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A Randomized Control Study to Find the Efficacy of Pursed Lip Breathing In Lung Volumes and Capacities of Patients with Chronic Obstructive Pulmonary Disease (COPD)

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ABSTRACT

Objective- *Efficacy of pursed lip breathing with medical management compared to only pursed lip breathing in lung volumes and capacities of patients with COPD.*

Study Design- *Pre and post experimental study design*

Setting- The study was conducted in Pulmonary Rehabilitation unit of Navodaya Medical College Hospital and Research Center, Raichur.

Participants- 30 patients who were suffering from mild to moderate symptoms of COPD were randomized into two groups by using simple random technique. They were experimental and control groups respectively. Interventions-30 subjects who were diagnosed with stable COPD were randomly allocated into experimental and control groups. Both the groups received medication of oral Theophylline + MID of Salbutamol and Ipratropium Bromide. However, experimental group received an additional intervention of pursed lip breathing.

Outcome Measures-Spirowin Computerised Spirometry

Results-There was a statistically significant improvement within the group for both the groups in all the parameters of lung volumes and capacities when compared pre and post test values. Whereas, there was highly significant post test difference in Tidal volume($P<0.02$) and Maximum Voluntary Ventilation($P<0.001$) in the experimental group when compared with the post test values of control group suggestive of the effect in the parameters of TV and MVV, which are an integral part of improvement of patients symptoms in COPD. But there was no significant difference in FEV1, FVC, FEV1/FVC ratio between the experimental and control groups after the treatment ($P>0.05$).

Conclusion- Present study concludes that there was no significant difference in pre test of treatment in both experimental and control groups. Significant improvement in TV and MVV in the experimental group and no significance difference was found in FEV1, FVC and FEV1/FVC ratio in control group in post test of treatment.

Key Words :MVV- Maximum Voluntary Ventilation, TV- Tidal Volume,FEV1- Forced expiratory volume within 1 second, FVC- Forced vital capacity, PLB- Pursed Lip Breathing

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is one of the chronic diseases worldwide. Several definitions exist for COPD. The American Thoracic Society (ATS) has defined COPD as "a disease state characterized by the airflow limitation due to chronic bronchitis or emphysema; the airflow obstruction is generally progressive, may be accompanied by airway hyper-reactivity, and may be partially reversible[1]. The British Thoracic Society defines COPD as a chronic, slowly progressive disorder characterized by airflow obstruction (reduced FEV_1 and FEV_1/FVC ratio) that does not change markedly over several months. The European Respiratory Society (E.R.S) has defined COPD as "reduced maximum expiratory flow and slow forced emptying of lungs[10]". The committee of recently formed "Global Initiative for Chronic Obstructive Lung Disease" (GOLD) has developed a working consensus definition of COPD. According to GOLD COPD is defined as "a disease state characterized by air flow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal response of the lungs to noxious particles or gases (FEV_1<80%, FEV_1/FVC ratio<7O%) [24]. Chronic obstructive pulmonary disease (COPD) encompasses chronic bronchitis and emphysema, is the fourth leading cause of death in the United States [6]. In United States more than 70,000 deaths annually result from COPD [7]. In addition COPD is a major cause of morbidity and disability and an economic burden to the health care system [2].

Cigarette smoking is the most common causative factor in the development of pulmonary emphysema [11]. The current thought of pathogenesis of pulmonary emphysema implicate neutrophils derived elastase as the agent of alveolar destruction. This enzyme is present in polymorpho nuclear leucocytes which occur in large numbers of the derived elastase punches small holes in biological membranes such as basement membranes.

Normally the terminal bronchioles which are lesser than 2mm in diameter and have no cartilage in their walls, are held open throughout the respiratory cycle as a result of elastic recoil of surrounding alveoli, which are tethered on the bronchiolar wall[15]. If alveolar septa are destroyed by elastase, the respiratory bronchioles collapse during exhalation and airway obstruction develops. Thus a pathological process that is primarily alveolar in nature results in a clinical syndrome manifested by airway obstruction.

