Journal of Physiotherapy 61 (2015) 182–189

Journal of PHYSIOTHERAPY

journal homepage: www.elsevier.com/locate/jphys

Research

The Manual Diaphragm Release Technique improves diaphragmatic mobility, inspiratory capacity and exercise capacity in people with chronic obstructive pulmonary disease: a randomised trial

Taciano Rocha [a], Helga Souza [a], Daniela Cunha Brandão [a], Catarina Rattes [a], Luana Ribeiro [a], Shirley Lima Campos [a], Andrea Aliverti [b], Armèle Dornelas de Andrade [a]

[a] *Department of Physical Therapy, Universidade Federal de Pernambuco - UFPE, Recife, Brazil;* [b] *Dipartimento di Elettronica, Informazione e Bioingegneria Politecnico di Milano, Milan, Italy*

KEY WORDS

Respiratory therapy
Manual therapy
COPD
Ultrasonography
Optoelectronic plethysmography

ABSTRACT

Questions: In people with chronic obstructive pulmonary disease, does the Manual Diaphragm Release Technique improve diaphragmatic mobility after a single treatment, or cumulatively? Does the technique also improve exercise capacity, maximal respiratory pressures, and kinematics of the chest wall and abdomen? **Design:** Randomised, controlled trial with concealed allocation, intention-to-treat analysis, and blinding of participants and assessors. **Participants:** Twenty adults aged over 60 years with clinically stable chronic obstructive pulmonary disease. **Intervention:** The experimental group received six treatments with the Manual Diaphragm Release Technique on non-consecutive days within a 2-week period. The control group received sham treatments following the same regimen. **Outcome measures:** The primary outcome was diaphragmatic mobility, which was analysed using ultrasonography. The secondary outcomes were: the 6-minute walk test; maximal respiratory pressures; and abdominal and chest wall kinematics measured by optoelectronic plethysmography. Outcomes were measured before and after the first and sixth treatments. **Results:** The Manual Diaphragm Release Technique significantly improved diaphragmatic mobility over the course of treatments, with a between-group difference in cumulative improvement of 18 mm (95% CI 8 to 28). The technique also significantly improved the 6-minute walk distance over the treatment course, with a between-group difference in improvement of 22 m (95% CI 11 to 32). Maximal expiratory pressure and sniff nasal inspiratory pressure both showed significant acute benefits from the technique during the first and sixth treatments, but no cumulative benefit. Inspiratory capacity estimated by optoelectronic plethysmography showed significant cumulative benefit of 330 ml (95% CI 100 to 560). The effects on other outcomes were non-significant or small. **Conclusion:** The Manual Diaphragm Release Technique improves diaphragmatic mobility, exercise capacity and inspiratory capacity in people with chronic obstructive pulmonary disease. This technique could be considered in the management of people with chronic obstructive pulmonary disease. **Trial registration:** NCT02212184. **[Rocha T, Souza H, Brandão DC, Rattes C, Ribeiro L, Campos SL, Aliverti A, de Andrade AD (2015) The Manual Diaphragm Release Technique improves diaphragmatic mobility, inspiratory capacity and exercise capacity in people with chronic obstructive pulmonary disease: a randomised trial. *Journal of Physiotherapy* 61: 182–189]**

Introduction

Chronic obstructive pulmonary disease (COPD) causes chronic inflammation of the airways and destruction of the lung parenchyma, which lead to structural changes and dynamic collapse in the small airways.[1] Its most striking feature is expiratory airflow limitation (ie, the ability to perform a complete exhalation is impaired, causing air trapping and lung hyperinflation).[1] The hyperinflation causes the diaphragm muscle fibres, which usually lie vertically in the zone of apposition, to become more transversely oriented. This makes the diaphragm's contraction less effective at raising and expanding the lower rib cage, and may even lead to a decrease in the transverse diameter of the lower rib cage during inspiration.[2,3] The diaphragm then undergoes a reduction in the number of sarcomeres to restore its pressure-generating capacity; however, as a consequence, diaphragmatic mobility is reduced. The reduction of diaphragmatic motion is a major risk factor for increased mortality in people with COPD.[4]

The deterioration in airflow limitation with COPD progresses slowly, so most people who present with symptoms of COPD are elderly.[5] Thus, in addition to the parenchymal abnormalities, musculoskeletal changes inherent to the ageing process contribute to worsening symptoms in these people.[5] These musculoskeletal changes include increased chest wall stiffness due to the calcification of the costal cartilages and costovertebral joints.

http://dx.doi.org/10.1016/j.jphys.2015.08.009

Those changes hinder rib cage expansion, increase the work of breathing and reduce functional capacity.[6,7]

Given the interdependent relationship between the respiratory and musculoskeletal systems, various manual techniques have been proposed for the treatment of COPD symptoms. A common goal is increasing the mobility of the thoracic structures involved in respiratory mechanics.[8,9] The Manual Diaphragm Release Technique is an intervention intended to directly stretch the diaphragmatic muscle fibres, which is described in detail in textbooks.[10,11] Although this technique is widely used in clinical practice in some regions, it is believed that, to date, there are no quantitative studies or clinical trials evaluating the effects of this technique. The present study aimed to evaluate the effects of the Manual Diaphragm Release Technique on respiratory function of people with COPD.

