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Research Article

EFFECT OF STRETCHING RESPIRATORY ACCESSORY MUSCLES IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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ABSTRACT

Objective: To determine the effects of respiratory accessory muscles stretching in chronic obstructive pulmonary disease (COPD).

Methods: A total of 30 patients with COPD were selected based on the inclusion and exclusion criteria. Group allocation was randomized and divided into two groups: Group A was treated with stretching respiratory accessory muscles and Group B was treated with conventional therapy (diaphragmatic breathing exercise and thoracic mobility exercise). All the patients were evaluated with chest expansion measurement using inch tape, dyspnea grade using modified Borg's scale, and 6 minutes walk test at baseline after which, treatment for a period of 4-week was given and same tests were repeated for post-test analysis at the end of 4 weeks.

Results: There is a significant difference between pre- and post-tests mean values in both groups. Group A being highly significant with a greater difference in pre- and post-tests values with a $p<0.0001$ for chest expansion measurements, modified Borg's scale and 6 minutes walk test.

Conclusion: This study showed that respiratory accessory muscle stretching significantly improved chest expansion, reduced dyspnea, and increase exercise tolerance level in patients with COPD.

Keywords: Chronic obstructive pulmonary disease, Respiratory, Accessory muscle stretching.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is considered as a systemic disease affecting not only lungs but also peripheral muscular system which further contributes to decrease oxygen delivery [1]. COPD is one of the leading cause of mortality and morbidity as the disease prevalence rate is underestimated due to the delay in diagnosis of the disease [2]. The disease is progressive and is characterized by acute exacerbations causing breathlessness, cough, and respiratory distress. The primary cause for COPD is repeated exposure to cigarette smoke, although occupational exposures may contribute toward its development. However, cigarette smoking plays a vital role [3]. The respiratory muscles are expected to function continuously throughout life to provide the appropriate level of ventilation for meeting the metabolic demands raised in the body [4]. Although various recommendations for management of COPD is available, concentrating on the peripheral muscular system helps to increase flexibility of muscles through stretching where contraction of the agonist against resistance takes place. Self-stretching, passive mobilization of joints and massage are also other techniques to manage peripheral muscle system [5].

In patients with severe COPD, mechanical efficiency of respiratory muscles causes decreased rib cage motion and increase abdominal motion leading to paradoxical pattern of breathing [6] which is common in diaphragm dysfunction. Due to dysfunction of diaphragm, accessory muscles of respiration play a major role. They are scalene, sternocleidomastoid, upper trapezius, pectoralis major, and serratus anterior. The activity of these muscles elevates shoulder girdle and increases vertical motion of the rib cage during the inspiratory phase of breathing. Retraction of these soft tissues and muscles around the chest wall limits the chest expansion [7]. These accessory muscles including abdominal muscle weakness and tightness could affect the diaphragm and cause severe breathlessness and poor exercise tolerance level.

Respiratory muscle stretch is a technique originally developed to alleviate exercise-induced respiratory distress in patients with the chronic pulmonary disease. In this technique afferent activities of external and internal intercostals muscle spindle are lengthened, to alleviate dyspnea to minimize the atrophy of respiratory muscles and facilitate coordinated contraction of respiratory muscles [8]. Systemic manifestations of COPD are known to involve both respiratory and peripheral muscles; respiratory muscles among COPD are exposed to potential imbalance between the needs and demands [9].

Lengthening of soft tissue around the chest wall and respiratory muscles helps efficiently in the contraction force and chest movement by gaining the lung volumes, breathing control [10]. Muscle stretching is a technique which is widely used in a rehabilitation program to increase flexibility as the muscle fibers are incapable of lengthening by itself, so it requires an external force, respiratory muscle are functional complex group of muscles. Stretching of muscle fibers promotes increase in the number of sarcomeres. In patients with COPD, muscle length would increase the efficacy of respiratory muscles and promote respiratory mechanics [11].