COPD is a disorder characterized by the presence of air flow obstruction that is generally progressive, that may be accompanied by airway hyper activity and may be partially reversible[17]. The most common pathology in the COPD's are sputum production, mucosal edema, inflammation of bronchial airways, mucous hyper secretion resulting in airflow obstruction leading to hyperinflation of lungs [18]. As the result of progressive bronchial inflammation and secretions, ventilation perfusion mismatching occurs and results in hypoxemia. Hypoxic vasoconstriction develops in the areas of pulmonary arterial bed exposed to the poorly

ventilated acini. Pulmonary artery pressure increase causing right ventricular hypertrophy and dilatation. As the right ventricle dilates the interventricular septum often bulges into the left ventricle, decreasing left ventricular output resulting in corpulmonale. Polycythemia, an increase in the amount of circulating RBC is another complication of advanced COPD[18].

Dyspnea is an important and debilitating symptom in patients with COPD[21]. Pathophysiological factors which contribute to dyspnea are increased intrinsic mechanical loading of inspiratory muscles, increased mechanical restriction of the chest wall, functional inspiratory muscles weakness, increased ventilatory demand, gas exchange abnormalities, dynamic airway compression and cardio vascular effects[16].

Hyper secretion can be caused by inhalation of smoke; by inhalation of antigens the inflammation is triggered. Irritation of the airways also causes changes in the molecular constituents of bronchial secretions [21]. Initially the increase volume of secretions is caused by increased secretion per secretary cells. As the disease progresses the number of secretary cells also increases[19].

As a result of airway obstruction, expiratory airflow is impeded and pulmonary hyper expansion develops resulting in the flattening of the diaphragm and making it in to relatively useless respiratory muscle. When the diaphragm is flat its costal fibres are arranged horizontally instead of being vertical with the contraction, the lower ribs move inwards (Hoover's Sign)[20]. According to Laplaz law T=r/T since the radius (r) is reduced here in the flattened diaphragm the tension producing capacity is reduced, so the tidal volume decreases since the volume of air is trapped in the lungs. There is increase in TLC and residual volume. Due to the stretch weakness of the intercostals there is reduced efficiency of the costal muscles noted by using EMG (Spahija 2005)[14].

The diagnosis and assessment of COPD is confirmed by Spirometry before the symptoms become apparent[4]. Spirometry is the gold standard as it is best standardized, reproducible and objective.

Various treatment methods are tried for this disabling condition [13]. Pharmacological management and chest clearing techniques have played vital role since the year 1996). Pierce. Et. al advocated pulmonary rehabilitation for the patients with COPD had shown remarkable improvement in symptoms control as well as functionally[5].

PURSED LIP BREATHING (PLB)

PLB is a maneuver that is frequently taught to patients with COPD in respiratory physiotherapy program to improve breathing efficiency and to manage dyspnea better during activities of daily living[9]. PLB aims to improve expiration both by its active and prolonged expiration and by preventing airway collapse because it promotes prolonged expirations with a decrease in end expiratory lung volume (EELV) which leads to lower breathing frequency and higher tidal volume [11]. PLB decreases the respiratory rate (from 19 to 12 breaths per minute) minute ventilation, as well as PACO2. Further it increases

the PAO_2 and $SAO_2$and in COPD patients at rest and during exercise[23].Additionally it is used to promote relaxation, to improve lung volumes and reduce dyspnea in patients with COPD[13]. PLB resulted in no change in pressure across the diaphragm and a less fatiguing breathing pattern of the diaphragm.

OBJECTIVE OF THE STUDY

To find the efficacy of PLB with Medication compared only to medication on lung volumes and capacities in patients with COPD.

METHODOLOGY

The study design was a randomized controlled trial. Ethical clearance was obtained from the Institution's ethical committee before commencement of the study. There were 30 participants with clinical diagnosis of stable COPD, who were referred to OPD Cardiopulmonary Unit, Navodaya Medical College Hospital and Research Center, Raichur and were willing to participate in this study.

