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Original Research Article

RESPONSE OF EXPIRATORY MUSCLES TRAINING TO POSITIVE END EXPIRATORY PRESSURE IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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ABSTRACT

Introduction: Although expiratory muscles have been little studied it is known that expiratory muscle strength is impaired in most patients with significant chronic obstructive pulmonary disease (COPD), the expiratory muscles partake in the generalized muscle weakness that is observed in those patients. The decreased expiratory muscle strength was associated with reduced patient's exercise capacity. There is need to find an alternate cost effective, easy technique which can help strength the expiratory muscles and improve the exercise capacity. An intervention like applying positive end expiratory pressure (PEEP) training could help in strengthening of expiratory muscles and improving the exercise capacity in patient with COPD.

Procedure: Forty COPD male patients were assigned into two equal groups: Group A consisted of 20 males whom received PEEP (10-20 cm H_2o, 15 minutes session, once daily for 4 weeks) plus standard chest physiotherapy. Group B consisted of 20 males received standard chest physiotherapy only. Maximum Expiratory pressure (MEP) and Six-minute walk distance (6MWD) were measured for each patient before and after treatment.

Results: There was a significant difference (p= 0.041) between study and control group patients in MEP post treatment (84.35 ± 9.73 vs 77 ± 12.11 cm H_2o). There was significant difference (p= 0.045) between study and control group patients in 6MWT post treatment (339.7 ± 54.126 vs 301.65 ± 61.78).

Conclusion: Positive expiratory pressure therapy is efficient in improving the expiratory muscle strength and exercises capacity and helps COPD patients to improve their active life.

KEY WORD: COPD, PEEP, Expiratory muscles, MEP, 6MWT.

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INTRODUCTION

(COPD) is a syndrome characterized and defined by a single physiological parameter: limitation of expiratory airflow. COPD has gained interest as a major public health concern and is currently the focus of intense research because of its persistently increasing prevalence, mortality [1]. COPD is a preventable and treatable disease that characterized by Reduction in oxygenation, pulmonary functions, and respiratory muscle strength, as well as radiological changes such

as atelectasis and air flow limitation which is not fully reversible. associated with an abnormal inflammatory response of the lung to cigarette smoke and other noxious particles or gases [1].

It is more likely that expiratory muscles of COPD patients, which persistently work under the overloads of increased airway resistance and decreased lung elastic recoil, would develop muscle dysfunction. It should be recognized, however, that the intensity of expiratory muscle dysfunction appears to be relatively low if compared with weakness shown by COPD patients in peripheral or inspiratory muscles [2].

(PEEP) therapy involves the application of a resistance to expiration in order to produce positive airway pressure. It is thought to stabilize airways, prevent premature airway closure improve ventilation and reduce gas trapping.

It has been used, and is recommended, as component of respiratory physiotherapy management for varying groups including those with cystic fibrosis acute and chronic respiratory disease and in the post-operative setting. Improvements in secretion clearance, functional residual capacity and oxygenation have been demonstrated with the use of positive expiratory pressure therapy [3].

However, there is little information about the actual clinical usage of(the technique, there is little definition of the patient groups most commonly prescribed PEEP therapy, the methods of administration [3].

Since muscle weakness might be improved through different mechanisms by training. These problems arouse our interest to investigate the response of expiratory muscle training to PEEP on COPD patients.

This study was designed to respond to the relative lack of information about the impact of using PEEP therapy on expiratory muscle strength measured by maximum expiratory pressure MEP and exercise capacity measured by six-minute walking test (6MWT).

MATERIALS AND METHODS

Subjects:

Forty COPD male patients, their ages ranged from 45 to 65 years. There were no significance differences ($p > 0.05$) between both groups in age. They were selected from the chest department , faculty of Medicine, Kasr Al Einy hospital.

