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Perspectives

Noninvasive Positive Pressure Ventilation: A Strategy for Exercise Prescription in Healthy Individuals

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Prolonged exercise and of high intensity require increased peripheral muscle work as well as the respiratory muscles, especially the inspiratory ones (diaphragm and intercostal) [1,2]. Hyperventilation is a necessary adjustment to maintain adequate oxygenation, including the respiratory muscles during exercise. Studies show that the inspiratory muscles can limit physical performance during exercise in healthy athletes and non-athletes [3,4].

Evidence confirmed the existence of blood flow redistribution of active peripheral muscles to the diaphragm, corresponding to approximately 14 - 16% of cardiac output [5]. These findings were subsequently better understood in the light of the discovery that during exercise intensity ≥ 80% VO_{2peak}, a competition for the blood flow between peripheral and respiratory musculature occurs [1]. Such evidence has ratified the concept of the existence of a metaboreflex respiratory muscle. The metaboreflex of the respiratory muscles occurs due to the accumulation of metabolic products that lead to activation of afferent fibers type IV, setting off in an increased vasoconstrictor activity resulting in a reduction of mechanical activity. It is believed that the outbreak of metaboreflex is the biggest responsible for th musculature fatigue. Through this physiological basis, we construct the hypothesis that the use of a noninvasive ventilatory support could be an alternative for high-intensity exercise maintenance for a longer period.

Patients in respiratory failure also show an increase in respiratory activity with consequent blood seizure for respiratory muscles and increased oxygen consumption, resulting in fatigue of the respiratory muscles that may result in death [6].

Ventilation with noninvasive positive pressure (NIV) and continuous positive airway pressure (CPAP) are ventilatory strategies that since the eradication of polio in the 60s to 80s of the last century, have replaced the iron lungs to treat patients with inability to maintain adequate alveolar ventilation and have consolidated with one of the greatest medical advances in respiratory care of patients with obstructive sleep apnea, neurodegenerative diseases, acute cardiogenic pulmonary edema and chronic obstructive pulmonary disease [7].

The improvement of the alveolar ventilation, reduction of intrinsic PEEP and stabilization of gas exchange promoted by NIV and CPAP promote the reduction of muscular work in subjects with lung disease of various etiologies that can reach 60%, the reduction of diaphragmatic activity between 17% and 93% depending on the ventilation mode, reduced respiratory rate and increased exercise tolerance in patients with chronic obstructive pulmonary disease COPD [2].

Harms et al. [8] demonstrated that the use of proportional assist ventilation (PAV) was able to promote a 14% increase in exercise time for cyclists.

In our study [9] we tried to identify if there was an alteration in the subjective sensation of effort, cardiovascular responses and an increase in high-intensity exercise time, however, we chose to promote a change in ventilatory support mode. We used the CPAP where the first description of its use during exercise in healthy subjects was made by Vroman et al. [10]. Nevertheless, the main conclusion assessed involved issues related to thermoregulation without the purpose of investigation in exercise time alterations. The paper entitled "*The effects of positive airway pressure on cardiovascular responses, perceived effort and time to exhaustion During high-intensity exercise in healthy subjects" published in 2013 in The Journal of Sports Medicine and Physical Fitness* [9] opens the possibility for the use of other forms of ventilatory support in high-intensity training.

We tried in this study to use tools of the everyday exercise prescription as the subjective sensation of effort in addition to ensuring safety regarding cardiovascular response. With the use of a cycle ergometer, we attempted to promote a five-minute warm-up period with load compatible with the first anaerobic threshold and later the subjects were instructed to cycle with load compatible with 80% of VO2peak until fatigue. This type of training demonstrated to be safe regarding the maintenance of chronotropic and inotropic responses consistent with activity, besides promoting a considerable increase in exercise time with the subjective sensation of effort proving to be effective to measure the intensity of effort both for the respiratory component as to the peripheral.

One of the greatest findings of the study was the increase in exercise time when using the CPAP (889 ± 270 sec with CPAP vs. 689 ± 256 sec without CPAP; $p = 0.037$) with the demonstration that cardiovascular responses and subjective sensation of effort are similar with or without the use of CPAP, however, the permanence in high-intensity exercise increases. We continued our investigations focusing primarily on the observation of the blood lactate behavior, intercostal muscles oxygenation, as well as variation in the use of the types of the ergometer.

However, caution is required in the prescription of noninvasive positive pressure ventilation associated with exercise in diseased individuals. Two recent meta-analyses concluded that, given the small number of available studies, the small sample sizes and the complete absence of power calculation, there is the need for randomized clinical trials with larger sample sizes based on statistical power calculations and designed to investigate the effect of training duration and intensity on rehabilitation [11]

We believe the evidence already produced concerning the thematic indicate that noninvasive positive pressure ventilation might be a great strategy for increasing training time in high-intensity exercises for healthy individuals (athletes and non-athletes).

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