INCLUSION CRITERIA

Participants with clinical diagnosis of mild to moderate COPD(GOLD) aged between 40-55 years of both males and females who were taking medications 15 days prior of this study.

EXCLUSION CRITERIA

Paticipants with the history of cardiovascular illness, any recent surgeries, severe respiratory illness, and patients other than COPD with drug treatment less than 15 days,

MATERIALS

Consent form, Respiratory Questionnaire, Spirowin Spirometry, Inch tape, Sphygmomanometer, Stethoscope, Weight scale and Stadiometer.

OUTCOME MEASURES

Lung volumes and capacities measured by Spirowin Spirometry.

PROCEDURE

All the participants with mild to moderate COPD were screened after finding the suitability as per the inclusion and exclusion criteria were requested to participate in the study. Participants were explained the treatment procedure. After explanation, informed consent in written form was taken. The subjects selected for the study was randomly allocated into 2 groups. Group 1(Experimental group) and Group 2(Control group) consisting of 15 subjects in each group. Initial evaluation of lung volumes capacities (FEV_1,FVC,FEV_1/FVC,TV,MVV) was done in both groups by computerized Spirowin spirometry. Patients were instructed to stop medication prior two days of spirometric procedure based on physician's advice to nullify the effect of bronchodilators and also instructed to stop taking full stomach meal before two hours of Spirometric procedure.

a) Color plate showing Spirometric Unit

b) Color plate showing Spirometric Procedure on Patient – 1

Since the Spirometric procedure is effort dependent maneuver, careful instruction in language which they can easily understand were given to the subjects for their better cooperation and coordination. FVC maneuver was performed by forcefully doing expiration TV was measured by performing SVC maneuver. This was performed with the subject using a mouth piece and wearing a nose clip. The subjects were asked to do the normal breathing followed by deep inhalation and exhalation at least for 12 seconds. MVV was measured by performing forceful inhalation and exhalation at least for 12 seconds. Each patient was asked to perform minimum two acceptable maneuvers and the best reading was noted. During FVC, the parameters FEV_1 and FEV_1/FVC were also measured.

All the parameters were converted to BTPS and recorded in liters.

INTERVENTION

The experimental group was given PLB for 8 minutes twice a day for six weeks along with the regular course of treatment. Whereas the control group was not given the PLB and asked to continue, their medications (Salbutamol+Ipratropium Bromide)

Procedure of PLB-

- Patients were made to sit comfortably and relax as much as possible.
- Procedure for PLB was demonstrated and explained in detail.
- The Subjects were asked to keep the shoulders in relaxed position.
- They were instructed to take deep and slow inspiration through nose and relaxed expiration through semi closed lips.
- The technique was given for 8 minutes twice daily.

PLAN OF ANALYSIS

Unpaired' test was used to analyze the data in inter group comparison of control and experimental group, whereas the paired t test was used to analyze the pre test and post test data of PLB within the group

Table- I

Table Showing Pre-Test Comparison Of Group-I & Group II

Sl. No	Lung volumes & Capacities	Group I		Group-II		't'	'df
		Mean	SD	Mean	SD		
01	FEV1	1.83	0.402	1.80	0.405	0.20*	28
02	FVC	3.04	0.630	3.04	0.5111	0.02*	28
03	FEV1/FVC%	60.60	9.30	58.73	8.13	*0.585**	28
04	TV	0.492	.1120	0.474	0.143	0.368*	28
05	MVV	63.87	*14.05*	62.93	14.2	0.18*	28

*(P>0.05) *** (P<0.01)

Table-II

Showing Post-Test Comparison Of Data For Group I & Group Ii

Sl. No.	Lung volumes & Capacities	Group I		Group -II		't'	'df'
		Mean	SD	Mean	SD		
01	FEV1	2.21	0.473	2.11	0.477	*0.58**	28
02	FVC	*3.15*	0.5111	3.14	*0.5266*	0.08*	28
03	FEV1/FVC %	70.27	*9.95*	66.60	9.34	1.041*	28
04	TV	0.703	*0.153*	*0.548*	0.158	2.74*1*	28
05	MVV	97.933	14.99	82.333	11.41	3.21***	28

