A New, Non-Invasive, Non-Laboratory Device and Method to Assess Pulmonary Ventilation and Anaerobic Threshold During Exercise

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Background: Anaerobic threshold (AT) is a fundamental physiologic measure for assessing exercise intensity and improving cardiorespiratory (aerobic) fitness by training/rehabilitation. Currently, the principal methods for the detection of AT are performed in the laboratory and require blood sample (for lactate level) or noninvasive cardiopulmonary exercise testing (CPET).

Aim: Develop new, non-invasive, non-laboratory apparatus for measuring pulmonary ventilation (VE) for the detecting the ventilatory anaerobic threshold (VAT) during exercise.

Methods: Chest strap consisting of vertical accelerometer, heart rate monitor and a stretch sensor for measuring breathing frequency (BF) and relative tidal volume (VT, driven by thorax expansion) which product of both, calculated by the processing unit, equals the pulmonary ventilation (VE) equivalent. 10 normal healthy adults age 20-35, wearing the Chest-Strap prototype and riding ergometer and later, another 20 wearing the advanced Chest-Strap running on the treadmill, performed maximal incremental ramp tests (CPET) to compare between the two methods.

Results: VAT determination showed an average 0.6% deviation of time and load betwen the Chest-Strap prototype and the CPET results in the ergometer test. Correlation between VE equivalent measured by the advanced Chest-Strap and VE measured by CPET in the treadmill running test was very high (r = 0.94)**.**

Conclusions: The advanced Chest-Strap accurately measures pulmonary attributes (BF, relative VT, and VE equivalent) relevant to the detection of VAT noninvasively, during running exercise. Further research is needed to verify the feasibility and reliability of the new Chest-Strap for detecting VAT under field conditions.