A Comparative Study between Inspiratory Muscle Training and Breathing Retraining Exercises on Improving Functional Capacity of Chronic Bronchitis Patients

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Abstract-
Aim
To compare between inspiratory muscle training(IMT) and breathing retraining Techniques(BRT) on improving functional capacity of chronic bronchitis patients.

Materials and methods:
For this study, sixty eight patients with moderate COPD were enlisted. Two groups were formed at random as the IMT and BRTgroup, they were given inspiratory training and breathing retraining exercises ranging from 15% to 60% of their maximum inspiratory capacity and breathing capacity. In addition to their prescribed drugs, both the groups received training and exercise for three days a week for eight weeks.

Results:
Forced vital capacity (FVC) andForced expiratory volume in the first second (FEV_1)improved greatly in both the IMT and BRT groups.In the 6-minute walking distance, each groups revealed a substantial improvement.

Conclusion:
To enhance the pulmonary function test (PFT), the respiratory muscle strength, and 6-minute walking distance (6MWT) both IMT and BRT must be included in pulmonary rehabilitation programs.

Key words -Chronic Obstructive Pulmonary Disease(COPD), respiratory muscle strength, Inspiratory Muscle Training (IMT), Breathing Retraining Exercises (BRT), spirometer, 6MWT.

I. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a chronic, intensifying lung disease that affects a large number of people around the world. Patients must receive medication for the remaining of their lifespan because it is incurable. It's a crippling illness that limits patients' movements and turns into a societal burden with high economical risks due to frequent hospitalizations. Respiratory muscle weakness is the ideal source behind this disability.

The Inspiratory muscle training (IMT) most predominantly used to develop enhanced inspiratory muscle strength and decreasingthe symptoms of the sense of dyspnea. However, the studies on the Breathing Retraining Techniques (BRT) is very much limited and available studies only show contradictory results. Thus the current research focus on the IMT and BRT in patients with COPD

Although with the advancements in medical treatment of COPD patients, these patients continue to be symptomatic, with severe dyspnea and minimal everyday activities(1).COPD is a disease that causes progressive airflow limitation and is partly reversible. Cigarette smoking is the cause for a crucial likelihood towards COPD, which affects the lungs as well as having a systemic effect (2, 3). By 2030, COPD is predicted to be the sixth most common cause of disability-adjusted life years and the fifth most common cause of death(4)

One of the most well-known indications in COPD is exercise indolence and this could be exceptional for also patients in higher degree of airflow limitation (5). Because hypoxemia noted as a tolerant training impact with a primary consideration of aerobic metabolism, the diaphragm does not convey thedropdown in oxidative capacity in COPD patients. Thus, it is critical to include diaphragm strength training and inspiratory muscle training in pulmonary rehabilitationsimilar patients rather than endurance training (6)–(8). Expiratory muscles, on the other hand, demonstrate a decrease in force and endurance (9). COPD patients with generalised myopathy may experience weakness in their respiratory muscles, which is often followed by inadequate coughing (10). Patients with COPD, particularly those who are hypercapnic (with CO2 retention), exploring abnormal length–tension relationship of the respiratory muscles, which set aside the chemical parameters for dyspnea. Because of that, when dyspnea occurs during exercise, more expiratory muscles start up(11)

Because of its comfortability, popularity, and reflectability, the 6MWT is a common submaximal test for assessing functional capacity in COPD patients (12, 13). The pressure created by the inspiratory and expiratory muscles can be concomitantly quantified at the mouth level as an indicator of respiratory muscle strength (2)

Hence it is proclaimed that, training the respiratory muscles can result in fibre type changes toward type IIa as well as increased strength, no extra benefits in terms of exercise capacity have been established (14) With a well-accepted data base, IMT is now a days recommended asefficientmodule of pulmonary rehabilitation. Resistive or pressure threshold equipment could be used to strengthen the inspiratory or expiratory muscles. Comparative clinical studies and effectiveness of this method have demonstrated favorable results, pressure threshold systems are more reliable (15).

Patients with inspiratory muscle weakness, lower PaO2, or higher PaCO2 may benefit considerably from IMT in terms of functional capability and inspiratory muscle strength, according to the findings (16). On the other hand, there are mixed results when it comes to the impact of various breathing exercises on oxygen saturation levels(17).Only limited data on the outcomes from BRT on respiratory muscle strength and exercise tolerance are available (18,19).Hence the current research could be promulgated as a trial of Evidence-based practice(EBP) in this controversial area of COPD patient management.

