IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Effect of active cycle breathing technique along with incentive spirometry versus active cycle breathing technique along with acapella in patients with moderate COPD in general population

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Abstract

Introduction: Chronic obstructive pulmonary diseases are the diseases which affect the respiratory tract that produce an obstruction to airway and that ultimately can affect both the mechanical function and gas exchanging capability of the lungs. Clinical symptoms include chronic cough, expectoration of mucus, wheezing and dyspnoea on exertion.

Method: 40 patients with mild to moderate COPD were selected according to inclusion and exclusion criteria and divided randomly into two experimental groups, as group A and group B, consisting of 20 patients each. A brief explanation about the treatment session was given to all the patients and informed consent is obtained. The value of peak expiratory flow rate and rate of perceived exertion were measured before the treatment (Day 1) and at the end of 4th week of treatment. Group A was treated with Active cycle breathing technique along with Spirometry and Group B received Active Cycle breathing technique along with Acapella device.

Conclusion: So this study concludes that there is less significant difference in the effect comparing Active cycle breathing technique along with Spirometry and Active cycle breathing technique along

with Acapella. Even though both groups has shown improvements within the groups in the Peak expiratory flow rate and Perceived exertion rate.

Keywords: Chronic Obstructive Lung Disease (COPD), Active Cycle Breathing Technique (ACBT), Positive Expiratory Pressure Technique (PEP), Acapella, Spirometry

Introduction

Chronic obstructive pulmonary diseases are the diseases which affect the respiratory tract that produce an obstruction to airway and that ultimately can affect both the mechanical function and gas exchanging capability of the lungs. Clinical symptoms include chronic cough, expectoration of mucus, wheezing and dyspnoea on exertion.

Chronic obstructive pulmonary disease is a major cause of morbidity and mortality across the globe. According to WHO estimates 65 million people have moderate to severe COPD. More than 3 million people died of COPD in 2005 corresponding to 5% of all deaths globally and its estimated to be the third cause of death by 2030. However it is known that low and middle income countries already shoulder much of the burden of COPD which almost 90% of COPD deaths taking place in these Countries. Studies have shown that pulmonary rehabilitation programmes are extremely effective in treating chronic obstructive pulmonary disease. Physiotherapists plays an essential role in the team of health professionals that run these programmes. Pulmonary rehabilitation programmes significantly improve the patient's health by reducing breathlessness, providing ways to control the disease and by improving the patient's ability to carry out daily activities. Better health leads to improvements in lung function and thereby improving quality of life.

Active cycle breathing technique (ACBT) involving three phases of breathing techniques. The first phase which helps you relax the airways. The second phase which helps to get the air behind the mucus plugs. The third phase helps force the mucus out of the lungs

Breathing control: Breathing control helps relax the airways. Breathing in is through the nose and breath out through mouth with very little effort. Gentle and normal breathing with the lower chest while relaxing the shoulder and upper chest.

Chest expansion exercises: Deep breath in followed by breath out without forcing the air out. This may be done with chest clapping of vibrating, followed by breathing control.

Huffing of Coughing: Also called forced expiratory technique huff cough at different, controlled lengths to move mucus up to the larger airways. This huffing should be repeated until all mucus which reaches the larger airways has been huffed out.

It is the active exhalation against a variable flow resistor reaching pressures of ~10-20cmH2O. It enhances bronchial hygiene therapy by improving airway patency and airflow through airways and/or retained secretions, which reduces air-trapping in susceptible patients, promotes increased mobilisation and clearance of secretions from the airways, enhances collateral obstructions, improving pulmonary mechanism and facilitating gas exchange. Secondarily it may help prevent or reverse atelectasis, prevent recurrent infection and slow disease progression. The vibration produced while exhalation through Acapella opens up your airways, facilitating the movement of mucus. Exhaling against resistance creates back pressure or positive pressure which allows mucus to move from peripheral airways to the larger central airways so it can be coughed out. Often a disposable single patient device is used or a disposable mouth piece for each patient can also be used.Chronic obstructive pulmonary disease patients gradually losses functional status and quality of life. In COPD, airway patency alteration, mucociliary functions or the ineffectiveness of the cough reflex can impair airway clearance and cause retention of secretions.In acute exacerbation, retention of secretions provoke an inflammatory response. This increases mucus production which leads to a vicious cycle of worsening of airway clearance. This may predispose to a full obstruction or mucus plugging of the airways resulting in atelectasis and impaired Oxygenation. Also, by restricting the airflow, partial obstruction can increase the work of breathing and lead to air trapping.

Airway clearance techniques or Bronchial hygiene therapy is used to mobilise and remove the retained secretions and to improve gas exchange and to reduce the work of breathing. These techniques form an important component in treatment of chronic obstructive pulmonary disease.

