Article ID: WMC001904 ISSN 2046-1690

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Article ID: WMC001904

Article Type: Research articles

Submitted on:27-Apr-2011, 04:57:44 AM GMT **Published on:** 27-Apr-2011, 05:08:28 PM GMT

Article URL: http://www.webmedcentral.com/article_view/1904

Subject Categories:REHABILITATION

Keywords: Pursed-lip Breathing, Arterial Blood Gases, Activities of Daily Living

How to cite the article: Izadi-avanji F S, Adib-Hajbaghery M . Effects of Pursed Lip Breathing on Ventilation and Activities of Daily Living in Patients with COPD . WebmedCentral REHABILITATION 2011;2(4):WMC001904

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Abstract

Background

Breathing rehabilitation techniques are designed to reduce symptoms, decrease disability, increase participation in physical and social activities, and improve the overall quality of life for individuals with chronic respiratory diseases. However, the role of these techniques remains unclear. This study examined the effects of pursed-lip breathing (PLB) on the respiratory function, arterial blood gases and the activities of daily living in patients with COPD.

Methods

A before-after quasi-experimental study was conducted on 40 COPD patients in Kashan, Iran. Spirogram and ABG were tested before and after three-months of PLB exercise and the Airway Questionnaire 20 (AQ20) was used to assess activities of daily living. Wilcoxon matched pairs was used for statistical analysis.

Results

O2sat was significantly increased ($P < 0.05$) and a tendency toward an increase in PaO2 was observed after three months of exercise. In addition, a decrease in PaCO2 ($P < 0.05$) and the respiratory rate ($P < 0.001$) was observed. Activities of daily living was also increased ($P < 0.001$). Forced expired volume second one (FEV1%) and forced vital capacity (FVC) did not change ($P > 0.05$).

Conclusion

Breathing retraining program can improve lung functions, arterial blood gas and the levels of activities of daily living. Therefore, breathing retraining should be included in respiratory physiotherapy programs in patients with COPD.

Introduction

Chronic obstructive pulmonary diseases (COPD) are major causes of disability and death [1]. It also imposes a significant economic and social burden, based on data from American and European studies [2-4]. Complications such as respiratory insufficiency and failure are major life-threatenning complications of COPD [5] that dramatically alter the well being of COPD patients as well as their Quality of life. Studies have shown the negative effects of the disease on the patients' activities, social functioning and emotional status [6,7]. Although standard medical therapy can alleviate symptoms, many patients with these diseases suffer from distressing symptoms of breathlessness that results from a chronic, irreversible and disabling disease. Since a comprehensive care program for patients with COPD was first described [1], pulmonary rehabilitation has become an established way to enhance standard therapy to control symptoms and optimize functional capacity of patients with disabling chronic lung diseases [1,8-14]. Breathing retraining techniques (BRTs) such as pursed-lip breathing (PLB) are important components of the comprehensive care programs [15,16]. Many investigators have studied the physiologic responses to PLB and other BRTs and reported different results in lung volumes, blood gases and exercise tolerance [8- 12, 17-18]. So, the role and efficacy of breathing retraining techniques such as PLB in the rehabilitation of people with COPD remains unclear [13-14, 19].

Although previous studies have shown important benefits of pulmonary rehabilitation, including increased exercise tolerance and quality of life and a decreased number of symptoms and use of health care services [9,14], However, these techniques are not considered as an integral part of the clinical management and health maintenance of patients with chronic respiratory disease in Iran because of equivocal evidences for its usefulness as well as poor staffing in hospitals and lack of facilities for formal patient education in clinical settings. So, COPD patients usually suffer fatigue and their distressful symptoms and frequently refer to the physician offices, emergency and hospitals and usually experience a considerable decrease in their quality of life. On the other hand, little is published related to these patients in Iran. Therefore, this study aimed to determine the effects of a breathing retraining educational program on physiologic criteria and activities of daily living in a sample of Iranian COPD patients.