Inclusion criteria: All Patients included in this study were diagnosed as mild to severe COPD,on optimized medical therapy all over the study, clinically stable (not suffering from recent respiratory tract infection 3 weeks before the study), they are willing to participate in the study.

Materials Used: 1. peep device (Astra Tech AB, Export, Sweden). 2. Micro Respiratory Pressure Meter (Micro RPM) from Micro Medical Ltd. 3. Stopwatch 4.an expiratory airway pressure indicator. 5. Pen and paper.

Forty COPD male patients were assigned into two equal groups: Group A consisted of 20 males with received (PEEP) (10-20 cm H2o, 15 minutes session, 1times per day-daily for 4 weeks) plus standard chest physiotherapy (postural drainage, percussion, vibration, and breathing exercises). Group B consisted of 20 males received standard chest physiotherapy only. Maximum Expiratory pressure (MEP) and Six-minute walk distance (6MWD) was measured for each patient before and after treatment

Procedures: A verbal explanation about the importance of this study procedure, main aims and conceptual approach was explained to every patient. an informed written consent was taken from them.

The procedures of this study divided into two main procedures: subjects in group A use (PEEP) device with one session daily for 4 consecutive weeks the patients had to breath in, but not to total lung capacity then exhale gently, the pressure detected by an expiratory airway pressure indicator is inserted into the system to pressure range from 10–20 cm H2O. Exhalation time lasted approximately 3 times longer than inhalation. One minute of PEEP breathing was followed by 2-3 forced expirations or huffs, a short period of relaxation and controlled breathing. Then repeat for 15 minutes (should stop if they experience breathlessness or any severe discomfort).

In both groups MEP (cm H_2o) to measure the expiratory muscles strength and 6MWT (meter) to measure the exercise capacity was taken pre

and post the study for each patient [4,5,6].

Statistical procedures: Statistics were analyzed using SPSS software package. Results are shown as the mean ± SD. Both t-tests were used to assess significance of differences within each group and between the two groups. Significance was accepted as P-value ≤ 0.05.

RESULTS

In study group the mean values ± SD of maximum expiratory pressure increased from 70.3± 8.7 to 84.35 ± 9.76 cm H_2o after applying Positive End Expiratory Pressure (PEEP). The mean difference was -14.05. Which is highly significance (P=0.000).

In control group the mean values ± SD of maximum expiratory pressure before the experiment was 76.6 ± 13.22 cm H_2o while after the experiment was 77 ± 12.118 cm H_2o. The mean difference was - 0.4. which is statistically insignificant (P=0.438).

Table 1: MEP before and after treatment for the study group.

Item	MEP (cm H2o)			MD	t-value	P-value	Sig
	$\bar{X}$±SD	Min	max				
Before	70.3 ± 8.7	54	90	-14.1	-8.736	0.000	S
After	84.35 ± 9.76	65	105				

Table 2: MEP before and after treatment for the control group.

Item	MEP (cm H2o)			MD	t-value	P-value	Sig
	$\bar{X}$±SD	Min	max				
Before	76.6 ± 13.22	57	105	-0.4	-0.793	0.438	NS
After	77 ± 12.118	57	100				

Table 3: 6MWT before and after treatment for the study group.

Item	6MWT (meter)			MD	t-value	P-value	Sig
	$\bar{X}$±SD	Min	max				
Before	291.35 ± 58.86	163	395	-48.4	-13.79	0.000	S
After	339.7 ± 54.126	215	439				

Table 4: 6MWT before and after treatment for the control group.

Item	6MWT (meter)			MD	t-value	P-value	Sig
	$\bar{X}$±SD	Min	max				
Before	298.95 ± 62.27	190	390	-2.7	-1.532	0.142	NS
After	301.65 ± 61.78	197	403				

In study group the mean values ± SD of 6 minutes' walk test increased from 291.35 ±58.86 to 339.7 ± 54.126 after applying Positive End Expiratory Pressure (PEEP). The mean difference was -48.35. Which is highly significant (P=0.000).

