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Intervention

Effects of guided deep breathing on breathlessness and the breathing pattern in chronic obstructive pulmonary disease: A double-blind randomized control study

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ABSTRACT

Objective: To investigate whether guided deep breathing using a device improves breathlessness, quality of life, and breathing pattern in moderate and severe stage of chronic obstructive pulmonary disease (COPD).

Methods: In total, 150 patients participated in a double-blind randomized controlled trial in a four-week intervention and a four-month follow-up. Participants were randomized into a guided deep breathing group (GDBG), music listening group (MLG), or sitting still group (SSG). The patients' symptom score using the St George's Respiratory Questionnaire (SGRQ), and a Global Rating Change scale (GRC) was applied to measure breathlessness as primary outcome. The activity score and impact score of SRGQ, and breathing pattern were secondary outcomes.

Results: Positive effects of the GDBG were detected in GRC scale in breathlessness at four weeks ($p = 0.03$) with remaining effect compared to MLG ($p = 0.04$), but not to SSG at four months follow-up. GDBG showed positive effect for respiratory rate ($p < 0.001$) at four weeks follow-up. A positive significant change ($p < 0.05$–0.01) was found in all groups of SGRQ symptom score.

Conclusion: GDBG had a beneficial effect on respiratory pattern and breathlessness. MLG and SSG also yielded significant improvements.

Practice implications: Guided deep breathing may be used as a self-management procedure.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is demanding for the individual patient and the symptom breathlessness and impaired quality of life (QOL) [1,2] increase during the more severe stages of the disease [3]. Breathlessness is often the reason why patients with COPD seek medical help. Thus, relieving symptoms and improving QOL are important aims for patient care and treatment approaches [3]. The use of pharmacological treatments alone is not effective; thus, additional nonpharmacological approaches such as breath retraining exercises have been suggested [4].

COPD is caused by a complex array of physical changes such as chronic obstruction of the airways and destroyed alveoli. This may lead to an overload or fatigue of respiratory muscles, disturbances of gas exchange between the lung and blood and air trapping [4]. Hence, people with COPD may develop an ineffective breathing pattern in form of an insufficient ventilation, resulting in an increased respiratory rate (RR), decreased vital capacity, and decreased time on inspiration (TIN), and expiration (TEX), which are also associated with symptoms of breathlessness/dyspnea [5,6].

Diaphragmatic breathing, deep breathing, yoga breathing, and pursed-lip breathing are breathing exercises that can affect the

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ability [7] to improve an ineffective breathing pattern, to breathe deeply and, thereby reducing breathlessness.

Studies have investigated the effects of diaphragmatic, pursed-lip breathing, and yoga breathing, but few were randomized control trials (RCTs) [8–11]. For instance, a recent systematic review by Holland et al. [10], based on pooled data from two RCTs reports that practicing pursed lip breathing gave less breathlessness. In the same review, one RCT on diaphragmatic breathing and one on yoga breathing showed effects on disease related QOL. All the said studies were rated as being of low to moderate quality and the results were interpreted as inconsistent, indicating that additional high quality RCTs are required. In addition, other interventions such as music listening alone and in combination with breathing control exercises have been found to reduce breathlessness in patients with COPD [12]. In order to refine the evidence of BCEs it is important to design breathing control trials that control for other interventions that might reduce breathlessness.

Previous studies that employed a biofeedback device to guide the user to breathe more deeply have reported positive effects on symptoms [13], blood pressure [14], and QOL [13,14] in patients with heart failure [13] and hypertension [14]. In the biofeedback device a voice guides the users through air phones/plugs telling them to follow music tones on inspiration and expiration based on the respiratory movement, measured with a sensor belt, while breathing patterns are stored in the device [15].

Such device-guided breathing control based on musical tones and instruction has not been investigated in patients with COPD and we hypothesize that it may guide patients to breathe more deeply and slowly and have positive effects on their breathing pattern and breathlessness.