*(P>0.05) *** (P<0.01)

Table-III

Table Showing The Pre-Test And Post Test Comparison Of Values Of The Same Group - Group -I

Sl. No.	Lung volumes & Capacities	PRE-TEST		POST-TEST		't'	'df'
		Mean	SD	Mean	SD		
01	FEV1	1.83	0.402	2.21	0.473	7.453**	14
02	FVC	3.04	0.630	*3.15*	*0.657*	9.823**	14
03	FEV1! FVC %	60.60	9.30	70.27	*9.95*	13.397**	14
04	TV	0.492	.1120	0.703	*0.153*	- 19.195**	14
05	MVV	63.87	14.045	97.93	14.992	18.161**	14

** (P<005)

Table –IV

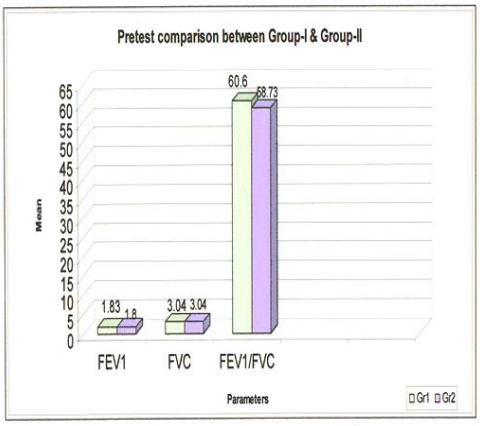
Showing the Pre-Test and Post Test Comparison of Values of The Same Group - Group –II

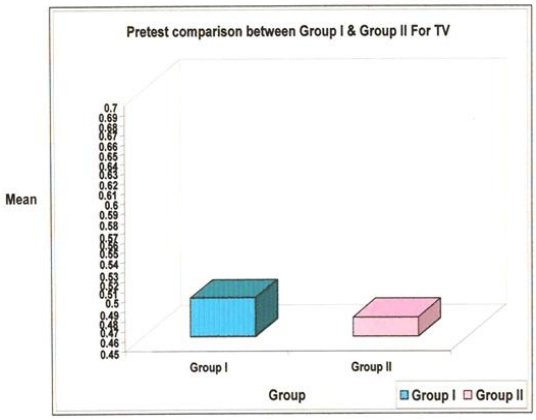
Sl. No.	Lung volumes & Capacities	PRE-TEST		POST-TEST		't'	'df'
		Mean	SD	Mean	SD		
01	FEV1	1.80	*0.405*	2.11	0.477	13.755**	14
02	FVC	3.045	0.5111	3.14	*0.5266*	9.927**	14
03	FEV1/FVC%	*58.731*	8.13	66.60	9.341	13.85**	14
04	TV -	0.474	0.143	0.548	0.158	16.944**	14
05	MVV	62.93	14.218	82.33	11.41	14.871**	14

RESULTS

Baseline Values

Statistically significant difference was not found between the groups(P>0.05) on the spirometric variables. In experimental group the pre test mean of FEV_1 was 1.83, FVC, 3.04, FEV_1/FVC was 60-60, TV was 0.492, and MVV was 63.87. In control group pre test mean of FVC was 3.04, FEV_1 was 1.86, FEV_1/FVC was 58.73, TV was 0.479 and MVV was 62.93. This shows that there was homogeneity between two groups before the experimental treatment(P>0.05)