In control group the mean values ± SD of 6 minutes' walk test before the experiment was 298.95 ± 62.27 while after the experiment was 301.65 ± 61.27. The mean difference was -21.2 Which is statistically insignificant (P=0.142).

DISCUSSION

There is much less data related to the expiratory muscles in COPD patients, However the expiratory muscle strength is impaired in most patients with significant COPD., the expiratory muscles partake in the generalized muscle weakness that is observed in patients with COPD. The decreased expiratory muscle strength was associated with reduced exercise capacity and reduced quality of life [7].

This study was designed to respond to the relative lack of information about the impact of using peep on expiratory muscle strength measured by MEP and submaximal exercise capacity measured by (6MWT).

The result of our study revealed statistically significant improvement in expiratory muscle strength (MEP), and exercise capacity (6MWT) after using the PEEP. as expiratory muscles can be trained similarly to the peripheral muscles with inexpensive devices that increase the resistive or threshold expiratory load on the expiratory muscles.

While decreased expiratory muscle strength was associated with reduced patient's exercise capacity [8] then wherever the expiratory muscle become stronger the patient significantly improved in their exercise capacity measures as the result of our study. And consequently, suggest a causative role for the former mechanism(PEEP).

Our findings are consistent with the results of the Study done by Nicolini A et al., 2014, Results supporting the use and the effectiveness of PEEP in (COPD) patients.

The difference that the study was three groups of intermittent positive pressure breathing(IPPB) temporary positive expiratory pressure(TPEP) and a group with pharmacological therapy alone, mean age was relatively higher 70±6, The duration of each treatment was 30 min per session

and was given twice daily with pressure only1cm H_2O [9].

Our findings are also consistent with the results of the study in 2013, Nicolini et al., they used the positive expiratory pressure (PEP) during the 6MWT which found that low threshold PEP of only 5cmH2O improved the distance walked in patients with moderate-to-severe COPD [10].

However, Wibmer et al., 2014 investigated the same kind of patients and found that, with a flow-dependent PEP in the range of 10–20 cm H2O, patients walked 30.8m less than the controls without devices [11].

Furthermore, Study by Mascardi V et al.,2016 using Temporary positive expiratory pressure (T-PEP) a device which applies an expiratory pressure d"1 cmH2O only two-week treatment with T-PEP but in this study in hospital and at home, Result revealed that MEP and 6MWT improved significantly in the two TPEP groups [12].

Also, Study done by Chien-Ling Su et al., 2006 stated that Four-week of positive expiratory pressure (PEP) as an adjunct to forced expiratory technique (FET) further enhanced 6minute walk distance(6MWD), and reduced cough difficulty compared to FET only in COPD patients with mucus hypersecretion [13].

However, Study done by Russo D et al., 2016 in patients with severe COPD, the application of 1cmH2O of PEP seems to improve the exercise tolerance as 10 cmH2O, with similar dyspnea during 6MWT [14].

Martin et al.,2011 applied two levels of threshold PEP (13.8 and 2 cm H2O) and demonstrated a significant decrease in dyspnea with the use of the higher level of PEP after a treadmill constant load test. the authors applied PEP only after the conclusion of the exercise test, rather than before - as our study- or during effort [15].

Weiner et al.,2003 studied the effects of expiratory muscle strength training (EMST) on expiratory muscle strength and, exercise performance as the participants of both groups exhaled through the expiratory port of the (Threshold Inspiratory Muscle Trainer). The treatment group, the expiratory load modified from 15 to 60 percent of their MEP, and the sham group was trained with a low load of 7 cm H2O they reported statistically significant changes in the treatment group: an increase (21%) in the MEP and statistically significant increase (19%) in the distance walked during 6MWT [7].

Finally, Future studies may lead to a more practical utilization of positive expiratory therapy. And further studies needed to test the effects of different levels PEEP on expiratory muscle strength and during aerobic and strength training protocol.