Traditional bronchial hygiene therapy techniques involve postural drainage, percussion and vibration combined with cough training. But these techniques cause hypoxemia, bronchospasm and fatigue in

COPD. These complications can be eliminated by ACBT which is more frequently used in the clinical setups

Spirometer is a device which is commonly used in pulmonary rehabilitation programmes in hospital setups. A simple device which gives visual feedback of respiration is used pre and post-surgical conditions of thorax as well as abdomen. A new apparatus for positive expiratory pressure technique called acapella for airway clearance has gained greater popularity among the therapists. This device called the Acapella is a small hand held device which combines positive expiratory pressure and high frequency oscillation therapy. Unlike flutter, it does not require gravity to work and can therefore be used at any angle. However no such studies have been done in COPD condition. The purpose of study is to compare the efficacy of ACBT along with Acapella and ACBT along with Spirometry in acute exacerbation of COPD.

Objectives of the study

To find out the effect of active cycle breathing technique along with incentive spirometry in patients with moderate COPD in general population.

To find out the effect of active cycle breathing technique along with acapella in patients with moderate COPD in general population.

To find out the effect of active cycle breathing technique along with incentive spirometry versus active cycle breathing technique along with acapella in patients with moderate COPD in general population. There is significant improvement in perceived exertion in patients with chronic obstructive lung disease following treatment combining ACBT along with Spirometry than ACBT along with Acapella.

METHODOLOGY

Study design

Pre-test and post-test experimental study design.

Study setting

The study was conducted at Department of Pulmonology, shree hari hospital at Ahemdabad.

Study duration

Study duration was 8 months and individual treatment duration was 4 weeks.

Sample method

By using simple random sampling method, 40 patients with mild to moderate COPD were selected according to inclusion and exclusion criteria and divided randomly into two experimental groups, as group A and group B, consisting of 20 patients each. Group A who received treatment with Active Cycle Breathing Technique along with Spirometry and group B who received treatment with Active Cycle Breathing Technique along with Acapella.

Sample size

40 patients were selected who fulfilled the inclusion and exclusion criteria and divided into two groups each consisted of 20 patients.

Criteria for selection

Inclusion criteria

Both males and females are selected.

Age group between 35-50 years.

Clinically diagnosed mild to moderate COPD.

Exclusion criteria

Age group below 40 and above 50 years.

Associated unstable cardiovascular diseases.

Patients with COPD who has undergone recent thoracic and abdominal surgeries.

Any associated restrictive lung diseases.

Patients with lung carcinoma or any other cancer.

Any other neurological deficits.

Patients with thoracic deformities and congenital deformities.

Patients with hypertension.

Variables

Independent variables

Active cycle breathing technique.

Spirometry.

Acapella (Positive Expiratory technique).

Dependent variables

Lung capacity.

Peak expiratory flow rate.

Rate of perceived exertion.

Outcome measures

Borg's scale for perceived exertion.

Peak Expiratory Flow Rate (PEFR)

Operational tools

Peak expiratory flow meter Spirometry.

Acapella (Positive pressure technique)

Measurement tools

Peak expiratory flow meter (Peak expiratory flow rate, PEFR), Modified Borg's Scale (Rate of perceived exertion, RPE)

Procedure

40 patient with mild to moderate COPD were selected according to inclusion and exclusion criteria and divided randomly into two experimental groups, as group A and group B, consisting of 20 patients each. A brief explanation about the treatment session was given to all the patients and informed consent is obtained. The value of peak expiratory flow rate and rate of perceived exertion were measured before the treatment (Day 1) and at the end of 4th week of treatment. Group A was treated with Active cycle breathing technique along with Spirometry and Group B received Active Cycle breathing technique along with Acapella device.

Active cycle breathing technique (both groups)

Patient is positioned in a relaxed sitting position and asked to do several minutes of relaxed diaphragmatic breathing exercise (breathing control). Then he is asked to take 3-4 active deep inspiration with passive relaxed exhalation (Thoracic expansion exercises), followed by relaxed diaphragmatic breathing (Breathing control). The patient is asked to feel the secretions entering the larger central airway, and then to do 2-3 huffs at higher volume, and then relaxed breathing control. The cycle is repeated 2-4 times as per patient's tolerance.

Frequency of Treatment:10-15 minutes per session, twice a day, 3 days per week.

Treatment Duration: 4 weeks.

Group a (ACBTand spirometry)

Subject asked to sit upright with the Incentive Spirometer held in an upright position, ask the subject to normally exhale and place his/her lips tightly around the mouthpiece. To achieve a Slow Sustained Maximal Inspiration (SMI), inhale at a sufficient rate to raise only the ball in the first chamber, while the ball in the second chamber remains at rest.

For a higher flow rate, inhale at a rate sufficient to raise the first and second balls, while the ball in the third chamber remains at rest. Exhale after performing the exercise, remove the mouthpiece from your lips and exhale normally.

Relax following each prolonged deep breath, take a moment to rest, and breathe normally. Then, repeat the exercise as directed by your health

Practitioner.