Due to the accessory muscle tightness in COPD patients, chest expansion is decreased, where the rib cage movement is also reduced which leads to hyperinflation leading to a chronic reduction of the opposition zone of the diaphragm. Therefore, this study focuses on chest mobilization technique by stretching the respiratory accessory muscles to determine its effects on chest expansion, dyspnea level, and exercise tolerance.

METHODS

An experimental study was performed after obtaining Ethical Committee approval at Saveetha Medical College Hospital; the study included 30 participants at Saveetha Medical College Hospital. An informed consent had been obtained from all the participants before initiation of the study.

Male and female participants aged between 30 and 55 years, diagnosed with COPD according to GOLD classification included dyspnea, ex-smokers, those with or without medications. Study excluded those with lung carcinoma, recent surgery history, any acute inflammatory conditions, smoking habit, unstable vital signs, and recent chest injuries. The following which Group allotment was randomized and was divided into two groups: Groups A and B.

All the subjects underwent pre-test measurement for chest expansion, dyspnea level with modified Borg scale and exercise tolerance measured using 6 minutes walk test and the same tests was repeated for post-test following the treatment duration of 1-month.

Group A

Group A - The experimental group was treated with hold and relax techniques of stretching to respiratory accessory muscles with coordinated breathing exercise. During hold time, the patient was asked to breathe in and during relax time breathe out.

The main respiratory accessory muscles were involved in stretching, and the procedure is explained below:

Upper trapezius

- Position of the subject: Sitting position and lean the neck to the opposite side
- Procedure: The therapist asked the subject to laterally flex the neck and head from side being stretched and slightly flex neck forward and depress the shoulder along with breathing exercise during hold and relax time.

Sternocleidomastoid

- Position of the subject: Standing or sitting position and align the spine and neck in neutral position
- Procedure: The therapist asked the subject to position the head in flexion, ipsilateral side flexion, and contralateral rotation along with breathing exercise during hold and relax time.

Pectoralis major

- Position of the subject: Standing
- Procedure: The therapist asked the subject to stand tall with the help of the forearm against a wall and the elbow to bend 90° on the side to be stretched, then gently turn the body away from the wall until a mild to moderate stretch is felt across chest along with breathing exercise during hold and relax time.

Lattismus dorsi

- Position of the subject: Standing
- Procedure: The therapist asked the subject to stand tall and put one arm overhead and use the other arm to grasp the elbow or wrist and gently pull down toward the opposite shoulder along with breathing exercise during hold and relax time.

Scalene

- Position of the subject: Sitting or standing position
- Procedure: The therapist asked the subject to place hand over the head and pull to the side to stretch the muscle along with breathing exercise during hold and relax time.

Serratus anterior

- Position of the subject: Standing straight and placing both hands at the back
- Procedure: The therapist asked the subject to reach behind the back and hold hand together and pull involved side across back at waist level and asked the subject to relax and repeat on opposite side along with breathing exercise during hold and relax time.

Treatment protocol

- Hold time: 10 seconds/muscle.
- Repetitions: 10 times/minutes for each muscle.
- Frequency: 4 times a week
- Duration: 1 month.

Group B

The control group was treated with conventional methods of the treatment which included diaphragmatic breathing exercises and thoracic mobility exercises.

Diaphragmatic breathing exercise

- Position of the subject: Sitting or half lying
- Procedure: The therapist asked the patient to place one hand on the patient's chest region and the other on the abdomen, and the patient was asked to breathe slowly and comfortably with inspiration and expiration - 4 times/week with - 10 repetitions/3 set/session/day.

Thoracic mobility exercises

- Position of the subject: Sitting
- Procedure: The patient was asked to exhale while bending forward to touch the floor with arms crossed at the feet, then the patient was asked to extend up while taking a deep inspiration and lift the arm up with a frequency of 4 times/week - 10 repetitions/3 set/session/day.

