Physical Medicine and Rehabilitation - International

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Austin Publishing Group

Special Article – Stroke Rehabilitation

Noninvasive Ventilation in Effort Tolerance in Chronic Heart Failure: Mini-Review

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Received: January 31, 2020; **Accepted:** March 06, 2020; **Published:** March 13, 2020

Abstract

Chronic heart failure is a complex multisystemic syndrome in which the heart is unable to pump blood to meet metabolic tissue needs and this makes its pathophysiological basis central. Dyspnea and intolerance to effort are the main manifestations and complaints caused by patients. As the disease progresses, the symptoms become more intense and, therefore, the individual becomes more limited in his activities, contributing to the reduction of quality of life and favoring morbidity and mortality. Changes in the histological and structural level of muscle fibers, peripheral and respiratory, make these patients great candidates for cardiovascular rehabilitation programs, in addition to additional therapeutic strategies to optimize results with the practice of supervised exercises. Thus, noninvasive ventilation is shown to be a therapeutic tool favorable to exercise tolerance in patients with stable chronic HF. This mini-review brings important research on the use of this therapeutic support in the population with heart failure and reduced left ventricular ejection fraction, however stable and in outpatient follow-up.

Keywords: Noninvasive ventilation; Heart failure; Intolerance exercise; Cardiac rehabilitation

Introduction

Heart failure (HF) is the inability of the heart to supply the periphery with adequate nutrients and oxygen. HF is either defined by the inability of the heart to pump blood adequately (HF with reduced ejection fraction, HFrEF) or the inability of the heart to fill adequately (HF with preserved ejection fraction, HFpEF) [1]. Fatigue, dyspnea, and exercise intolerance are the result of the progression of heart failure [2,3]. These clinical manifestations can negatively influence the activities of daily living and lead to increased hospital admissions and mortality [4,5].

When reference is made to exercise intolerance in these individuals, events at the muscle level become of great relevance, such as: presence of peripheral muscle atrophy with type I alteration to type IIb fibers, atrophy of type II fibers and reduced muscle blood flow. In addition, muscle atrophy is considered a factor that often leads to the development of cardiac cachexia, contributing to worsening respiratory symptoms [6].

A metabolic stimulation of small afferent fibers of types III and IV, originating from the diaphragm and respiratory muscles, seems to be triggered or called metaborreflex. For this mechanism, during the practice of high intensity exercises, the respiratory musculature is more used, requiring an increase in the local blood supply. Thus, there is a redistribution of blood flow from peripheral to respiratory muscles. This set of events promotes early fatigue during physical exercise, especially in patients with HF [7,8].

New therapeutic modalities complementary to exercise training may assist individuals with low exercise capacity [9]. Non-invasive ventilatory support is one of these modalities [10]. Previous studies have shown that the reduction in respiratory muscle overload probably results in a better balance between oxygen supply and demand, with beneficial effects on dyspnea and less discomfort in the legs during exercise during high-intensity exercise in patients with heart failure [11]. Therefore, the association of exercise with Non-Invasive Ventilation (NIV) can reduce or delay the activity of the meta-reflex, consequently, it can also increase the exercise tolerance of these patients [12].

Therefore, the purpose of this mini-review is to explore the evidence on the use of non-invasive ventilation in exercise tolerance in patients with chronic heart failure with reduced ejection fraction and to provide information that contributes to the practical therapeutic context, especially in the field of rehabilitation. in patients with stable disease.

Noninvasive Ventilation in Effort Intolerance

The perception that NIV may have a beneficial contribution to exercise tolerance in patients with chronic heart failure is largely anchored in the findings of important studies that applied therapy before performing any exercise tolerance or functional capacity assessment test and saw that there have been improvements.

One of the aspects involved in this, is that with the progression of the disease, patients experience difficulties in participating in rehabilitation programs because of dyspnea and reduced tolerance to effort [11,13]. Strategies such as neuromuscular electrical stimulation [14], inspiratory muscle training [15], and noninvasive ventilation [16], along with exercise, are being investigated to maximize the gains made with cardiac rehabilitation programs and optimize the participation of patients in rehabilitation.