GROUP B (ACBT AND ACAPELLA)

Subjects were asked to seat in a comfortable position leaning forward with elbows supported on a table and neck slightly extended in order to open up the airway. The acapella was held horizontally and tilted slightly upwards in order to get maximal oscillatory effect and was place in the mouth. Inspiration was done through the nose. A slow breath in, only slightly deeper than normal with a breath hold of 3-5 seconds followed by breath out through the acapella at a slightly faster than normal. After 4-8 of these breaths, a deep breath with a 'hold' at full inspiration was followed by a forced expiration through the acapella. This precipitates expectoration and was followed by a pause for breathing control, and then according to the subject's preference a cough or huff was done.

The full effects of the vibrations induced by the acapella may be received by changing the angle of the device. Movement of the acapella upwards increases the pressure and frequency. While doing the procedure the patient must keep the cheeks flat and use the abdominal muscles effective exhalation. The vibration of the chest may be palpated by the patient to provide feedback as to the optimal angle of the device. An acapella session consists of 10 to 15 breaths followed by huffing, with session lasting about 20 minutes. To avoid dizziness due to hyper ventilation, a patient should refrain from forced exhalation. It may be necessary to pause every 5 to 10 exhalations before resuming the session. At any point make sure the subject should not to inhale through the acapella

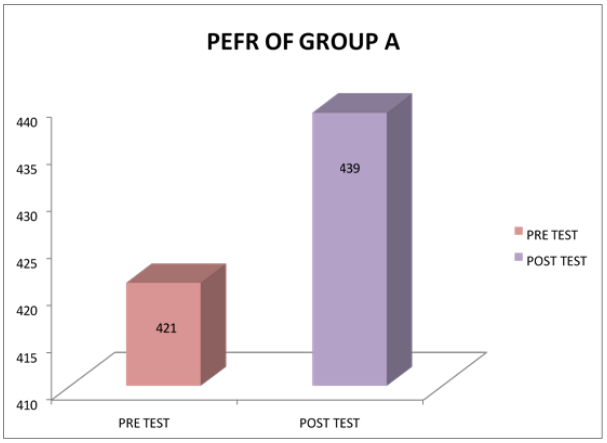
The acapella should be cleaned regularly with hot soapy water. In the hospital the equipment should be sterilised according to infection control recommendations.

Frequency of Treatment:

15 minutes per session, twice a day, 3 days per week.

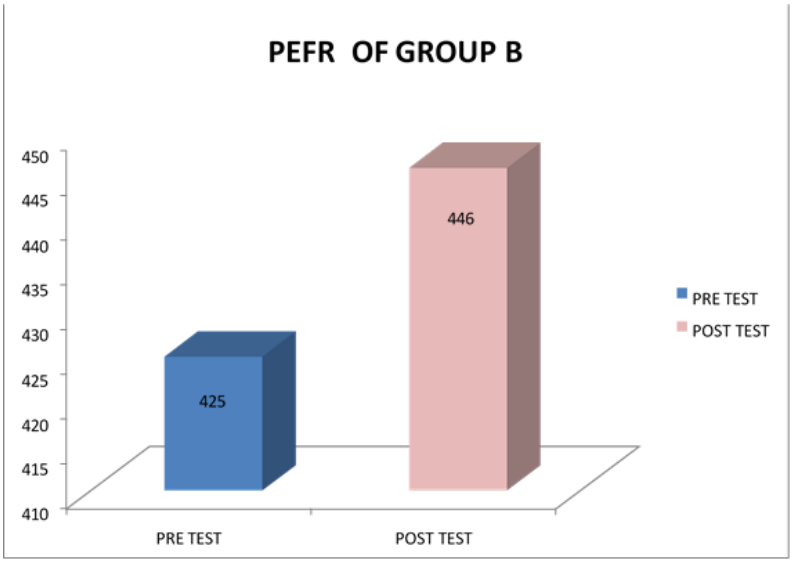
Treatment duration: 4 weeks.

S.NO	GROUP A	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	PRE-TEST	421.00	61.89	18.00	13.0767
2.	POST-TEST	439.00	58.66		