II. MATERIALS AND METHODS

This study has beenendorsed by the Ethical Committee of Vels Institute of Science and Technology and Advanced Studies and follows the recommendations proposed by the Statements framed by this commitee

In this study, the comparison of the effects of IMT and BRT on 68 patients has been focused. Both of the patients had baseline inspiratory muscle weakness (as measured by a decrease in maximal inspiratory pressure [MIP]) and expiratory muscle weakness (as measured by a decrease in maximal expiratory pressure [MEP]), and after the training program, proclaimed advancement in their respiratory muscle strength and 6-min walk test (6MWT).

When the absolute and relative changes between the two groups were evaluated, it was determined that both IMT and BRT are efficacious in increasing respiratory muscle efficiency and functional ability as determined by the 6MWT. The IMT group has made more progress.

2.1 Patients-

The current study included 68 individuals with a mild degree of COPD, as defined by the American Thoracic Society's guidelines. They were selected from the Shri Isaarivelan Mission Hospital's outpatient clinic in Chennai. Spirometry testing with forced expiratory volume in the first second (FEV1) of the projected expiratory airflow constarintswas considered to find out the degree of expiratory airflow limitation.

The participants were between the ages of 40 and 60. These patients neithersuffered any respiratory illness in the previous two months, nor were they participating in a pulmonary rehabilitation programme.

The following were used as exclusion criteria: severe airflow obstruction (FEV_1 50% of predicted value), chest infection within the previous two months, chronic respiratory failure requiring supplemental O_2, use of drugs such as corticosteroids or anabolic steroids within the previous three months that could affect neurological or musculoskeletal disorders, CO_2 retention, decreased exercise capacity, cardiac disease, mental disorders and pulmonary hypertension that could affect cooperation.

2.2 Instrumentation

The assessment instrument utilized for this study is Spirometry.

To meet the inclusion criteria, the extent of expiratory airflow obstruction was determined with the help of a micro respiratory pressure meter, that is, to estimate forced vital capacity (FVC), FEV_1 and FEV_1/FVC to measure MIP and MEP for evaluation before and after the pulmonary rehabilitation program, and to adjust the intenseness of the resisted breathing exercises for the study groups. MIP and MEP can be used to estimate respiratory muscle strength indirectly.

III. PROCEDURES

3.1 Assessment procedure

The greatest value was noted to identify the degree of airflow obstruction before and after the study. FVC, FEV_1, and FEV_1/FVC were measured three times and the biggest value was noted to identify the degree of airflow obstruction before and after the study. The two biggest values of FVC or FEV_1 should not differ by more than 5% to assure test repeatability. The tests were carried out in a sitting position.

3.2 6-Minute walk test

This walking test was conducted for a distance of 30-meter with an instruction to walk with their maximum possible capacity of speed. Patients were instructed to stop if they were unable to continue and then restart walking. During the test, pulse oximetry was used to discontinue the walking test if the SpO2 fell below 4 percent of the resting value or below 90%.The test was performed two times at an interval of 15-minute break in between each trial, with the mean value observed to account for the training effect.

3.3 Data analysis

The t-test was used to compare subject characteristics in both groups. The effect of training on FEV1, FVC, FEV_1/FVC, and 6MWT was examined using a Pre-test and Post-test study. The interlinkage effects of treatment and time were analyzed.

IV. RESULTS

4.1 Flow chart – Experimental methods

The personals from both the genders male and female contributed topatients selected for this study.The disease severity was moderate. Two groups of 68 COPD patients with moderate severity of disease were selected for IMT and BRT for a period of eight weeks. Pretest and posttest values were compared for both the groups. The flowchart for this study is shown in Figure 1.

4.2 Pretest comparison between IMT and BRT groups

The pretest values of FEV1/FVC ratio of IMT and BRT groups were found to be 0.624 and 0.621 respectively with the p-value of 0.05($p \leq 0.05$).

4.3 Posttest comparison between IMT and BRT groups

The posttest values of FEV1/FVC ratio of IMT and BRT groups were found to be 0.632 and 0.630 respectively with the p-value of 0.05($p \leq 0.05$). The post test values of the six minute walk test(6MWT) were observed as 65 and 48 for IMT and BRT groups respectively.

