

TO COMPARE THE EFFECT OF ACTIVE CYCLE BREATHING TECHNIQUE AND POSTURAL DRAINAGE IN SUBJECTS WITH BRONCHIECTASIS

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ABSTRACT: The Aim of this study is to compare the Efficacy of Active Cycle of Breathing Technique and Postural Drainage in Patients with Bronchiectasis. **Materials and Methodology:** A Quasi Experimental study design consists of reviews of charts of Bronchiectasis patients. Thirty patients were included, (60%) were males, (40%) were females; the average age was 56 years. All the patients are presented with unilateral lung involvement. Pre- and Post-Treatment scores of FVC, FEV1, PEFR and SPO2 are assessed to know their breathing capacity by Pulmonary Function test and Pulse Oximetry. **Results:** The pre and post test values were assessed by PFT and Pulse Oximetry in group A and group B. The mean difference value of FVC is 83 and 77, FEV1 is 81 and 77, PEFR is 209 and 197 and SPO2 is 98 and 94 respectively. The standard deviation of FVC is 1.26 and 1.06, FEV1 is 2.93 and 1.69, PEFR is 3.51 and 3.13 and SPO2 is 1.41 and 1.00 respectively. The paired „t“ test value of FVC is 250.31 and 175.20, FEV1 is 103.75 and 102.30, PEFR is 226.26 and 196.85 and SPO2 is 263.30 and 246.50 respectively. The paired „t“ test value is more than table value 2.15 for 5% level of significance at 14 degrees of freedom. The calculated „t“ values by unpaired „t“ test of FVC is 36.45, FEV1 is 10.71, PEFR is 10.92 and SPO2 is 8.88 respectively. The calculated „t“ values were more than the table value 2.05 for 5% level of significance at 28 degrees of freedom. **Conclusion:** The paired „t“ test values have shown that ACBT was more effective than Postural Drainage in improving airway clearance in patients with Bronchiectasis. The unpaired „t“ test values have shown that there was significant difference between two groups in showing improvement in their quality of life in patients with Bronchiectasis.

Keywords:

Pulmonary Function test, Pulse Oximetry, Active Cycle of Breathing, Postural Drainage

INTRODUCTION

Bronchiectasis is one of the most common diseases in the rural and industrial areas of India. There are reports of high prevalence in relatively isolated populations with poor access to health care and high rates of respiratory tract infections during childhood. Bronchiectasis is an abnormal dilatation of the bronchi associated with obstruction and infection. Clinically, Bronchiectasis is defined as an abnormal dilatation of medium size bronchi and bronchioles (about the fourth to ninth generations), generally associated with previous, chronic necrotizing infections within these passages. The etio-pathogenesis of Bronchiectasis is related to bronchial obstructions, infections or both in a large majority of patients. The condition most commonly affects the lower lobes, the lingual and then the middle lobe. It tends to affect the left lung more than right, although 50% of cases are bilateral. It is an uncommon disease with the potential to cause devastating illness including repeated respiratory infections requiring antibiotics, disabling productive cough, shortness of breath, and occasional hemoptysis.

Typical signs and symptoms include; Sputum overproduction, Fever, Pleurisy, Dyspnea, Chronic cough, Hemoptysis, Added sounds, Clubbing. Pulmonary function test of patients with localized bronchiectasis show reduction in FEV1, maximal mid expiratory flow rate, Maximal voluntary ventilation (MVV), diffusing capacity and increase in residual volume. Spirometry often shows a limitation of airflow with a reduced ratio of forced

expiratory volume in one second (FEV1) to forced vital capacity (FVC), a normal or slightly reduced FVC, and a reduced FEV1. A reduced FVC may indicate that airways are blocked by mucus, which collapse with forced exhalation or there is pneumonitis in the lung. High-resolution CT has become the best tool for diagnosing bronchiectasis, clarifying the findings from chest radiography and mapping airway abnormalities that cannot be seen on plain films of the chest. The invention of Broad spectrum antibiotics in this era has lessened the mortality and morbidity rate in respiratory infective diseases. The most accepted treatment protocol preferred for Bronchiectasis now days includes oral, aerosolized or intravenous antibiotic therapy according to the severity of the exacerbation and mucus clearance by means of bronchial Hygiene assistive devices, surgical resection, chest physiotherapy like breathing exercises, postural drainage, high-frequency chest compression, forced expiratory techniques etc. Enhancing the removal of respiratory secretions in patients with bronchiectasis is beneficial. Physical means such as gravitational postural drainage and the forced expiration technique (FET) used for chest physiotherapy may also be effective. In addition to the control of cough, postural drainage, chest physiotherapy, thinning and loosening of secretions, the administration of a bronchodilator and of inhaled corticosteroids has been a part of maintenance therapy and treatment for acute exacerbations. ACBT could an effective method of airway clearance technique in Bronchiectasis and it is effective in cleaning secretions and improving lung functions. These techniques can be used in stable COPD patients according to the patient's and the Physiotherapist's preferences.

