ISSN 2250-3153

Efficacy of ventilatory muscle training in patients with Chronic Obstructive Pulmonary Diseases (COPD)

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***Abstract*- Study** Design: Randomized controlled trial

Objective: To find out the effectiveness of ventilatory muscle training in COPD.

Background: COPD patients experiences increased resistance to air flow, Air trapping and hyperinflation of lungs. Hyperinflation places ventilatory muscles at mechanical disadvantage. Ventilatory muscle training may improve the muscle strength and endurance, pulmonary function and sensation of respiratory effort. Thus the purpose of our study is to focus on the management of patients with COPD for the improvement of respiratory muscle function, exercise performance and reduction of dyspnoea.

Methods and measures: The sample consisted of clinically diagnosed 63 subjects with COPD. Subjects were randomly divided in two groups that is experimental group treated with medications along with ventilatory muscle training (VMT) under supervision. Second control group treated with medications for eight weeks. Their baseline data includes dyspnoea scale (ATS), 6 min. walk test, Spirometer value (SVC, MVV, FEV1/FVC) and after VMT post measurements were taken for further analysis.

Results: Two groups were homogeneous regarding all parameters at baseline. Statistical analysis was done by using Graph Pad Instant software (Trial version 3.03) post exercise data shows highly significant difference between two groups i.e. ($p<0.01$)

Conclusion: Ventilatory muscle training can be used as an adjunctive intervention in the treatment of in COPD

***Index Terms*-** Incentive spirometer, COPD, Ventilatory muscle, strength and endurance, Dyspnoea

***Implications*-** This Method can be used to treat the patients with COPD as a non-invasive method with improvement in comfort of patient.

I. INTRODUCTION

Approximately thirty million people of either sex suffer from chronic obstructive pulmonary disease with the fourth leading cause of death amongst the population in the age group of 65 to 84 years with a huge economic impact in relation to direct medical expenditure. Patients with Chronic obstructive pulmonary disease (COPD) experiences increased resistance to airflow, air trapping, and hyperinflation of the lung, which places the inspiratory muscles at a mechanical disadvantage. Exercise and activity limitation are characteristic features of chronic obstructive pulmonary disease. Exercise intolerance may result from ventilator limitation, cardiovascular impairment, and/or skeletal muscle dysfunction. [1,2 3].

Presence of airflow obstruction caused by chronic bronchitis & emphysema is characteristic of chronic obstructive pulmonary disease. The airflow obstruction is generally progressive and may be accompanied by airway hyper reactivity & often partially reversible. Declining lung function is almost universally caused by the effects of exposure to tobacco smoke & develops insidiously so that patient often do not complain of exertion dyspnoea unless and until one second forced expiratory Volume (FEV1) is within 40% to 50% of its predicted value [4,9].

Dyspnoea frequently limits activity and reduces health-related quality of life, impaired lung function; peripheral muscle deconditioning and respiratory muscle dysfunction .The rationale for ventilatory muscle training in patients with chronic obstructive pulmonary disease is very strong. These patients not only have weakness of respiratory muscles, but also experience alterations in their chest wall mechanics that reduces the effectiveness of diaphragm with increase in the work for breathing[5,6]

Current state of the management of COPD consists of multidisciplinary approach to patient care. There are Significant advances in knowledge and use of pharmacological therapy for controlling the symptoms of COPD. The role of nutritional intervention, exercise training and pulmonary rehabilitation are established important therapeutic strategies for the improvement in exercise tolerance and reducing dyspnoea and leg fatigue. Respiratory rehabilitation is now days recognized as an important part of the management of patients with chronic obstructive pulmonary disease. The widespread application of such programmes should proceed by evidence of directly attributable improvements in function. [7, 8]

The aim of exercises in COPD is for improvement in regional ventilation and gas exchange by the ventilatory pump. Since dynamic hyperinflation improves respiratory muscle function, decrease in dyspnoea, improvement in exercise tolerance and quality of life in patients with COPD. Several studies of various authors had concluded that ventilatory muscle training may enhance respiratory muscle function and can reduce the dyspnoea in patients with moderate to severe COPD. According Smith et al, ventilatory muscle training (VMT) may

improve ventilatory muscle strength, to lower and probably diminish the sensation of respiratory effort [11].