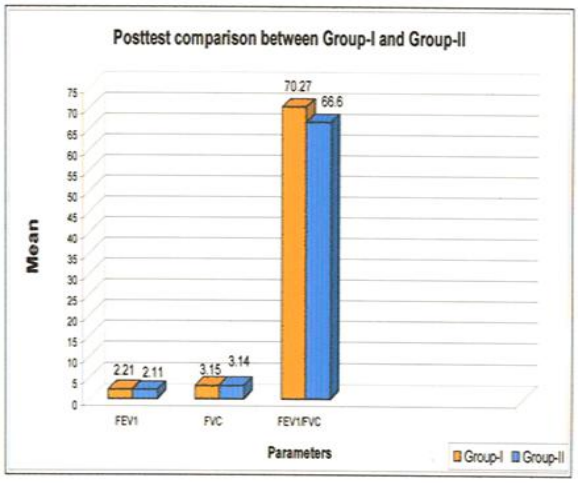


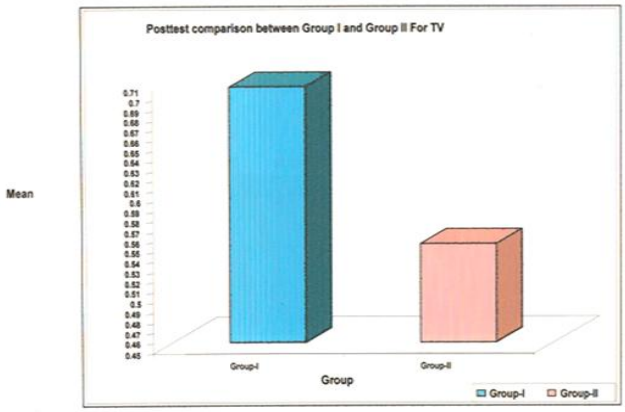
Post Test Comparison of Lung Volumes and Capacities in Experimental and Control Groups-

The experimental group mean of FEV_1 was 2.21 with the SD of 0.473, FVC was 3.15 with SD of 0.5111, FEV_1/FVC was 0.703 with SD of 0.153 and MVV was 97.933 with SD of 14.99. Control

group had shown the values of FEV_1 of 2.11 with SD of 0.477, FVC was 3.14 with the SD of 0.5266, FEV_1/FVC was 66.60 with SD of 9.34, TV was 0.548 with the SD of 0.158 and MVV was 82.333 with the SD of 11.41.

These finding showed that there was no statistically significant difference found in FVC, FEV_1 and FEV_1/FVC ratio(P>0.05) between the groups in post test of treatment. Although there was highly significant difference found in TV(P<0.02) and MVV(P<0.01) between the groups in post test treatment.





Intra Group Comparison of Pretest and Post Test of Lung Volumes and Capacities of the Same Group (Group 1 and Group 2)

The pre test mean of FEV_1 was 1.83 when compared with the post test mean was 2.21(P<0.05). The obtained 't' value in paired 't' test for FEV1 was 7.453, pretest mean of FVC was 3.041 compared with post test mean of 3.15(P<0.05). The pretest mean of FEV_1/FVC was 60.60 compared with post test mean was 13.397(P<0.05). The pretest means of TV was 0.492 compared with post test mean was 19.195(P<0.05) and MVV was 63.87 compared with post test mean was 19.95(P<0.05). This shows that there was significant difference between the pre and post test of treatment in experimental group.

The pretest mean of FEV_1 was 1.80 when compared the post means was 2.11(P<0.05). The pretest mean of FVC was 3.045 compared with post test mean was 3.14(P<0.05). The pretest mean of FEV_1/FVC ratio was 58.73 compared with post test mean 66.60(P<0.05). The pretest mean of TV was 0.474 when compared with post test mean was 0.548. The pretest mean of MVV was 62.93 when compared with post test was 82.33(P<0.05). This finding has shown that there is significant difference in pre and post of treatment in control group(P<0.05)

So this analysis had shown there was statistically significant improvement with in the group for both the groups in all the parameters of lung volumes and capacities when compared pre and post test values. Whereas there was highly significant post test difference in TV (P<O.02) and MVV (P<O.OO 1) in the experimental group when compared with the post test values of control group suggestive of positive effect in the parameters of TV and MVV, which are an integral part in the improvement of patients symptoms in

COPD. Hence null hypothesis Ho is rejected and the research alternative hypothesis H_1 is retained.