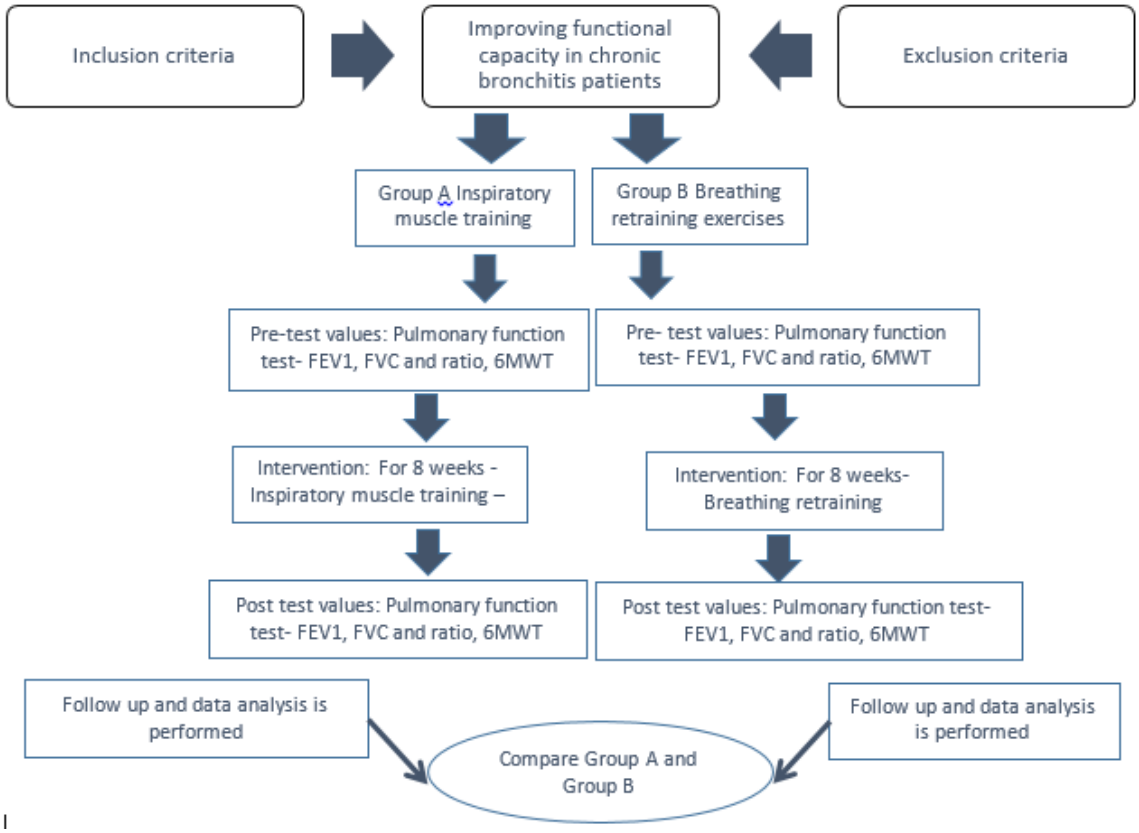

Figure 1. Flow chart for the study procedure

The pre test and post test values of FEV_1/FVC of both the study groups are shown in Figure 2 and the values the of 6- minute walk test is depicted in Figure 3.

