



Short-term effects of three slow expiratory airway clearance techniques in patients with bronchiectasis: a randomised crossover trial

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Abstract

Objective To compare the efficacy of three slow expiratory airway clearance techniques (ACTs).

Design Randomised crossover trial.

Setting Tertiary hospital.

Participants Thirty-one outpatients with bronchiectasis and chronic sputum expectoration.

Interventions Autogenic drainage (AD), slow expiration with glottis opened in lateral posture (ELTGOL), and temporary positive expiratory pressure (TPEP).

Main outcomes Sputum expectoration during each session (primary endpoint) and in the 24-hour period after each session. Leicester Cough Questionnaire (LCQ) score and spirometry results were recorded at the beginning and after each week of treatment. Data were summarised as median difference [95% confidence interval (CI)].

Results Median (interquartile range) daily expectoration at baseline was 21.1 (15.3 to 35.6) g. During physiotherapy sessions, AD and ELTGOL expectorated more sputum than TPEP [AD vs TPEP 3.1 g (95% CI 1.5 to 4.8); ELTGOL vs TPEP 3.6 g (95% CI 2.8 to 7.1)], while overall expectoration in the 24-hour period after each session was similar for all techniques ($P=0.8$). Sputum clearance at 24 hours post-intervention was lower than baseline assessment for all techniques [AD vs baseline -10.0 g (95% CI -15.0 to -6.8); ELTGOL vs baseline -9.2 g (95% CI -14.2 to -7.9); TPEP vs baseline -6.0 g (95% CI -12.0 to -6.1)]. The LCQ score increased with all techniques (AD 0.5, 95% CI 0.1 to 0.5; ELTGOL 0.9, 95% CI 0.5 to 2.1; TPEP 0.4, 95% CI 0.1 to 1.2), being similar for all ACTs ($P=0.6$). No changes in lung function were observed.

Conclusions Slow expiratory ACTs enhance mucus clearance during treatment sessions, and reduce expectoration for the rest of the day in patients with bronchiectasis.

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Introduction

Impaired mucociliary clearance in patients with non-cystic fibrosis bronchiectasis (henceforth referred to as 'bronchiectasis') [1] usually produces a continuous productive cough that affects patients' quality of life significantly

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[2–4]. Mucus retention has also been associated with a major decline in lung function, more exacerbations and a higher risk of mortality in patients with bronchiectasis and other chronic respiratory diseases [3,5,6].

Current guidelines for the management of bronchiectasis and physiotherapy indicate that bronchial drainage could be a relevant non-pharmacological tool to avoid mucus retention [7,8] and possibly improve quality of life [9]. Nevertheless, evidence supporting this common belief remains scarce [10].

Slow expiratory airway clearance techniques (ACTs) [i.e. autogenic drainage (AD), slow expiration with glottis opened in lateral posture (ELTGOL), and positive expiratory pressure devices] are currently attracting more interest than conventional chest physiotherapy techniques (i.e. postural drainage, percussion and vibration) due to higher patient adherence and preference [11,12]. The main mechanism to improve mucus clearance is the generation of expiratory flow exceeding inspiratory flow [13], thereby making slow expiratory ACTs (flow-assisted/active drainage) an option to increase mucus transportation.

AD is the most popular self-administered technique in cystic fibrosis [14], but very limited information is available in patients with bronchiectasis [15]. Evidence supporting the use of ELTGOL in respiratory diseases has grown in the last few years [16–18]. Finally, temporary positive expiratory pressure (TPEP), a new positive expiratory pressure technique, has been proposed recently in some European countries for people with hypersecretion [19,20].

No ACT has been shown to be more effective than another in improving mucus clearance in bronchiectasis [21,22], possibly due to methodological limitations. Indeed, the short-term effects of chest physiotherapy are usually evaluated during a single session [22], and the effects of long-term mucus clearance are not considered after the intervention.

As adherence to treatment over time is a usual limitation for all ACTs [12,23], it is crucial to select the most appropriate technique according to patient autonomy and preferences in order to improve results [8]. However, the short-term effectiveness of slow expiratory ACTs with different degrees of autonomy (total autonomy, requiring physiotherapist assistance or device-dependent) has not been investigated to date in respiratory diseases. Therefore, a comparative trial assessing the efficacy of different techniques is needed to help physiotherapists to choose the most appropriate therapy for each patient.

Accordingly, three slow expiratory ACTs (AD, ELTGOL and TPEP) with different degrees of autonomy were studied to determine the effects of mucus clearance in stable adult patients with bronchiectasis and chronic expectoration. The secondary aim of this study was to evaluate differences between the techniques related to the impact on cough, lung function and patient preference.

Methods

Patients

Patients were recruited from the Bronchiectasis Clinic of Hospital Clinic, Barcelona, Spain from October 2010 to June 2013. The inclusion criteria were: (1) radiological diagnosis of bronchiectasis based on a high-resolution computed tomography chest scan; (2) mean daily production of spontaneous sputum ≥ 15 ml (measurements from two non-consecutive days during the week prior to starting the protocol); and (3) clinical stability over the previous 6 weeks (defined as no need for extra antibiotics or changes in usual therapy, no haemoptysis and no clinical features of exacerbation) [24].

Participants were excluded for the following reasons: (1) smokers or former smokers; (2) cystic fibrosis; (3) active interstitial lung disease or active tuberculosis [9]; (4) severe lung function impairment [forced expiratory volume in 1 second (FEV₁) $\leq 30\%$ predicted, forced vital capacity (FVC) $\leq 45\%$ predicted and peak expiratory flow < 270 l/minute]; and (5) regular chest physiotherapy during the previous month (at least two sessions per week) [9]. Withdrawal criteria were: (1) pulmonary exacerbation during the study; or (2) any new medical or personal condition hindering study continuation. Patients only participated once in the study.

Written informed consent was obtained from the patients, and the study was approved by the Hospital Clinic Research Ethics Committee.

Study design

Three slow expiratory ACTs were compared in an open-label, randomised three-way, crossover trial. Block randomisation was computer generated by an independent investigator, and the allocation was concealed. Each technique was applied in three non-consecutive sessions during the same week. A 7-day washout period was required between the different techniques to avoid carryover effects. Therefore, the three treatment arms lasted 5 weeks in total (Fig. 1). The study was performed in accordance with the CONSORT statement for non-pharmacological trials (Clinical Trial Registration Number NCT01854788).

Physiotherapeutic interventions

Three slow expiratory ACTs with different levels of autonomy were used.

Autogenic drainage

Patients were instructed to breathe from lower lung volume levels in the expiratory reserve volume, through higher lung volume levels into the inspiratory reserve volume with the glottis open [13,25]. This technique was considered to have total autonomy as the physiotherapist only gave advice to patients during the performance of AD.

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