RESULTS

From the statistical analysis made with the quantitative data revealed statistically significant difference between the Groups A and B, and also within the group. Comparison of pre- and post-tests results of chest expansion measurements for Group A (Table 1) and Group B is shown in Table 2. Both Groups A and B post-test mean value of chest expansion were compared in the Graph 1 which shows that Group A is greater significant than Group B with the p=0.001.

Table 1: Comparison of pre- and post-operative results of chest expansion measurements for Group A

Group A chest expansion	Mean±SD		t value	p value
	Pre	Post		
Axilla level	0.787±0.508	1.460±0712	8.8729	0.0001
4 ICS level	1.093±0.524	1.500±0.562	17.8226	0.0001
Xiphi level	1.113±0.587	1.493±0.595	9.3889	0.0001

SD: Standard deviation, 4 ICS: 4th Intercostal space

Table 2: Comparison of pre- and post-operative results of chest expansion measurements for Group B

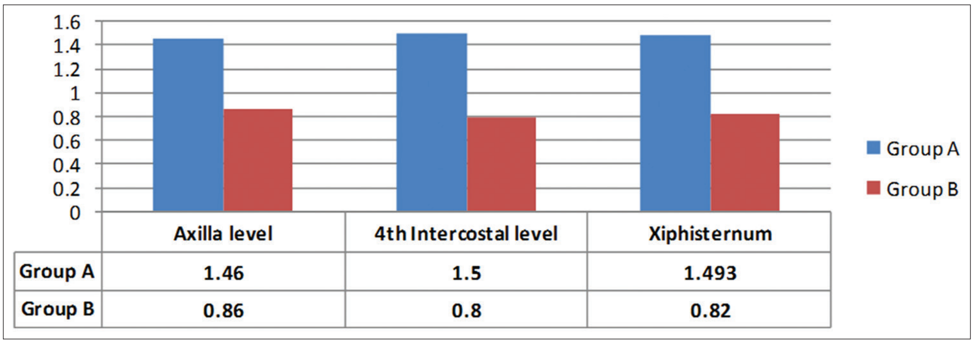
Group B chest expansion	Mean±SD		t value	p value
	Pre	Post		
Axilla level	0.600±0.355	0.860±0.414	5.344	0.0001
4 ICS level	0.740±0.676	0.800±0.366	3.6742	0.0025
Xiphi level	0.760±0.269	0.820±0.273	3.6742	0.0025

SD: Standard deviation, 4 ICS: 4th Intercostal space

Table 3: Comparison of pre- and post-operative results for modified Borg scale between Groups A and B

Group	Mean±SD		p value
	Pre	Post	
Modified Borg scale			
A	1.23±1.02	1.17±0.08	0.001
B	2.53±1.060	2.27±1.100	

SD: Standard deviation



Graph 1: Comparison of post-test results of chest expansion measurement between Groups A and B

Table 4: Comparison of pre- and post-operative results for 6 minutes walk test

Group	Mean±SD		t value	p value
	Pre	Post		
6 MWT				
A	306.63±62.38	305.45±70.45	3.65	0.001
B	311.93±60.45	302.5±60.12	18.5	0.003

6 MWT: Minute walk test, SD: Standard deviation

Table 3 shows the comparison of pre- and post-tests results between Groups A and B of modified Borg's scale. Group A is greater significant than Group B with the p=0.001.

Pre- and post-tests values of 6 minutes walk test were compared between Groups A and B shown in Table 4. The post-test mean value of 6 minutes walk test in Group A is greater significant than Group B with the p=0.001.

Statistical analysis shows that there is a significant difference between pre- and post-tests mean values in both groups. Group A being highly significant with a greater difference in pre- and post-tests values with a p<0.0001 for chest expansion measurements, modified Borg's scale and 6 minutes walk test.