Citation: Brandão DC, Figueiredo TG, do Rêgo Barros AEV, de Araújo BTS, Leite JC, Campos SL, et al. Noninvasive Ventilation in Effort Tolerance in Chronic Heart Failure: Mini-Review. Phys Med Rehabil Int. 2020; 7(1): 1169.

The use of noninvasive ventilation in HF patients aims to decrease the respiratory burden and improve gas exchange and can contribute to reducing the dyspnea, increased cardiac debit, and intolerance to exercise [17,18]. Thus, it becomes an alternative to reduce respiratory work, increase arterial oxygenation and lung compliance, due to its sensitive performance in cardiorespiratory interaction, providing a better cardiac and respiratory response during exercise [19].

The idea of using ventilatory support during aerobic training is to reduce respiratory work and increase patients' physical performance, increasing oxygenation in the peripheral muscle microcirculation and improving local blood flow, in addition to improving oxygenation due to increased transpulmonary pressure, which facilitates alveolar ventilation. Likewise, it can act to increase intrathoracic pressure, with a decrease in transmural pressure in the left ventricle, reducing preload and afterload, helping to improve cardiac function and relieve the symptoms of HF [20].

Three studies addressed the use of NIV before the 6-minute walk test (6MWT). The most recent study [21] used inspiratory pressure-IPAP parameters: 12 cmH20 and expiratory pressure-EPAP: 06 cmH20, BIPAP mode, after a 6-minute walk test (6MWT) (test 1), for 30 minutes and then the test was repeated (test 2). There was a greater distance covered and less sensation of dyspnea in the NIV group compared to the control group21. The other two studies[22,23] used a similar protocol, with NIV in CPAP mode = 10cmH20 for 30 minutes before the 6MWT was performed, and found greater distance traveled [22,23], as well as lower values of dyspnea [22] and blood lactate [22] in the group of patients submitted to therapy.

However, this positive response in tolerance to effort was also found through the cardiopulmonary test of maximum effort [24] (TECP). In a current and unique study, using NIV (BIPAP mode, IPAP: 15 and EPAP: 05cmH20) for 30 minutes and right after CPET, there was an increase of 12.3% in peak VO2 (oxygen consumption), increase in duration test, which speaks in favor of improving exercise tolerance, in addition to the reduction in $T_{1/2}$/VO2 (need for shorter recovery time from exercise), increase in maximum heart rate and variation in heart rate (maximum less initial) during the test, indicating improved chronotropic responses. This study allows the clinical implication of such findings is that NIV can be implemented in combinations with physical activity programs to improve performance and optimize training and recovery time in the population with HF [24].

An important and unique study in its analysis variables [25], used NIV (PAV mode) during high intensity exercises in patients with severe chronic HF and found increased tolerance to effort, oxygenation and muscle blood volume in the group submitted to the intervention, demonstrating beneficial effects on the supply of energy to the muscles in activity.

Even so, there are still few studies that used NIV in the context of cardiovascular rehabilitation, highlighting one study26 that used the initial 30 minutes of cardiac rehabilitation to apply a NIV (CPAP = 10cmH20) and then physical training was performed : high intensity aerobic exercises and strength exercises for upper and lower limbs (3 times a week, 10 weeks, total of 30 sessions). The main findings were improvement in dyspnea and quality of life in the group with ventilatory support.

Conclusion

There is favorable evidence for the use of NIV in patients with chronic HF and, therefore, it is necessary to encourage the study of its applicability in the outpatient cardiac rehabilitation environment, in which these patients are inserted to reaffirm the benefits if they persist when there is an association with physical training, in addition to being able to better determine the long-term effects, which ventilation parameters and modes are most appropriate, types of training, in addition to trying to stratify the CI profiles that benefit the most.

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