Pulmonary Function Test, Oxygen saturation and Peak Expiratory Flow Rate can measure the effects of postural drainage and Active Cycle of Breathing Techniques. Monitoring Pulmonary Function Test provides a guide to the state and function of the respiratory system. It indicates the Forced Expiratory Volume in one second (FEV1), Vital capacity, Forced Vital Capacity, the Peak Expiratory Flow Rate and oxygen saturation (SPO2) which is used as means of monitoring the effects of postural drainage and active cycle of breathing techniques in bronchiectasis.

There is not enough evidence to support or refute the use of bronchial hygiene physical therapy in patients with chronic obstructive pulmonary disease and bronchiectasis. Considering the above factors, the need arises to examine the effects of Broncho-pulmonary hygiene physical therapy and to compare the efficacy of Active cycle of breathing technique versus Postural drainage in the management of patients with bronchiectasis to know which technique is more effective for patients with Bronchiectasis.

MATERIALS AND METHODOLOGY

3.1 MATERIALS

- Treatment couch
- Treatment chair
- Towel
- Stop clock
- Stethoscopes
- B.P Apparatus

3.2 METHODOLOGY

- All patients underwent a cardio examination and posture evaluation.
- CT Lungs and x ray show the severity of Bronchiectasis.

- PFT and Pulse Oximeter are conducted to know how the patients affected with Bronchiectasis.

3.3 POPULATION

- Patients with age group of 30-60 years having severity of Bronchiectasis.

3.4 CRITERIA FOR SAMPLE SELECTION

3.4 (a) INCLUSION CRITERIA

- Both genders.
- Age group between 30-60 years.
- Sufficient hearing and vision.
- Cases of isolated bronchiectasis.
- Unilateral lung involvement

EXCLUSION CRITERIA

The exclusion Criteria were conditions with symptoms of raised intra cranial pressure, Head and neck injury until stabilized, Active hemorrhage with hemodynamic instability, Recent spinal surgery (e.g., Laminectomy) or acute spinal injury, active hemoptysis, Empyema, Broncho pleural fistula, Pulmonary edema associated with congestive heart failure, Large pleural effusions, pulmonary embolism, Aged, confused, or anxious patients who do not tolerate position changes, Rib fracture, with or without flail chest, Tumors, Active cases of tuberculosis.

3.5 SOURCE OF DATA

- In patient Saveetha college of physiotherapy thandalam

3.6 SAMPLE SIZE

- Sample size is 30 subjects
- Group A-15 patients
- Group B-15 patients

3.7 STUDY DESIGN

- Quasi Experimental design
- Pre and Post experimental Study Design

3.8 SAMPLING METHOD

- Convenient Sampling Method

3.9 DURATION OF THE STUDY

- The total duration of the study is 6 Months.

3.10 TREATMENT DURATION

Active cycle of breathing technique for 15 - 20 minutes. Each standardized ACBT cycle lasted around two minutes. Three treatment sessions in a day were given with an interval of four hours between each session.

3.11 PARAMETER

- Pulmonary Function Test
- Pulse Oximetry

VARIABLES

- Forced Vital Capacity (FVC)
- Forced Expiratory Volume in one second (FEV1)
- Peak Expiratory Flow Rate (PEFR)
- Pulse Oximetry

3.12 PROCEDURE

The subjects were explained about the treatment, experimental procedures and outcome measures. Formal written consent was obtained from each subject and ethical clearance was obtained from Institutional Ethical Committee of PPG College of Physiotherapy. The selected 30 subjects were then randomly assigned to any of the two experimental treatment groups i.e. Group A and Group B of 15 subjects each. Group A, received Active cycle of breathing technique for 15 - 20 minutes. Each standardized ACBT cycle lasted around two minutes. During the study the total number of ACBT cycle performed during the treatment phase was individualized and not set. Three treatment sessions in a day were given with an interval of four hours between each session. Total study period was for eight hours. ACBT was administered to the affected lobe after explaining the procedure to the patients. Group B, have received postural drainage for 15–20 minutes. Three treatment sessions in a day were given with an interval of four hours between each session. Total study period was for eight hours and traditional postural drainage procedures were given to the affected lobes. The outcome tools used in the study were Pulmonary Function Test to measure Force Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1) and Peak Expiratory Flow Rate (PEFR) and Pulse Oximetry was used to measure SPO₂, which were done before administering the treatment and at the end of treatment for both the groups.