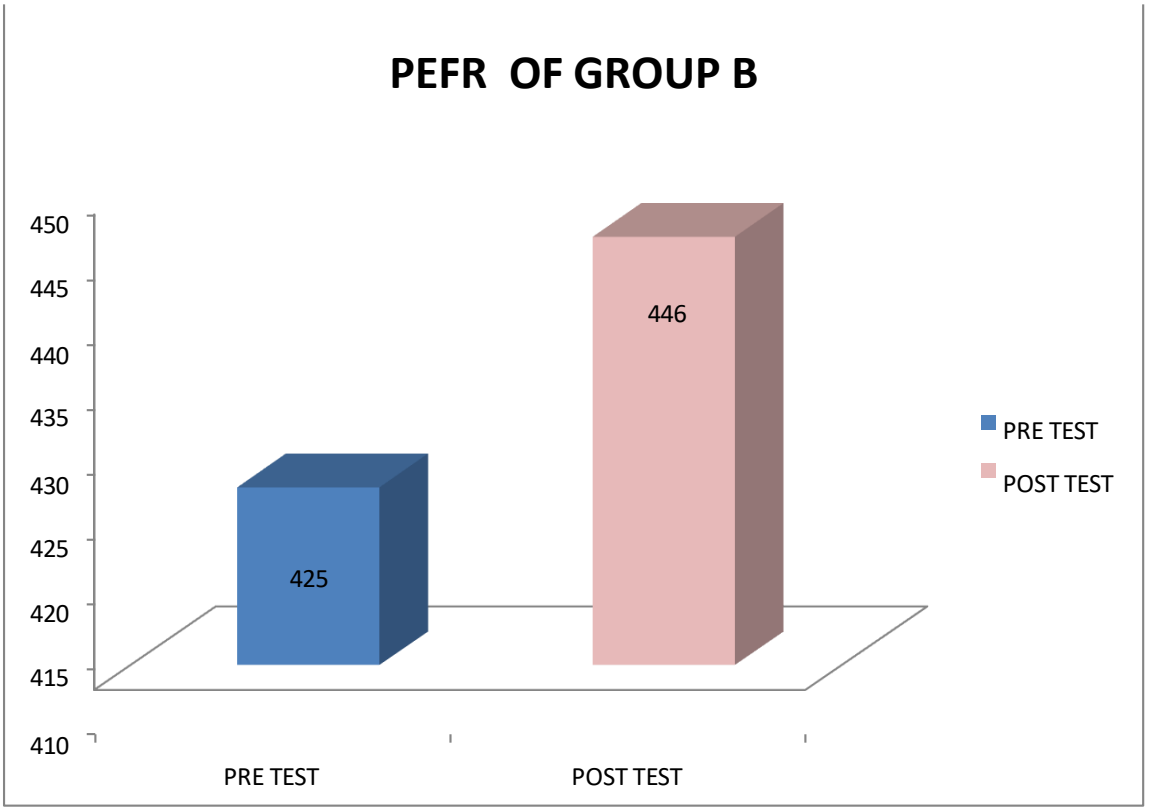


S.NO	GROUP B	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	PRE-TEST	425.0	64.37		

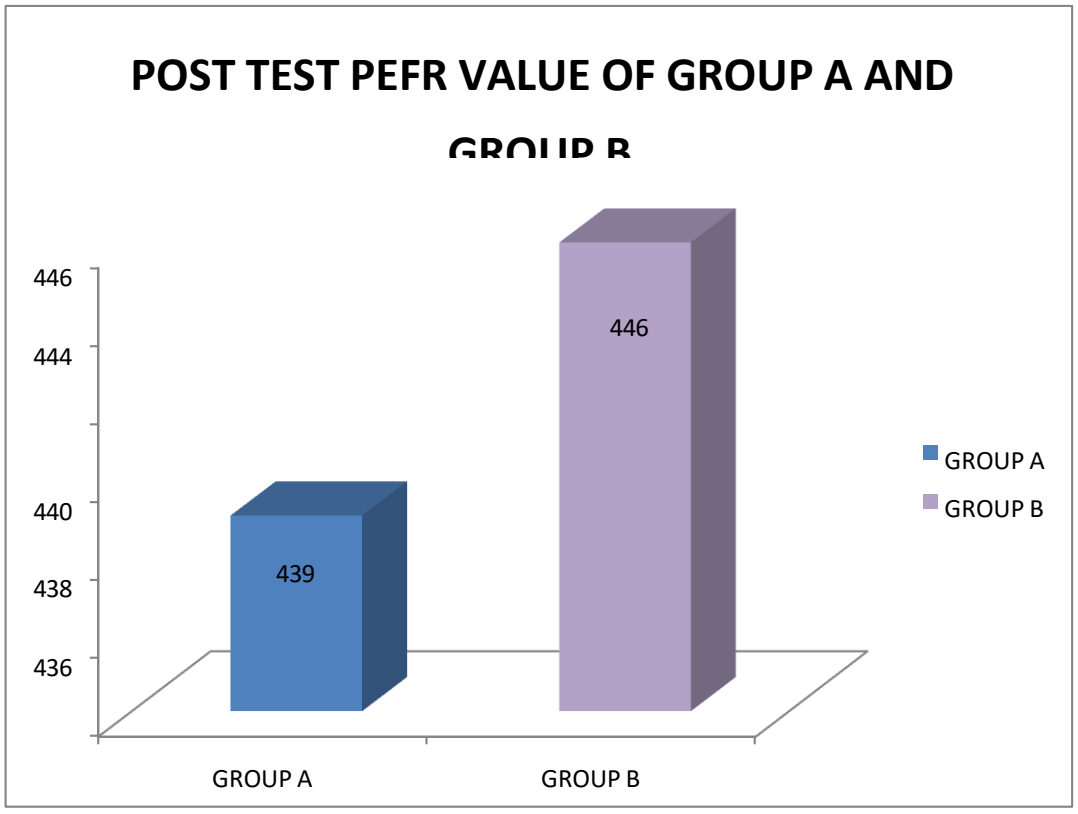
2.	POST-TEST	446.50	58.98	21.5	14.3333



S.NO	GROUP	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	GROUP A	439.00	58.66	7.50	0.4033
2.	GROUP B	446.50	58.96		