DISCUSSION

Chronic obstructive pulmonary disease is considered as a systemic disease affecting lungs as well as many other organs [12]. Their manifestations lead to skeletal muscle dysfunction mainly affects leg muscles as Muscle fatigue is more predominant than dyspnea in some patients with COPD [19]. The severity of COPD progresses to restriction of upper limb usage, as hyperinflation of chest places pectoralis major muscle in shortened position and secondary postural deformities develop such as elevated shoulder girdle, protracted and abducted scapulae with medially rotated humerus, increased tightness and stiffness of accessory muscles of respiration, increased work of breathing [12].

The purpose of this study was to enhance chest expansion and facilitate the normal respiratory pattern of breathing, as the patients with COPD more commonly use accessory muscles for breathing which becomes tightened. The study was conducted for a period of 4-week which uses simple exercises and is cost-effective. The results showed significant improvement in Group A which consists of respiratory accessory muscles stretching with co-ordinated breathing exercise in COPD patients over Group B, which consists only of conventional therapy.

Lanza Fde *et al*. demonstrated that chest wall mobility is associated with the lung volume. It shows that greater the respiratory muscle strength increases the lung volume, greater the expansion of both the upper and lower rib cage enhancing the chest wall mobility during inspiration [13]. Results of this study show that stretching enhances the chest expansion by lengthening the accessory respiratory muscles.

Puckree concluded that intercostals stretch was effective in altering the breathing pattern sufficiently by stretching the intercostals spaces during inspiration and improved gas exchange in patients with pulmonary disorders [14]. Wada *et al*. evaluated effect of respiratory muscle stretching on thoracoabdominal mechanics and functional capacity in COPD patients and found that respiratory muscle stretching improves the ventilatory capacity and functional capacity of the individual by reducing dyspnea [15].

Etnyre et al concluded that inhibitory neural influences have an effect in reducing motor pool excitability, that is assumed to reduce muscle contractility thereby improves muscle compliance by reciprocal activation and promotes in muscle lengthening [20]. Thereby accessory inspiratory muscle self-stretching exercises increase joint mobility of thoracic cage and thereby further improves pulmonary function. The study targeted on self stretching of accessory inspiratory muscles, showed improvement in expiratory vital capacity, expiratory reserve volume and inspiratory reserve volume, and increase in chest muscle length, enhancing the pulmonary function [16]. Intercostals stretch activates stretch receptors in the chest wall and stimulates the efferent nerve cells which are neurologically linked with medulla and enhances the chest wall elevation, expansion of intra-thoracic lung volume which improves intra-thoracic lung volume and flow rate percentage which further enhances oxygen saturation [17]. Minoguchi *et al*. compared the respiratory muscle stretching with inspiratory muscle training among COPD and have found that respiratory muscle stretch gymnastics were clinically benefitted than inspiratory muscle training [18].

This study has used exercise regiment which consists of stretching respiratory accessory muscles with coordinated breathing exercise in COPD patients. Once the patient gets accustomed to the exercise in the hospital it requires no equipment at all, is easy to perform, thus making pulmonary rehabilitation cost-effective, which is well suitable for Indian population. The active method of treatment included in this study appears to be safe and effective in chronic respiratory patients. However, this study has provided evidence that hold and relax stretching techniques can improve the restrictive component of COPD and improve chest wall mobility by increasing chest expansion, reduced dyspnea level and increase exercise tolerance level by improving 6 minutes walk distance in patients with COPD in the short-term.