Methods

This quasi-experimental study was conducted in the respiratory ward of Shahid Beheshti Hospital in Kashan, Iran. This is an educational hospital affiliated with Kashan University of Medical Sciences. All COPD patients without cardiac, renal? hepatic and gastrointestinal disorders as well as patients with uncontrolled diabetes and/or hypertension who hospitalized during the study have considered as potential samples. Diagnosis of COPD was made according to the American Thoracic Society (ATS) criteria [20]. A longitudinal case registry method was used and 40 patients were initially volunteered to enroll in the study. However, nine patients declined to complete the study. All patients were free from their exacerbation for at least 7 days; they continued their bronchodilators and refrained from smoking at least two weeks before the study.

Instruments

Two instruments were used including a checklist (consisting of demographic and anthropometric data such as age, sex, weight, height and smoking history, arterial blood gases and spirogram results, respiratory rate (RR) and the Airways Questionnaire 20 (AQ20) [21].

Pack-year was calculated according the following formule [(number of cigaretes multiplied by smoking years) divided to 20 [22]. Body mass index [BMI] was calculated by dividing the weight to the height² (kg/m²) [23]. Arterial blood gases (ABG) were assessed by means of an ABL-300 analyzer. The blood samples were obtained from radial artery? during spontaneous breathing of room air in the semi-recumbent position. Spirogram was assessed using a spirometer, model Fukuda ST-95.

The AQ20 has been developed to measure and quantify disturbances in the activities of daily living and health-related quality of life (HRQoL) of patients with asthma or COPD. It has 20 items with yes, no, and not applicable responses. "Yes" responses are scored as 1, and "No" and "Not applicable" are scored as 0. The AQ20 scores range from 0 to 20, with a score of zero indicating no impairment. However in this study we reversed the scoring system so that the "Yes" responses were scored as 0, and "No" and "Not applicable" were scored as 1, hence, the score of 20 indicated no impairment.

The questions of the original English version of the AQ20 were initially translated into Farsi. Subsequently, a physician with a good knowledge of English performed a retrograde translation into English. The two English versions (original and retrograde) were compared. No specific item needed to be replaced. Reliability was calculated using the Spearman Correlation Coefficient (r=0.91).

Interventions

The researchers contacted each of the potential participants to explain the objectives of the study. If the participant agreed to take part in the research, an educational sessions was held for each patient on the day of discharge. An arterial blood sample was obtained for ABG analysis and a spirometry performed before the educational session. The patients' respiratory rate was also checked by the stuff nurse who was not aware of the study and then was recorded in the patients' checklist. All the educational sessions were conducted by the first researcher. At the beginning of the sessions all subjects were administered the AQ20 and demographic-anthropometric checklist. Then the subjects were educated for Pursed Lip Breathing. The content of educational sessions was similar for all subjects. It consisted of a talk delivered by the main researcher on the benefits and the technique of PLB [to inhaled through their nose for at least 2-3 seconds (with a closed mouth), then exhaled slowly for 4 to 6 seconds through pursed lips held in a “whistling” position [24], followed by showing the technique by the researcher as a role player. Then the patients wanted to exercise the technique. They also watched the effects of PLB on their O2 saturation in a pulse oximeter. I t was assumed that this biofeedback might encourage patients to continue PLB in home. At the end of educational session and were instructed to performed PLB four times a day [before each meal and before sleep for at least 30 minutes]. The patients were also given the researchers' telephone number and were asked to contact the researchers if they experienced chest pain and sever dyspnea during the exercises. Each educational session lasted for 30 minutes averagely.

Main researcher phoned patients every two weeks and checked them for their compliance and any complication. After follow-up for three months, each patient invited to the hospital and the final evaluation was done similar to the initial process [including fulfilling the AQ20 and checklist].

This study received ethics approval from the ethic committee of Kashan University of Medical Sciences. All subjects provided written consent before participation.

Statistical Analysis

Data analysis was performed by SPSS using descriptive and analytical statistics. All data are presented as mean and standare deviation. Comparison between the results before and after the intervention was made by the Wilcoxon matched pairs

test. A p-value of less than 0.05 was considered significant.

