculty of Engineering, Tel-Aviv University, Israel. Prof. Scheinowitz, an exercise physiologist is a Member of the European Network for the Promotion of Health Enhancing Physical Activity, WHO (World Health Organization), Europe. He was a member of the "Healthy Israeli 2020" initiative, Ministry of Health, Israel (for the promotion of physical activity); Member of the National Coalition for the Prevention and Treatment of Cardiovascular Diseases; and Member of the National Coalition for Health Promotion, Ministry of Health. He supervised over 60 graduate and doctorate students and published nearly 200 publications: original articles, review articles, books, book chapters, and abstracts.

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