Present study provides the physiotherapeutic management of chronic obstructive pulmonary disease. Pulmonary rehabilitation using whole body exercise training improves peripheral muscle function and reduces dyspnoea but does not improve respiratory muscle function. But providing adequate training intensities, specific loading of the inspiratory muscles with commercially available hand-held devices can improve ventilatory muscle strength and endurance. Several studies have investigated the effects of ventilatory muscle training on dyspnoea in COPD subjects. Present study was carried out by controlling respiratory cycle by using both an incentive target-flow device to facilitate and control through visual feedback [10 16, 20].

II. MATERIALS AND METHODS

A randomized control trial was conducted at Department of Physiotherapy, Pravara Rural Hospital, Loni, Ahmednagar District Maharashtra state, India from 1August 2010 to 31 Jan. 2011.

Subjects: A total of 110 subjects with a clinical diagnosis of COPD were screened to find out their suitability for the study. However, only 69 subjects were found suitable to participate in the study. When these subjects were requested to participate in the study only 60 subjects participated and completed the study. The inclusion criteria were both sexes, clinical diagnosis of COPD with the age between 40 to 70 years and willingness to participate in the study. COPD as defined under ATS with mild to severe air flow obstruction as per the score of ATS was 1 to 3. Base line values of PFT were with 50% to 65 % of their predicted values. Exclusion criteria were presence of any associated systemic disease or any clinical situations that are contraindicated.

Equipment: Spirometer- P.C.BASED RMS spirometer with Computer interface Machine for PFT measurement, Incentive spirometer for resistant training to ventilatory muscles, Stethoscope, Sphygmomanometer, Postural drainage table.

Procedure: All subjects selected under study diagnosed as COPD as per definition of the American Thoracic Society with mild to moderate airflow obstruction (FEV1 50% to < 65% of predicted). All subjects were stable in condition and free of any clinical evidence of cardiovascular, musculoskeletal, neuromuscular disease or any other disease that interferes with the study.

Subjects were informed about the procedure and were requested to sign an informed written consent following which each subject underwent a standardized history and physical examination as well as the data was collected for the baseline PFT values that includes (SVC, MVV, FEV1/FVC) dyspnoea scale (By American Thoracic Society) 6 min. walk test, After this all subjects were randomly allocated to control group (Group I) and study group (Group II.) Control group continued their medication as per the advice of physician and Breathing exercises. study group subjects received supervised ventilatory muscle training along with medication advised by their physician. There were two parts of the study for all subjects. A two week learning phase (pre training) was the first part in which familiarization of subjects with the procedure. Since they regularly visited the laboratory and did procedure very correct manner. we assumed that they were compliant. We also tested control group, who were on medication and the breathing exercises for a period of two weeks, in a manner similar to the study group. Instructions were given to breathe comfortably and after two weeks all subjects were instructed to continue their training up to eight weeks. All tests were carried out in the beginning and end of training along with measurement of PFT values , Dyspnoea score, exercise capacity on the distance walked in 6 minute.

Patient performing exercise on incentive spirometer

(R.M.S. SPIROMETER) P.C based computer interface machine

Spirometer

Table No. 16 Comparison of and post exercise mean value of all parameters in(Group I) Control group and (group II) study group .