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Conflicts of interest: **None**

REFERENCES

[1]. Spyratos D, Chloros D, Sichletidis L **(**Diagnosis of chronic obstructive pulmonary disease in the primary care setting. Hippokratia 2012;16(1):17-22.

[2]. Susana Mota, Rosa Gu ell, Esther Barreiro, Ingrid Solanes, Alba Ram ýrez-Sarmiento, Mauricio Orozco-Levi, Pere Casan, Joaquim Gea, Joaquin Sanchis, Clinical outcomes of expiratory muscle training in severe COPD patients, respiratory Medicine 2007;101;516–524.

[3]. Johnston CL, James R, Mackney JH.The current use of positive expiratory pressure (PEP) therapy by public hospital physiotherapists in New South Wales. New Zealand Journal of Physiotherapy 2013;4 1(3):88-93.

[4]. American Thoracic Society Statement. Guidelines for the six-minute walk test. Am J Respir Crit Care Med 2002;166:111–7.

[5]. Acquistapace F, Piepoli M: The walking test: use in clinical practice. Monaldi Arch Chest Dis 2009;72:3–9.

[6]. Enright, P. L., Kronmal, R. A., Manolio, T. A., Schenker, M. B. & Hyatt, R. E. Respiratory muscle strength in the elderly. Correlates and reference values. Cardiovascular Health Study Research Group. American Journal of Respiratory and Critical Care Medicine, 1994;149(2):430-438.(

[7]. Weiner P, Magadle R, Beckerman M, Weiner M, Berar-Yanay N. Specific expiratory muscle training in COPD. Chest. 2003;124(2):468–73.

[8]. Ramirez-Sarmiento A, Orozco-Levi M, Barriero E, et al. Expiratory muscle endurance in chronic obstructive pulmonary disease. Thorax 2002;57:132–136.

[9]. Nicolini A, Mollar E, Grecchi B, et al. Comparison of intermittent positive pressure breathing and temporary positive expiratory pressure in patients with severe chronic obstructive pulmonary disease. Arch Bronconeumol 2014;50:18-24.

[10]. NicoliniA, MerliakF, Barlascini C. Use of positive expiratory pressure during six minute walk test: results in patients with moderate to severe chronic obstructive pulmonary disease. Multidiscipl Resp Med. 2013;8:19.

[11]. Wibmer T, Ridiger S, Heitner C, Kropf-Sanchen C, Blanta I, Stoiber KM, et al. Effects of nasal positive expiratory pressure on dynamic hyperinflation and 6- minute walk test in patients with COPD. Respir Care. 2014;59:699–708.

[12]. Mascardi V, Grecchi B, Barlascini C, Banfi P, Nicolini A. Effectiveness of temporary positive expiratory pressure (T-PEP) at home and at hospital in patients with severe chronic obstructive pulmonary disease. J Thorac Dis 2016;8(10):2895-2902.

[13]. Su, C-L., Chiang, L. L., Chiang, T. Y., Yu, C. T., Kuo, H. P., & Lin, H. C. Domiciliary positive expiratory pressure improves pulmonary function and exercise capacity pulmonary with chronic obstructive pulmonary disease. Journal of the Formosan Medical Association = Taiwan yi zhi, 2007;106(3):204-211.

[14]. Russo D, Simonelli C, Paneroni M, Saleri M, Piroddi IMG, Cardinale F, et al. ¿Cuál es el nivel óptimo de presión espiratoria positiva (PEP) capaz de mejorar la tolerancia a la deambulación de los pacientes con EPOC grave? Arch Bronconeumol. 2016;52:354–360.

[15]. Martin AD, Davenport PW. Extrinsic threshold PEEP reduces post-exercise dyspnea in COPD patients: a placebo-controlled double-blind cross-over study. Cardiopulm Phys Ther J. 2011;22:5–10.

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