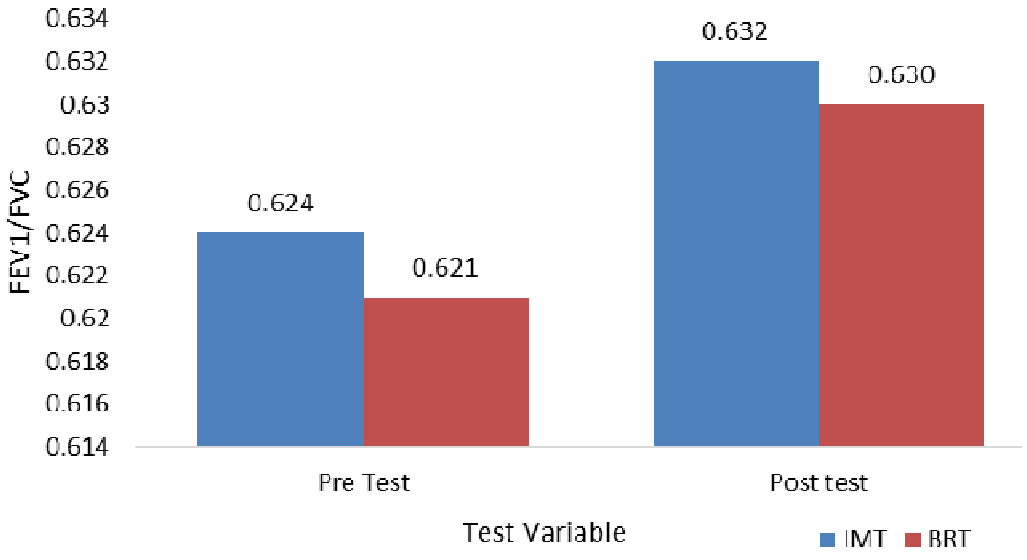

Figure 2. The Pre-test and Post-test values of FEV_1/FVC of both the study groups

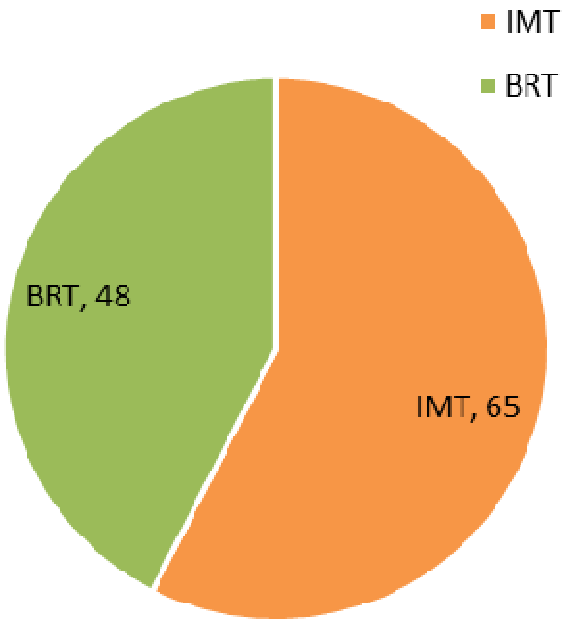

Figure 3. Values of 6- minute walk test

V. DISCUSSION

Bernie M Bissett et al.,(20) has reported rapid strength gain while giving IMT for 2 weeks on mechanically ventilated patients, the present study goes in good agreement while giving IMT for COPD patients.

F. S. F.RAM et al.,(21) has not shown any considerable improvement on asthma patients with BRT, on the contrary in the present study a moderate recovery was observed in COPD patients after BRT for 8weeks.

Gordon H. Guyatt et al.,(22)reveals positive results by conducting 6 minute walk test on 18 patients with chronic heart failure and 25 patients with chronic lung disease for 12 weeks. The same holds good for 68 COPD patients for a walk distance of 30 meter with two trials with 15 minute break between each trial.

VI. CONCLUSION

So as to achieve the improvements in pulmonary function tests, respiratory muscle strength, and 6-minute walking distance, both IMT and BRT have to be used in pulmonary rehabilitation programs for COPD patients with mild airway blockage. The safest, easiest, and most successful strategy for a given patient is always the optimal option for reaching a specific clinical goal. Selecting an IMT and BRT strategy necessitates a thorough understanding of both the treatments available and the individual condition and needs of the patient being treated.

VII. REFERENCES

[1]. Sasaki M, Kurosawa H, Kohzuki M. Effects of inspiratory and expiratory muscle training in normal subjects. J Jpn Phys Ther Assoc. 2005;8(1):29–37.

[2]. Vimal G, Kolek V, Jaskova J. Respiratory muscle assessment in acute exacerbation of chronic obstructive pulmonary disease and its role as a potential biomarker. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2012;156(4):302–311.

[3]. Petrovic M, Reiter M, Zipko H, Pohl W, Wanke T. Effect of inspiratory muscle training on dynamic hyperinflation in patients with COPD. Int J Chron Obstruct Pulmon Dis. 2012;7:797–805.