Parameters	Group I (Control Gr,n=30) Pre Mean ± SD	Group II Study Gr.,n=30) Post Mean ± SD	't' value	'p' value	Results
M V V	28.6± 5.69	97.05 ± 12.62	21.73	p<0.01	Highly significant
S V C	2.05 ± 0.50	3.36 ± 0.44	13.18	p<0.01	Highly significant
$FEV_{1/}$ FVC	43.76 ± 3.94	54.50±3.37	9.34	p<0.01	Highly significant
Dyspnoea	03± 0	1.3 ±0.40	18.88	P<0.01	Highly significant
Walking Distance	93.95 ± 10.45	161.25±21.34	13.06	P<0.01	Highly significant

III. RESULTS

Following results revealed the improvement in pulmonary function. Post exercise value of MVV in study group(Group II) observed was 97.05L/min as compared to control group (GroupI), which was 44.9L/minute (t = 51.777, p<0.01) showing high significance. Post exercise value of SVC in study group observed was 3.36L/min as compared to control group, which were 2.22.L/min (t =5.596, p<0.01) showing high significance. Post exercise value of $FEV_{1/}$ FVC in study group was 54.50 as compared to control group 46.00. (t =14.206, p <0.01) that is highly significant. By comparing the dyspnoea grades according to ATS (American thoracic society) it was observed that post exercise dyspnoea mean values in study group (1.3) and in control group (2.2) (t =4.466, p <0.01) is highly significant

Assessment of exercise performance was by maximum distance walked in 6 minutes. In study group, 93.95 meters walking distance was increased up to 161.25 metres but in control group it was 95.15metres increasing up to 108 metres .This shows that there was increase in walked distance in study group, which is more than in control group. This can be because of combined training reduced dyspnoea and increased strength and endurance of the ventilatory muscles as well as peripheral muscles.

(MVV- Maximal voluntary ventilation , SVC- Sustained vital capacity,FEV_1- Forced expiratory volume in 1 min., FVC- Forced vital capacity.)

IV. DISCUSSION

The results of this study suggests that COPD subjects who participated in Ventilatory muscle training in additionto their regular medication had better reduction in dyspnoea and improvement in pulmonary function as compared to control group subjects who continued only with their medication and breathing exercises . This could be due to the effect of strength training by incentive spirometer. Which places the load on respiratory muscles that involves contraction of respiratory

muscles [7] Assessment of the efficacy of these programs typicallyhas focused on reduction of dyspnoea, improve pulmonary function and psychological advantages of training program. Exercise is a critical component in the treatment care plan of the patients of impaired respiration that is COPD.

It was decided to use incentive spirometer as a training device. This device is useful in both i.e. controlling depth of inspired air (target flow) and encourages the patient (incentive) to perform them by the means of visual feedback. Moreover, this is less expensive where respiratory frequency needs to be controlled. SVC reflects the strength while MVV reflects the endurance of the ventilator muscles [11,12,18,19,] It is observed in most of the studies that breathing against load has increased maximum inspiratory pressure and endurance capacity of inspiratory muscles because of the significant hypertrophy of the predominantly of type I and type II fibres in the diaphragm.

There are many forms of exercise programs but in present study, training program mainly included the resistance training with incentive spirometry. It was an observation that in patients with chronic obstructive pulmonary disease that diaphragm was flattened, depressed with limited respiratory excursion and consequently making a minimal contribution to ventilation. Therefore these exercises are designed for increased contractions and pressure change with improvement of diaphragmatic excursion.

Three basic principles of skeletal muscle training are overload, specificity and reversibility. The training used in our study rested on this principle that is training on incentives spirometer of sufficient intensity to produce training effect (overload) and the training and testing device used the same training modality (specificity). The reversibility principle states that the effect of conditioning decline after training ceases. Therefore, whenever patients finished the training period we recommended them to continue performing breathing exercises regularly in order to maintain the obtained improvement [7, 8]. According to AACPR committee, we have concluded that VMT can be useful part of pulmonary rehabilitation for COPD patient. It is believed that this study can be a valuable help for exercise prescription in subjects with COPD without co-morbidity.

V. CONCLUSION

Ventilatory muscle training can be used as an adjunctive intervention in the treatment of in COPD as a non-invasive method with improvement in comfort of patient.

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