REFERENCES

1. Wagner PD. Skeletal muscles in chronic obstructive pulmonary disease: Deconditioning, or myopathy? Respirology 2006;11(6):681-6.
2. Celli BR, MacNee W Standards for the diagnosis and treatment of patients with COPD: A summary of the ATS/ERS position paper. Eur Respir J 2004;23(6):932-46.
3. De Troyer A, Estenne M. Functional anatomy of the respiratory muscles. Clin Chest Med 1988;9(2):175-93.
4. MacIntyre NR. Muscle dysfunction associated with chronic obstructive pulmonary disease. Respir Care 2006;51(8):840-7.
5. O'Shea SD, Taylor NF, Paratz J. Peripheral muscle strength training in COPD: A systematic review. Chest 2004;126(3):903-14.
6. Ito M, Kakizaki F, Tsuzura Y, Yamada M. Immediate effect of

respiratory muscle stretch gymnastics and diaphragmatic breathing on respiratory pattern. Respiratory Muscle Conditioning Group. Intern Med 1999;38(2):126-32.
7. Courtney R. The functions of breathing and its dysfunctions and their relationship to breathing therapy. Int J Osteopath Med 2009;12:78-85.
8. Aida N, Shibuya M, Yoshino K, Komoda M, Inoue T. Respiratory muscle stretch gymnastics in patients with post coronary artery bypass grafting pain: Impact on respiratory muscle function, activity, mood and exercise capacity. J Med Dent Sci 2002;49(4):157-70.
9. Gea J, Pascual S, Casadevall C, Orozco-Levi M, Barreiro E. Muscle dysfunction in chronic obstructive pulmonary disease: Update on causes and biological findings. J Thorac Dis 2015;7(10):E418-38.
10. Leelarungrayub D. Chest mobilization techniques for improving ventilation and gas exchange in chronic lung disease. In: Kian-Chung O, editor. Chronic Obstructive Pulmonary Disease – Current Concepts and Practice. Ch. 20. p. 399-422. Available from: http://www.intechopen.com.
11. Moreno MA, Catai AM, Teodori RM, Borges BL, Cesar Mde C, Silva Ed. Effect of a muscle stretching program using the Global Postural Reeducation method on respiratory muscle strength and thoracoabdominal mobility of sedentary young males. J Bras Pneumol 2007;33(6):679-86.
12. Putt MT, Watson M, Seale H, Paratz JD. Muscle stretching technique increase vital capacity and range of motion in patients with chronic obstructive pulmonary disease. Arch Phys Med Rehabil 2008;89(6):1103-7.
13. Lanza Fde C, de Camargo AA, Archija LR, Selman JP, Malaguti C, Dal Corso S. Chest wall mobility is related to respiratory muscle strength and lung volumes in healthy subjects. Respir Care 2013;58(12):2107-12.
14. Puckree T, Cerny F, Bishop B. Does intercostal stretch alter breathing pattern and respiratory muscle activity in conscious adults. Physiotherapy 2002;88(2):89-97.
15. Wada J, Borges-santos E, Silva RA, Porras DC, Paisani D, Silva CM, *et al*. Effects of respiratory muscle stretching on thoracoabdominal mechanics, functional capacity and dyspnea in COPD patients. Eur Respir J 2014;44: (Suppl 58) P3662.
16. Han D, Yoon N, Jeong Y, Ha M, Nam K. Effects of cervical self-stretching on slow vital capacity. J Phys Ther Sci 2015;27(7):2361-3.
17. Mohan V, Aziz KB, Kamaruddin K, Leonard JH, Das S, Jagannathan MG. Effect of intercostals stretch on pulmonary function parameters among healthy males. EXCLI J 2012;11:284-90.
18. Minoguchi H, Shibuya M, Miyagawa T, Kokubu F, Yamada M, Tanaka H, *et al.* Cross-over comparison between respiratory muscle stretch gymnastics and inspiratory muscle training. Intern Med 2002;41(10):805-12.
19. Casaburi R, ZuWallack R. Pulmonary rehabilitation for management of chronic obstructive pulmonary disease. N Engl J Med 2009;360(13):1329-35.
20. Etnyre BR, Abraham LD. H-reflex changes during static stretching and two variations of proprioceptive neuromuscular facilitation techniques. Electroencephalogr Clin Neurophysiol 1986;63(2):174-9.