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Respiratory muscle fatigue and functional capacity in heart failure: a randomized study

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ABSTRACT

Aim: To compare the effect of inspiratory muscle and expiratory muscle fatigue on the functional capacity in outpatients with systolic heart failure. **Method:** a randomized, crossover study, controlled, double-blind, focusing on outpatients, from June 2014 to December 2015. Individuals will be allocated to a group that will perform 80% inspiratory and expiratory muscle effort (IME and EME) in terms of maximum airway pressure to induce fatigue, or 0% for the placebo (three sets of 10 repetitions). The order in terms of effort and load will be randomized. Before and after the respiratory muscle effort, capillary lactate testing and a six-minute walk test will be performed. **Expected results:** Specific training for respiratory muscles can improve the functional capacity and the prognosis of these patients with systolic heart failure.

Descriptors: Heart Failure; Muscle Training; Exercise Tolerance.

INTRODUCTION

Inspiratory muscle training (IMT) has demonstrated beneficial effects in patients with heart failure (HF), such as improvement in peak oxygen consumption, quality of life, dyspnea, decreased inspiratory muscle fatigue due to the attenuation of the metabolic reflex, and increased distance covered on a six-minute walk test (6MWT)⁽¹⁾.

The lessening of expiratory muscle strength is associated with the severity of heart failure⁽²⁾. However, there is no literature about the association between inspiratory and expiratory muscle training for affected individuals. Further study about the influence of the weakness of the respiratory muscles, especially in terms of exhalation, and its repercussions to this population is required. Thus, more specific training for respiratory muscles could improve their symptoms, prognosis and functional capacity (FC).

To assess FC, the 6MWT - a predictor of hospitalization and mortality from HF⁽¹⁾ - should be performed. Thus, this study has the hypothesis that specific training with regard to respiratory muscles can improve muscle strength, functional capacity, quality of life and prognosis of patients with heart failure.

AIM

To compare the effects of inspiratory and expiratory muscle fatigue on the functional capacity in outpatients with systolic heart failure.

METHOD

Study design and participants

Randomized, crossover, controlled, double-blind study, focused on outpatients, from June

2014 to December 2015, at a clinic of Antonio Pedro University Hospital (Niterói / RJ) specializing in heart failure.

Participants

In order to be considered eligible for the study, we selected patients with HFNEF (using Boston criteria)⁽³⁾, functional class II and III (New York American Association), of any gender, of more than 18 years of age, being monitored at the Coração Valente Heart Failure Clinic, Antonio Pedro University Hospital, Fluminense Federal University. Patients with a heart rate greater than 120 bpm at rest, systolic blood pressure of greater than 180 mm/Hg and diastolic pressure of greater than 100 mm/Hg at rest, malnutrition (body mass index < 20kg/m²), cold and/or flu in the four weeks prior to the study, users of psychotropic drugs, muscle relaxants and immunosuppressants, patients with inability to walk due to musculoskeletal problems, with chest pain during the previous four weeks or cognitive changes in their medical records, were excluded from the study.

Variable definitions

The independent variable refers to an intervention through exercise in terms of muscle training, which in turn will have an effect on measure-dependent variables in the form of fatigue, lactate concentration and dyspnea. Associative variables are clinical and sociodemographic characteristics.

Sample calculation

The sample was calculated considering the outpatient population (n = 60) with a 95% confidence level and 5% margin of error. 23 patients were included in this study. Considering a 20%

rate of discontinuance in terms of monitoring of the patients, the estimated sample is 18 individuals. Calculations were done using WinPepi v.11.43 software.

Study protocol

- Stage 1 - multidisciplinary consultation (medical, nursing, nutrition and physiotherapy): analysis of exams of recent images, anthropometry, manovacuometry and 6MWT;
- Stage 2 - Randomization using draw technique in blocks to define the training order: face (IME) and crown (EME). After the draw, the numbered cards will be placed in envelopes and kept in a safe place;
- Stage 3 – IME and EME patients will undergo inspiratory muscle training with a linear load resistor (*powerbreath*) with either 80% of maximal inspiratory pressure or 0% of maximal inspiratory pressure (randomized loads with three sets of 10 repetitions and 1 minute interval between series); only the EME group will hold the expiratory muscle training with a threshold, following the same protocol. The two groups will perform the 6MWT after respiratory muscle training. A capillary blood test will be undertaken to collect lactate before and after RMT;
- Stage 4: Rest for a period of 30 minutes. Patient will then be reviewed, and submitted to respiratory muscle training with a different load;
- Stage 5: 24-hour wash out. After this period there will be a crossover of the groups, with a repetition of the protocols of stages 3 and 4.

Data Analysis

Data organization will be made with the use of Microsoft Excel 2007 software and the analysis using SPSS (*Statistical Package for Social Sciences*)

v.17.0. Categorical variables will be expressed through absolute and relative frequency distributions “n” (%) and percentages. The continuous variables will be calculated in terms of average, median, standard deviation, coefficient of variation (CV) and percentiles. In the inferential analysis, the Student t and Mann-Whitney tests will be used. Cronbach’s alpha will calculate and confirm the reliability of the data. To investigate the association between respiratory muscle strength and distance covered, the chi-square test will be used. For categorical variables, the Pearson correlation coefficient will be used for comparison between groups. A p value < 0.05 will be considered statistically significant for all analyzes.

Ethical aspects

All the volunteers will sign the Informed Consent Form according to the Resolution 466/2012 of the National Health Council (NHC). The study is approved by the Research Ethics Committee of the Antônio Pedro University Hospital (HUAP), at the Fluminense Federal University (UFF), under the opinion 719,591.

EXPECTED RESULTS

We expect that specific training of the respiratory muscles will improve the functional capacity and prognosis of patients with systolic heart failure.

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