But there was no significant difference in FEV_1, FVC, FEV_1/FVC ratio between the experimental and control groups after the treatment (P>O.05). Hence the researcher failed to reject the Ho. For the above mentioned parameters.

DISCUSSION

PLB is a pattern of respiration used, spontaneously by some patients with chronic air way obstruction and taught to many as one facet of breathing retraining.

Lung hyperinflation, by increasing the motor command to and reducing the strength of the respiratory muscles, causes increased amount of Residual volume thereby decreasing the FEV_1/FVC ratio, tidal volume and MVV. Although Tidal volume increases in the mild stages of COPD it is greatly reduced as the obstruction progresses.

PLB is more effective form of breathing in the sense that during PLB less air has to be breathed to absorb a given amount of Oxygen. During PLB the air which is present in the mouth creates back pressure. As a result of this PLB prevents air way collapse which resulting in less air trapping and prominent increase in tidal volume, this is linked to the large decrease in trans pulmonary elastic resistance and to symptom relief.

The total number of thirty subjects (N30) in two groups were taken. In each group N= 15 with age group between 40 to 55 were having mild to moderate COPD according to GOLD classification. Pre and post test values of Spirometric parameters of FEV_1, FVC, FEV_1/FVC ratio, TV and MVV were taken by using Spirowin Spirometer.

The experimental group was given PLB for eight minutes twice daily for six weeks along with their regular medication whereas the control group was asked to continue the regular medication only (Oral Theophyline & MID of Salbutarnol + Ipratopium Bromide).

The result from the current study showed that technique of PLB in mild to moderate COPD has a greater effect on increasing the tidal volume (VT) and Maximum Voluntary ventilation and has no significant effect on FEV_1, FVC and FEV_1/FVC ratio, although there was a transient improvement on FEV_1,FVC and FEV_1/FVC ratio which is not statistically significant.

The Experimental group had shown highly significant difference in Tidal volume (TV) (p<O.O2) and MVV (P<0.01) when compared with control group in post test comparison. There was significant difference in spirometric parameters of FEV_1, FVC and FEV_1/FVC ratio, TV and MVV in both experimental and control groups when compared with pre and post test of treatment. On the contrary no significant difference was found in FEV_1, FVC and FEV_1/FVC ratio between the experimental and control groups in post test comparison (P>0.05).

The parameters of FEV_1, FVC, and FEV_1/FVC ratio, TV and MVV have shown significance in both experimental and control groups when compared with pre and post test of treatment it could be due to drug effect.

The common medication of Oral Theophyline 200mg & MID of Salbutamol + Ipratropium Bromide (six hourly) were used by both the groups prescribed by the Physician. There was no significant difference in FEV_1, FVC and FEV_1/FVC ratio between the experimental and control groups in post test comparison (P>0.05). It may be due to PLB involves in slow and passive expiratory process, it did not shown significant effect in the FEV_1,forced vital capacity (FVC) and FEV_1/FVC ratio.

These findings are supported by the following authors in their research.

Roberto Bianchi, MD; Francesco Gigliotti et al (2002) studied the effect of PLB on chest wall kinematics and breathlessness with 22 patients in COPD. They found that PLB increases the tidal volume (VT) of chest wall (P<O.000004), decreases the Borg score (P<0.04), reduces the end expiratory volume of the chest wall (P<0.000004) and significant increase end inspiratory volume of chest wall (L)(p<0.003). Authors have concluded PLB decreases the end expiratory volume of the chest wall, increases tidal volume and reduces the breathlessness by lengthening the expiratory time (TE) and respiratory duty cycle (Ttot)[23].