PEFR OF GROUP B
450
445
440
435
430
425
420
415
410
425
446
PRE TEST
POST TEST
PRE TEST
POST TEST

S.NO	GROUP	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	GROUP A	439.00	58.66	7.50	0.4033
2.	GROUP B	446.50	58.96		



S.NO	GROUP A	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	PRE-TEST	4.100	1.483	1.275	9.5753
2.	POST-TEST	2.825	1.184		

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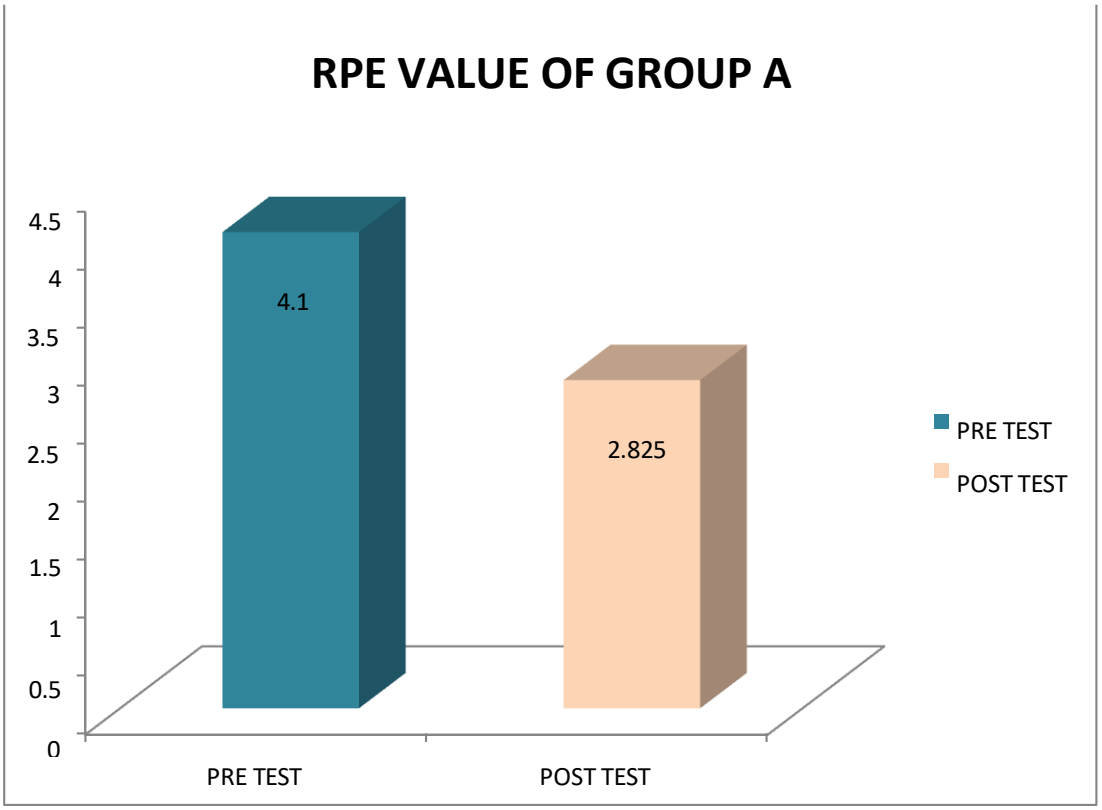
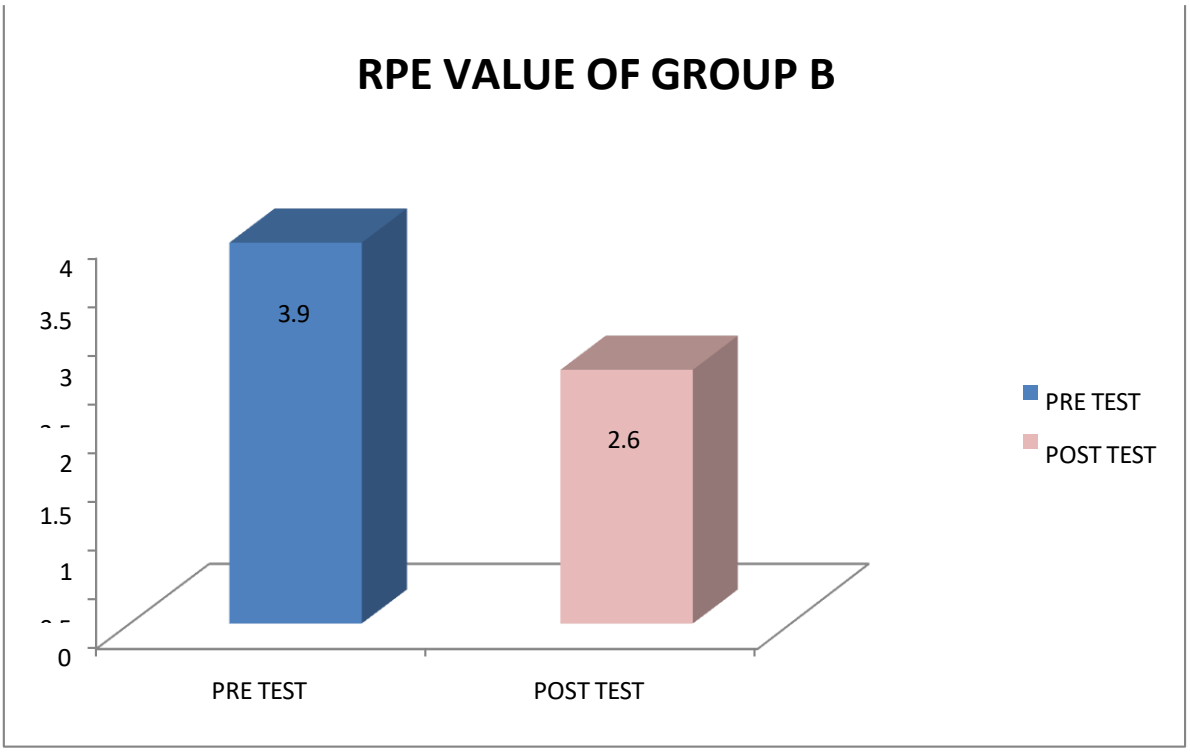
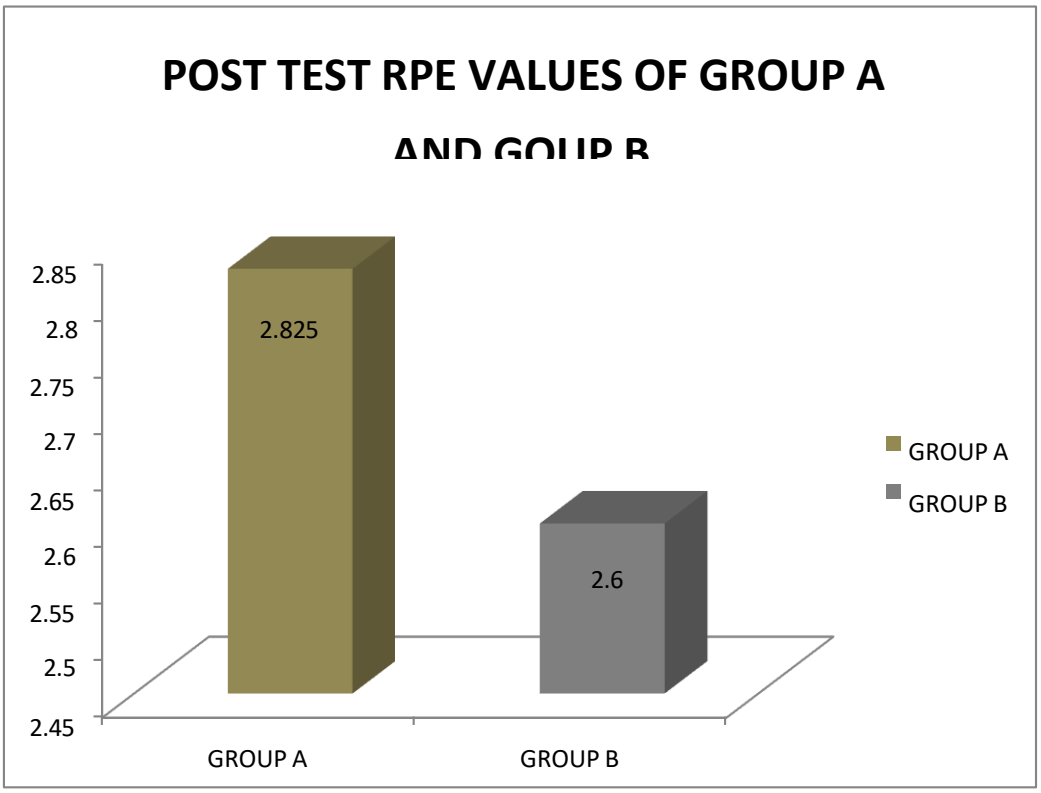