Results

Forty patients were initially recruited; however, three of them presented chest pain during the study and six did not return for the final evaluation, making up 31 patients at final stage (including 22 male and 9 femal). The mean age of the participants was 71 years (sd=16). They had an average of 68 kg of weight (sd=21 kg) and an average of 168 cm of heights (sd=6 cm). the mean BMI of the participants was also 25.7 (sd=4.7). They also had an average of 37.1 pack-year of smoking (sd=14). After three months of pursed-lip breathing exercise, O2 Saturation (SaO2) was significantly increased (P =0.002). Though a tendency was observed toward an increase in PaO2 but it was not statistically significant. In addition, a decrease in $PaCO_2$ was observed that was equal to 6.4% (P =0.014). The pH of arterial blood did not change(table 1). No significant statistical changes were observed in the forced expired volume second one (FEV1%) and forced vital capacity (FVC) (table 1). The breathing frequency was significantly decreased (P=0.000). level of activities of daily living was also increased (table 1).

Discussion

The present study showed that PLB could improve arterial blood gases and the QoL in patients with COPD. The most changes observed in PaCO2 that decreased more than 6%. Also The respiratory rate was significantly decreased. Mueller et al have evaluated the effect of PLB on PaO_2, $PaCO_2$ and oxygen saturation (SaO_2) in COPD patients at rest and during exercise. They found a significant increase in PaO_2 and SaO_2 and a significant decrease in $PaCO_2$ at rest[11]. Several researchers reported that PLB and some other breathing exercises could prolonge expiration and would decrease the EELV, leading to lower raspiratory rate and higher tidal volume; the end result is an improvement in ventilatory efficiency [11, 12, 25-28].

Our study showed that regular PLB exercises could increase SaO2. In addition, an insignificant increase was observed in PaO2. These findings are consistent with Tiep et al [29]. Also Jones et al [30] have reported that breathing rehabilitation techniques such as PLB could significantly reduce oxygen consumption in patients with stable COPD. These authors recommended that COPD patients can be trained to use breathing rehabilitation techniques in order to minimize their metabolic demands of respiration.

The present study showd that PLB assisted the patients toward optimal capabilities in carrying out their activities of daily living and improved their overall quality of life. Previous studies have shown that , progressive hyperinflation occurs in severe COPD. So, breathing becomes more tachypneic and a larger fraction of the breath is composed of anatomic dead space air [31]. These changes compromise the ability of the inspiratory muscles to generate enough pressure and eventually inspiratory muscle weakness results [32]. Therefore, many activities of daily living of these patients are limited. These limitations would decrease the quality of life and psychosocial disability would eventually occure. Breathing retraining techniques such as PLB could decrese the patient's tieredness and this cycle would interrupted. Some other researchers have also hypothesized that breathing retraining may reduce hyperinflation and thus improve the pationt's endurance [33,34]. Previous researches have also showed that PLB causes an increas in recruitment of the accessory muscles of the chest wall and abdominal muscles activity throughout the entire respiratory cycle while, at the same time, the work of diaphragmatic muscle decreases. All these changes would lead the COPD patients to breathe more efficiently and consume less oxygen [12, 25, 30].

Conclusion(s)

Our study was the first study on the breathing retraining in our region. We conclude that PLB can lead to significant changes in the variables of the breathing pattern in patients with COPD. The breathing pattern associated with PLB could make the ventilatoin more efficient and will increase the arterial oxygen saturation. as the present study showed, education should be a key factor in the rehabilitation of patients with COPD and pursed lip breathing should be taught and practiced. We did not use a control group and therfore furthere studies with a control groupe is suggested.

Acknowledgement(s)

The authors would like to acknowledge Kashan University of Medical Sciences for supporting the project and the assistance of all patients who participated in this research. We also thanks for Dr Ibrahim Razi for his valuable helps in the process of the study.

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Illustrations

Illustration 1

Table 1- Blood gases, lung function studies and The score of ADL before and after the intervention

Table 1

Variable	Before	After	P
	Mean±sd	Mean±sd	(by Wilcoxon matched pairs test)
SaO2	85.6 ±5.9	88.6 ± 4.3	0.002
PaO2	58.7±11.7	62 ±14.8	0.116
PaCO2	51.5 ±11	48.2 ±8.5	0.014
PH	7/37±4.4	7.38 ±3.9	0.101
FEV1 (%)	56.9 ±9.4	57.9 ± 10.4	0.071
FVC (%)	76.9 ±12.1	75.2 ±9.3	0.563
RR	24.3 ±3.6	23.1 ±2.9	0.000
ADL	8.4±5.2	10.45±5.4	0.000

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