Mueller.E, Thomas Petty et al (1970) studied the efficacy of PLB on ventilation and arterial blood gas changes during rest and exercise in 12 subjects with COPD at Colarado. They found during both rest and exercise PLB significantly decreased the respiratory rate (RR), Minute ventilation (VE) and increased tidal volume (VT) (P<0.025). In both the groups PLB improved $PaCo_2$, $Pa0_2$ and $Sa0_2$ at rest not during exercise. It is concluded that source of symptom benefit from PLB may relate to decreased air way collapse with resultant enlarged tidal volume (VT) and slowed respiratory rate(P<0 .05)[22].

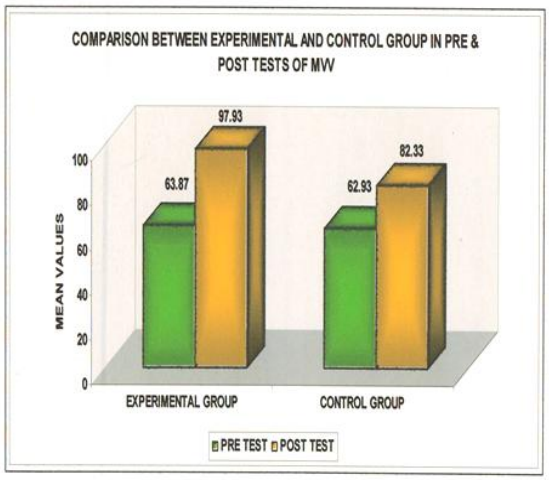
Moteley 1963 conducted an experimental study to find the efficacy of PLB with 55 patients on severe COPD. Published data suggested that PLB decreased respiratory rate (15 to 09), increased tidal volume (494m1 to 814 ml), VE was unchanged, Sa02 increased from (89.5% to 92.1%) and PaCo2 was decreased (40mm/hg to 37mm/hg)[24].

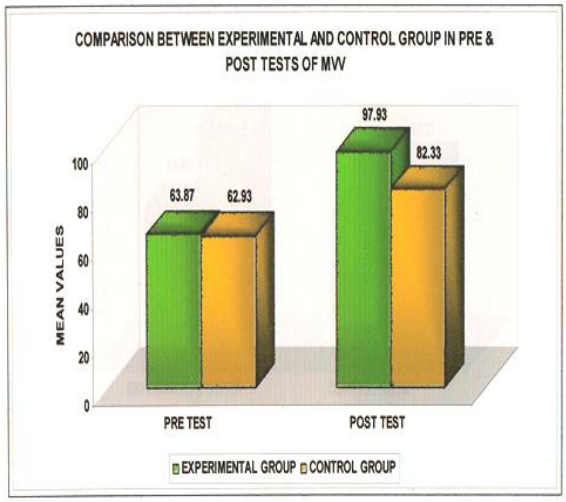
Breslin EH (1991) conducted a study to find the pattern of respiratory muscle recruitment during Pursed Lip Breathing in COPD.PLB led to increased rib cage and accessory muscle recruitment during inspiration and expiration, increased abdominal muscle recruitment during expiration. PLB resulted in no change in pressure across the diaphragm and less fatiguing breathing pattern of the diaphragm. He concluded that PLB protects the diaphragm from fatigue in COPD[3].

The present study indicates that PLB is a more effective pattern of respiration. So it can be employed to improve the tidal volume (VT) and MVV along with drug treatment in patients with COPD.

LIMITATIONS

Further studies are needed to determine the effect of PLB on FEV_1, FVC & FEV_1 /FVC ratio as the present study had limitation only to mild to moderate COPD and the sample size of only30.





CONCLUSION

The present study concluded there was no significant difference in pre-test of treatment in both experimental and control groups. Significant improvement in Tidal Volume (TV) and Maximum Voluntary Ventilation (MVV) in the experimental group and no significant difference was found in FEV_1, FVC & FEV_1/FVC ratio when compared with control group in Post- test of treatment.

There was no significant difference was found in lung volumes and capacities in control group when compared with experimental group in post-test of treatment.

Significant improvement was found in lung volumes and capacities between pre and post test of treatment in both groups.

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