S.NO	GROUP B	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	PRE-TEST	3.900	1.252	1.300	13.1745
2.	POST-TEST	2.600	1.304		



S.NO	GROUP	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	GROUP A	2.825	1.184	0.225	0.5713
2.	GROUP B	2.600	1.304		



Results

For this study 40 subjects with moderate COPD were selected according to inclusive and exclusive criteria and randomly divided in to two groups with 20 subjects in each experimental group (Group A and Group B). Treatment duration was 4 weeks. Age group of the participants varies from 35 years to 50 years. The demographic representations of the groups are given in table I to VI.

The Paired 't' test analyses for the pre test and post test variable Peak expiratory flow rate for the Group A and Group B patients with moderate COPD which was shown in table I and II. Both the groups show significant differences in the pre test and post test values. The 't' value for the Group A is 13.0767 and the 't' value for the Group B is 14.3333. The unpaired't' test analysis for the post test variables of both group for the Peak expiratory flow rate for measuring peak expiratory flow in patients is shown in the table III. There was no significant difference shown between the Groups. Subjects in Group A showed same improvements as that of Group B. The unpaired 't' value for the post test variables for both groups is 0.4033. The Paired 't' test analyses for the pre test and post test variable for the Modified Borg's Scale for measuring perceived rate of exertion in patients with moderate COPD which was shown in table IV and V. Both the groups show significant differences in the pre test and post test values. The 't' value for the Group A is 9.5753, the 't' value for the Group B is 13.1745. The unpaired 't' test analysis for the post test variables for the both group for perceived rate of exertion in patients with moderate COPD is shown

in the table VI. There was no significant difference shown between the Groups. Subjects in Group A showed improvements same as that of Group B. The 't' value for the post test variables for both groups is 0.5713. The statistical analysis revealed that there was statistically significant improvement in the peak expiratory flow rate and rate of perceived exertion in both the groups, but there is no statistically significant improvements in the peak expiratory flow and perceived rate of exertion between the group A and group B.

Discussion

The purpose of the study is to find out the effect of active cycle of breathing technique with Spirometry with active cycle of breathing with Acapella on Peak expiratory flow rate and perceived exertion in patients with chronic obstructive pulmonary diseases. 40patients who were referred from Department of pulmonology were selected for the study. All were subjects were divided into two equal groups 20 subjects in each group. Group A Subjects underwent Active cycle of breathing technique with Incentive spiromtery, whereas Group B receives Active cycle of breathing technique with Acapella. Chronic obstructive pulmonary disease is one of the major conditions which cause morbidity and mortality. COPD affected by 10% of general population who age more than 40 years. It is the fourth leading cause of death worldwide. Pulmonary pathologies in COPD are characterized with partially reversible flow restriction in the airway. COPD patients complain of incapacitating dyspnoea, reduced functional capacity and episodes of acute exacerbations. (Mikelsons C, 2008).

Physiotherapy plays a key role in multidisciplinary interventions. Physiotherapy management includes addressing issues relating to reducing work of breathing, promoting airway clearance, improving mobility and promoting rehabilitation and contributing to the provision of effective noninvasive ventilation services. Chest physiotherapy includes positioning the patient to maximize ventilation, manage the secretion retention, breathing and whole body exercises to improve strength and function, and application of adjuncts designed to maximize lung function. (Garrod R & Lasserson T 2007).

Dyspnea refers to the sensation of breathlessness, shortness of breath, or difficulty breathing that is commonly observed in patients with respiratory and cardiac disease. (Anzueto A & Miravitlles M, 2017). Management of dyspnea in COPD requires lot of understanding of the mechanisms. Dyspnea occurs

due to inputs from somatic proprioceptive afferents and inspiratory motor command output. Respiratory disruption that causes a mismatch between medullary respiratory motor discharge and peripheral mechanizes or afferent feedback gives rise to a distressing urge to breathe which is independent of muscular effort. Recent brain imaging studies have shown increased limbic system activation in response to various dyspneogenic stimuli and emphasize the affective dimension of this symptom. All of these mechanisms are likely instrumental in exertional dyspnea causation in COPD. (O'Donnell et al., 2007).

Active cycle of breathing technique (ACBT) is used in the management of airway clearance and it included breath holding, thoracic expansion exercises and huffing. (Wange et al., 2016). This techniques help the diaphragm to work correctly while breathing, strengthens the diaphragm, and reduces the work of breathing by lowering the breathing rate and reducing the demand for oxygen with lessened effort. (Melam et al., 2012).

In this study the subjects in Group A, Subjects underwent Active Cycle of breathing techniques with Incentive Spirometery through a set of treatment protocol which was formulated by Department of Physiotherapy, RLJT Hospital. All the subjects in the group underwent 4 weeks of training programme. Following the treatment, their pre test values and the post test values were calculated and analyzed for the results.

ACBT is an airway clearance technique which can be done in sitting and can be done either independently or with an assistant. It can be easily taught to the patient and doesn't require any specialized equipment. There are various evidences shows that ACBT helps in improvement of lung function and sputum clearance in patients with COPD. (Hess DR 2002).

Few researchers have identified the effect of ACBT in improvement of pulmonary function, arterial blood gasses exchange, and improvement of exercise tolerance and dyspnea (Savci et al., 2000). Many studies have also identified the efficacy of ACBT and its effectiveness in clearance of lung fields and improvement of pulmonary function in patients with bronchiectasis. (Mohammed et al., 2012).

In another study by Patterson et al., (2004) ACBT and test of incremental respiratory endurance were used in 20 stable COPD patients mainly with bronchiectasis in a randomized crossover trial. In their

conclusion ACBT was found to be a more effective method of airway clearance in bronchiectasis than incremental respiratory endurance during a single treatment session. The results of the study showed ACBT resulted in a significant increase in pulmonary functions FEV1, FEV1/FVC and a reduction in dyspnea.