Therefore, the research questions for this study were:

1. In people with COPD, does the Manual Diaphragm Release Technique improve diaphragmatic mobility after a single treatment, or cumulatively?
2. Does the technique also improve exercise capacity, maximal respiratory pressures, and kinematics of the abdomen and chest wall?

Method

Design

A single-centre, randomised, controlled trial was conducted in the Physiotherapy Department of the Universidade Federal de Pernambuco, Brazil, to determine the effects of the Manual Diaphragm Release Technique in adults with clinically stable COPD. Eligible participants were randomly allocated to one of two groups according to a random number table, which was held by a research associate who was not otherwise involved in the study. To ensure that allocations remained concealed until eligibility and enrolment were confirmed, the associate did not indicate to the therapist which group the participant would be allocated to until immediately before the intervention. Participants who were randomised to the experimental group received six treatments with the Manual Diaphragm Release Technique, while the control group received six sham treatments. Outcomes were measured before and after the first and sixth treatments. The researchers responsible for outcome measurement and data analysis were not permitted to know which group each participant belonged to. The protocol complied with the Declaration of Helsinki.

Participants, therapists and centre

The study's inclusion criteria were: ex-smokers; clinically stable (ie, no exacerbation in the previous 6 weeks); aged $>$ 60 years; and post-bronchodilator measurements of forced expiratory volume in one second (FEV_1) $<$ 80% predicted and $FEV_1 \leq 0.7$ of forced vital capacity (FVC).[1] The exclusion criteria were: other cardiopulmonary diseases, body mass index $>$ 30 kg/m^2, previous thoracic surgery, lack of consent, and inability to understand the verbal commands necessary for the outcome assessments.

A portable spirometer[a] was used to assess FEV_1 and FVC according to American Thoracic Society/European Respiratory Society criteria,[12] which were interpreted against predicted values for the Brazilian population.[13] Age and gender were also recorded at baseline.

The interventions were applied by a single investigator, who had 8 years of experience as a physiotherapist and 3 years of experience specifically treating respiratory patients. Participants were recruited from the local university hospital. The study was conducted in a dedicated laboratory for cardiopulmonary physiotherapy research within the Physiotherapy Department.

Intervention

Participants in both groups received six treatments, separated by 1 to 2 days, during a 2-week period. The same therapist performed the intervention in both groups, in order to ensure similar application of the experimental and sham interventions.

Participants assigned to the experimental group received the Manual Diaphragm Release Technique, as shown in Figure 1. The participant lay supine with relaxed limbs. Positioned at the head of the participant, the therapist made manual contact with the pisiform, hypothenar region and the last three fingers bilaterally to the underside of the seventh to tenth rib costal cartilages, with the therapist's forearms aligned toward the participant's shoulders. In the inspiratory phase, the therapist gently pulled the points of contact with both hands in the direction of the head and slightly laterally, accompanying the elevation of the ribs. During exhalation, the therapist deepened contact toward the inner costal margin, maintaining resistance. In the subsequent respiratory cycles, the therapist progressively increased the depth of contact inside the costal margin. The manoeuvre was performed in two sets of 10 deep breaths, with a 1-minute interval between them.

In the control group, a sham protocol was applied. Manual contacts, duration, and positioning of the therapist and participant were the same as in the experimental group, but the therapist maintained only light touch with the same anatomical landmarks, without exerting pressure or traction.[14] This was intended to blind all participants about their group assignment during the study.

Outcome measures

The primary outcome was diaphragmatic mobility and the secondary outcomes were exercise capacity, maximal respiratory pressures, and abdominal and chest wall kinematics. Outcomes were measured in both groups on four occasions: before and immediately after the first treatment session (Pre 1 and Post 1) and immediately before and after the sixth treatment session (Pre 6 and Post 6). The only exception was exercise capacity, which was measured at Pre 1 and Pre 6.

Diaphragmatic mobility

To evaluate diaphragmatic mobility, a high-resolution ultrasound[b] with a 3.5 MHz convex transducer was used according to the protocol suggested by Testa and colleagues.[15] Each participant was verbally instructed to perform an inspiratory capacity manoeuvre, and each curve corresponding to the diaphragmatic

Figure 1. Manual Diaphragm Release Technique. Source: Authors' own photo. With the participant lying supine, the therapist made manual contact (pisiform, hypothenar region and the last three fingers) with the underside of the costal cartilages of the seventh to tenth ribs. During the participant's inspiration, the therapist pulled gently in a cephalad direction accompanying the elevation movement of the ribs. During exhalation, the therapist deepened contact toward the inner costal margin. On subsequent breaths, the therapist sought to gain traction and smoothly deepen the contact. The manoeuvre was performed in two sets of 10 deep breaths, with a 1-minute interval between them.