In the present study, we performed a three-armed double-blind RCT to investigate whether subjects in the moderate and severe stages of COPD reported beneficial effects on breathlessness, QOL, and their breathing pattern after a four weeks intervention program using device-guided breathing control and at four months follow-up compared with a group who listened to music and a sham control group who sat still.

2. Methods

2.1. Research design

We performed a three-armed, parallel group, double-blind, randomized RCT where the patients were in the moderate or severe stages of COPD. The arms comprised a guided deep breathing group (GDBG), a music listening group (MLG), and a sham group sitting still (SSG).

In total, 150 patients with COPD who had been diagnosed with moderate and severe stages of COPD according to the Global Initiative for Chronic Obstructive Lung Disease criteria participated in this study [3]. The patients were enrolled between July 2011 and September 2013 from outpatient units at three different hospitals in Oslo, Norway (Hospitals A, B, and C) following similar treatment procedures. All the participants were offered free transportation to attend individual appointments at the main hospital A.

2.2. Recruitment

At each hospital nurses and doctors were instructed to screen for and recruit eligible patients with moderate and severe stage COPD. Patients were given oral and written information at each hospital before they consented to be contacted by telephone by the researcher or a study nurse to confirm their willingness to participate in the study as well as fulfilling the exclusion and inclusion criteria (Table 1).

Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Diagnosis of COPD in medical records with moderate stage or severe stage[a] at inclusion.	Change in medication during the last four weeks.
MRC dyspnea scale[b] $\geq$1 at inclusion.	Diagnosis of cancer.
Able to read, write, and speak Norwegian	Presently attending a pulmonary rehabilitation course or other similar COPD education course.
	Attending a competing study.
	Diagnosis of neuromuscular disease or dementia.
	Present drug abuse or alcohol abuse.
	Receiving help from a pulmonary physiotherapist.

[a] Moderate stage and severe stage = FVC $<$ 70% and FEV1% $\geq$ 30% and $\leq$ 80% of predicted values (FVC = forced volume capacity, FEV1 = forced expiratory volume in 1 s).

[b] MRC (Medical Research Council) dyspnea scale measures disabilities associated with breathlessness using five levels (0–4), where a higher score represents more disabilities associated with breathlessness.

2.3. Ethics

The study was approved by the data protection supervisor of the three hospitals and by the Regional Committee for Medical Research Ethics for Southern Norway (reference number: 2010/1521), as well as reported to the Clinical Trials government registry (ClinicalTrials.gov identifier: NCT015120043). The protocol complied with the Declaration of Helsinki. All participants signed a written consent before entering the study.

2.4. Intervention

The participants were instructed orally and in writing by a study nurse on how to use the device (RespeRate, InterCure Inc., New York, USA; www.Resperate.com/MD) [13,15]. The device was used for the first time at the hospital for 15 min and later at home, twice a day (i.e. morning and evening) for four weeks. When using the device the participants were told to sit down in a comfortable chair with few interrupting elements around them.

During the intervention, the patients used the same device to measure their breathing pattern, but different instructions were given via earphones/earplugs.

The GDBG group members used the device and received instructions about how to breathe slowly based on their RR, which was measured by a sensor belt that was placed around the waist. The device played soft, non-rhythmic music in the background, and a voice instructed the participants to breathe out while the musical note lasted during expiration, whereas a new musical note followed during inspiration.

The MLG group members listened to the same music being played in the background as the GDBG group members, but they were not given any instructions to breathe slowly.

The SSG members only received an introductory instruction to sit down and listen to the same music for 1–2 min, but without any instructions about breathing or music during the at the rest of the session.

2.5. Data collection

A questionnaire booklet covering self-reported outcomes related to sociodemographic variables, breathlessness, and QOL was sent by postal mail. Participants were asked to complete the questionnaire at home 1–2 days before attending the main project hospital at baseline (T1), in the follow up after four weeks (T2) and four months after baseline (T3).