Pryor et al.,1990, in their study stated that, a decrease in oxygen saturation caused by chest percussion may be avoided by using the ACBT technique. ACBT increased forced vital capacity, peak expiratory flow rate, arterial oxygenation and exercise performances. Incentive Spirometry is usually a treatment choice for the post operative care patients to prevent pulmonary complications. The use of Incentive spirometry appears to improve arterial blood gases and health-related quality of life in patients with COPD exacerbations, although it does not alter pulmonary function parameters. (AARC, 1991). Incentive spirometry play a major role in improving the ventilation, aids in restoration of alveolar aeration and improves oxygenation. It was hypothesized that the use of Incentive spirometry in patients with COPD may improve oxygenation, lung function and quality of life. (Basoglu et al., 2005).

Efficacy of Incentive spirometry with the deep breathing exercises aids in the prevention of postoperative pulmonary complications. Incentive spirometry and deep breathing exercise have been found to be more effective. (Thomas et al., 1991).

Incentive spirometry as an inspiratory muscle training device was evaluated in the present study. Incentive spirometry is designed to mimic natural sighing or yawning by encouraging the patient to take long, slow, deep breaths and it can be used for inspiratory muscles training. The use of Incentive spirometry increases transpulmonary pressure, inspiratory volumes and inspiratory muscle performance. (AARC, 1991).

Incentive spirometry increases the quality of breathing improved the maximum inspiratory pressure (PImax) and dyspnoea. It also improves inspiratory muscle performances. (Scherer et al., 2000). Igarashi et al 1994, has assessed the effects of IS on pulmonary function and ABG in healthy adults of advanced age and in COPD patients. An improvement in inspiratory muscle strength and endurance might reduce symptoms and improve functional capacity in patients with severe COPD, even if airway obstruction does not improve.

Group B subjects underwent Subjects underwent Active Cycle of breathing techniques with Acapella device through a set of treatment protocol which was formulated by Department of Physiotherapy. All the subjects in the group underwent 4 weeks of training programme. Following the treatment, their pre-test values and the post test values were calculated and analyzed for the results.

Stasis of secretions in respiratory diseases leads to chronic infection, inflammation and lung destruction. (Newhouse et al., 1998). Several types of airway clearance adjuncts are commercially available to aid in mucus mobilization and expectoration. Oscillating PEP (OPEP) is designed to be used with a steady expiratory maneuver. Acapella is already known to be effective in airway clearance. Acapella combines the principles of high-frequency oscillation and PEP by employing a counterweighted lever and magnet. Acapella produced higher amplitudes at the medium and high settings.

The Acapella created more stable air flow oscillations (less variation in amplitude and frequency). Acapella consistently generated higher-amplitude oscillations with the lowest flow tested (5 L/min). That higher pressure build-up during occlusion results in a higher subsequent flow burst and presumably a greater mucus transport effect.

Acapella produces transformation of stagnation pressure to cause expiratory flow to decrease which enhanced mucus clearance has a lot to do with the increased acceleration and short bursts of high flows that result when the pressure that builds up behind the occlusion is released; the higher the pressure build-up, the higher the subsequent flow burst. This pressure builds up because of the tension in the elastic components of the lungs, relaxation of inspiratory muscles, and contraction of expiratory muscles. During the short bursts of expiratory flow caused by the OPEP devices, high flow spikes of turbulence may exist farther down in the lungs, as well as in the upper airways, causing increased drag on the mucus on the airway walls. (Fink et al., 2002)

Studies done by many researchers confirmed that the acapella device is very effective in removal of secretions thereby it enhances the lung performance. (Naraparaju et al., 2010). Some researchers have advised that Acapella's performance is not gravity-dependent (i.e, dependent on device orientation) and may be easier to use for some patients, particularly at low expiratory flows. (Volsko et al., 2003). Acapella can be used as an adjunctive exercise program along with ACBT to improve airway clearance

and breathing. (Senthil et al., 2015). Based on the statistical analysis the result of this study shows that Active cycle of breathing technique with the adjunction of Acapella clears secretion, improves the peak expiratory flow rate and reduces the dyspnea as like as the active cycle of breathing and Incentive spirometery. So both the techniques are equally effective. There was no significant differences exists between the two groups.

Conclusion

1. There is significant improvement of Perceived exertion rate in both the groups.

2. There is significant improvement of Peak expiratory flow rate in both the groups.

3. When the Peak expiratory flow rate of group A and group B are Compared the result showed less significant difference.

4. When the Rate of perceived exertion of group A and group B are compared the result showed less significant difference.

So this study concludes that there is less significant difference in the effect comparing Active cycle breathing technique along with Spirometry and Active cycle breathing technique along with Acapella. Eventhough both groups has shown improvements within the groups in the Peak expiratory flow rate and Perceived exertion rate.

Limitations and recommendations

Sample studied was small and the study reduces the generalising ability therefore a future study with much larger population is recommended.

- FEV1 and FVC can be measured by computerised pulmonary function test.
- More reliable and accurate tools can be used.

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