[4]. Geddes EL, O'Brien K, Reid WD, Brooks D, Crowe J. Inspiratory muscle training in adults with chronic obstructive pulmonary disease: an update of a systemic review. Respir Med. 2008;102(12):1715–1729.

[5]. Dumitru L, Iliescu A, Dinu H, et al. Disability in COPD and chronic heart failure, is the skeletal muscle the final common pathway. Maedica (Buchar). 2013;8(2):206–213.

[6]. Romer LM, Polkey MI. Exercise induced respiratory muscle fatigue implications for performance. J Appl Physiol (1985). 2008;104(3):879–888.

[7]. Berteanu M, Iliescu A, Dumitru L. Chest physiotherapy. In: Tratat de Reabilit are pulmonarasubredactia. Tudorache V, Lovin S, Friesen M, editors, Mirton, Timisoara; 2009:189–208.

[8]. Tateishi Y, Eguchi Y, Tohyama Y. Impaired muscle oxygenation during incremental cycle exercise in COPD patients compared with age matched healthy subjects. Open Rehabil J. 2011;4:32–41.

[9]. Ramirez-Sarmiento A, Orozco–Levi M, Guell R, et al. Inspiratory muscle training in patients with chronic obstructive pulmonary disease: structural adaptation and physiological outcomes. Am J Respir Critical Care Med. 2002;166(11):1491–1497.

[10]. Weiner P, McConnell A. Respiratory muscle training in chronic obstructive pulmonary disease: inspiratory, expiratory or both? Curr Opin Pulm Med. 2005;11(2):140–144.

[11]. Chen S, Wu YT, Lin JJ, Lee CN, Huang CY, Chiang LL. The correlations of the six-minute walk test and respiratory functions in chronic obstructive pulmonary disease patients with chronic hypercapnia. J Ex Clin Med. 2014;4(1):47–51.

[12]. Chien JY, Ruan SY, Huang YC, Yu CJ, Yang PC. Asynchronous thoraco-abdominal motion contributes to decrease 6-minute walk test in patients with COPD. Respir Care. 2013;58(2):320–326.

[13]. Ghofraniha L, Sani ZD, Vakilian F, et al. The six-minute walk test for the evaluation of pulmonary disease. JCTM. 2015;3(2):284–287.

[14]. Lotters F, Van Tol B, Kwakkel G, et al. Effects of controlled inspiratory muscle training patients with COPD: a meta–analysis. Eur Respir J. 2002;20(3):570–576.

[15]. La-Ciuga H, Rosenbek JC, Davenport PW, Sapienza CM. Functional outcomes associated with expiratory muscle strength training: narrative review. JRRD. 2014;51(4):535–546.

[16]. Gosselink R, De Voss J, Heuvel VD, Segers J, Decramer M, Kwakkel G. Impact of inspiratory muscle training in patients with COPD: what is the evidence? Eur Respir J. 2011;37(2):416–425.

[17]. Ramos EMC, Vanderlei LCM, Ramos D, Teixeira LM, Pitta F, Veloso M. Influence of pursed – lip breathing on heart rate variability and cardiorespiratory parameters in subject with chronic obstructive pulmonary disease. Braz J Physical Ther. 2009;13(4):2288–2293.

[18]. Mota S, Guell R, Barreiro E, et al. Clinical outcomes of expiratory muscle training in severe COPD Patients. Respire Med. 2007;101(3):516–524.

[19]. Neves LF, Reis MH, Plentz RD, Matte DL, Coronel CC, Sbruzzi G. Expiratory and expiratory plus inspiratory muscle training improves respiratory muscle strength in subjects with COPD: systematic review. Respir Care. 2014;59(9):1381–1388.

[20]. Bissett BM, Leditschke IA, Neeman T, Boots R, Paratz J. Inspiratory muscle training to enhance recovery from mechanical ventilation: a randomised trial. Thorax. 2016 Sep;71(9):812-819.

[21]. F.S.F. Ram, E.A. Holloway, P.W. Jones,Breathing retraining for asthma,Respiratory Medicine,2003, Volume 97, Issue 5,501-507.

[22]. Guyatt GH, Sullivan MJ, Thompson PJ, et al. The 6-minute walk: a new measure of exercise capacity in patients with chronic heart failure. Can Med Assoc J. 1985;132(8):919-923.