TECHNIQUES

GROUP (A) RECIVED ACTIVE CYCLE OF BREATHING

People with a lung problems often cough and produce more phlegm (sputum) than is usual. It is important to remove sputum from your lungs to help you breathe more easily, prevent chest infections and reduce bouts of coughing. Leaving sputum in your chest can make your condition worse.

The Active Cycle of Breathing Techniques (ACBT) is one way to help you to clear sputum from your chest. ACBT is a set of breathing exercises that loosens and moves the sputum from your airways. The

ACBT exercises are breathing control, deep breathing and huffing which are performed in a cycle until your chest feels clear.

Breathing Control

- Breathing control is breathing gently, using as little effort as possible.
- Breathe in and out gently through your nose if you can. If you cannot, breathe through your mouth instead
- If you breathe out through your mouth you can use breathing control with **„Pursed lip breathing“**
- Try to let go of any tension in your body with each breath out
- Gradually try to make the breaths slower

Try closing your eyes to help you to focus on your breathing and to relax It is very important to do Breathing Control in between the more active exercises of ACBT as it allows your airways to relax. Breathing control can also help you when you are short of breath or feeling fearful, anxious or in a panic.

Deep Breathing Exercises

Take a long, slow, deep breath in, through your nose if you can. Try to keep your chest and shoulders relaxed. Breathe out gently and relaxed, like a sigh. You should do 3-5 deep breaths. Some patients find it helpful to hold their breath for about 2-3 seconds at the end of the breath in, before breathing out. Try the deep breathing exercises both with and without holding your breath and see which works best for you.

Huffing

A huff is exhaling through an open mouth and throat instead of coughing. It helps **move sputum up your airways so that you can clear it in a controlled way. To „huff“ you**

Squeeze air quickly from your lungs, out through your open mouth and throat, as if you were trying to mist up a mirror or your glasses. Use your tummy muscles to help you squeeze the air out, but do not force it so much that you cause wheezing or tightness in your chest. Huffing should always be followed by breathing control. There are 2 types of huff, which help to move sputum from different parts of the lungs.

The Small-long huff

This will move sputum from low down in your chest. Take a small to medium breath in and then huff (squeeze) the air out until your lungs feel quite empty, as detailed above.

The Big-short huff

This moves sputum from higher up in your chest, so use this huff when it feels ready to come out, but not before. Take a deep breath in and then huff the air out quickly. This should clear your sputum without coughing.

GROUP (B) RECEIVED POSTURAL DRAINAGE

Left Lower Lobe

Lie on your right side with your head down and a pillow under your hips and legs.

Percuss the left side from the armpit to the bottom of your ribs.

Bend your left leg and rotate your body so your chest is pointing down.

Percuss the back on the left side from shoulder blade to bottom of the ribs.

Right Lower and Middle Lobes

Lie on your left side with your head down and pillows under your hips and legs.

Percuss right side from the armpit to the bottom of the ribs.

Bend your right leg and rotate your body so your chest is pointing down.

Percuss the back on the right side from the shoulder blade to bottom of the ribs.

Right Lower and Middle Lobes

Lie on your left side with your head down and pillows under your hips and legs.
Percuss right side from the armpit to the bottom of the ribs.

Bend your right leg and rotate your body so your chest is pointing down.

Percuss the back on the right side from the shoulder blade to bottom of the ribs.

Right and Left Lower Lobes (Back)

With this position you can drain and percuss both lower lobes at the same time.

This position may be difficult for you if you have a trach or are on a ventilator.

Lie face down with a pillow under your chest and stomach.

Percuss on either side of the spine from the shoulder blade to the bottom of the ribs.

Right and Left Upper Lobes (Back)

Sit in a chair with a pillow in front of your stomach and lean forward.

Percuss over the shoulder blades on both sides

Right and Left Upper Lobes (Front)

Sit up in a chair with a pillow behind your back and lean back.

Percuss over the upper part of both sides of the chest to the nipple.

Percuss only to the top of the breasts in females.

RESULT

Table 4.1 and Figure 4.1 shows the age distribution among the study. The patients were in the range of 30-60 years. The mean average age of Group A and Group B were 56.

TABLE-4.1(MEAN AVERAGE AGE GROUP OF GROUP A AND GROUP B)

Mean Age Group	Group A	Group B
Female's	57	56
Male's	56	55

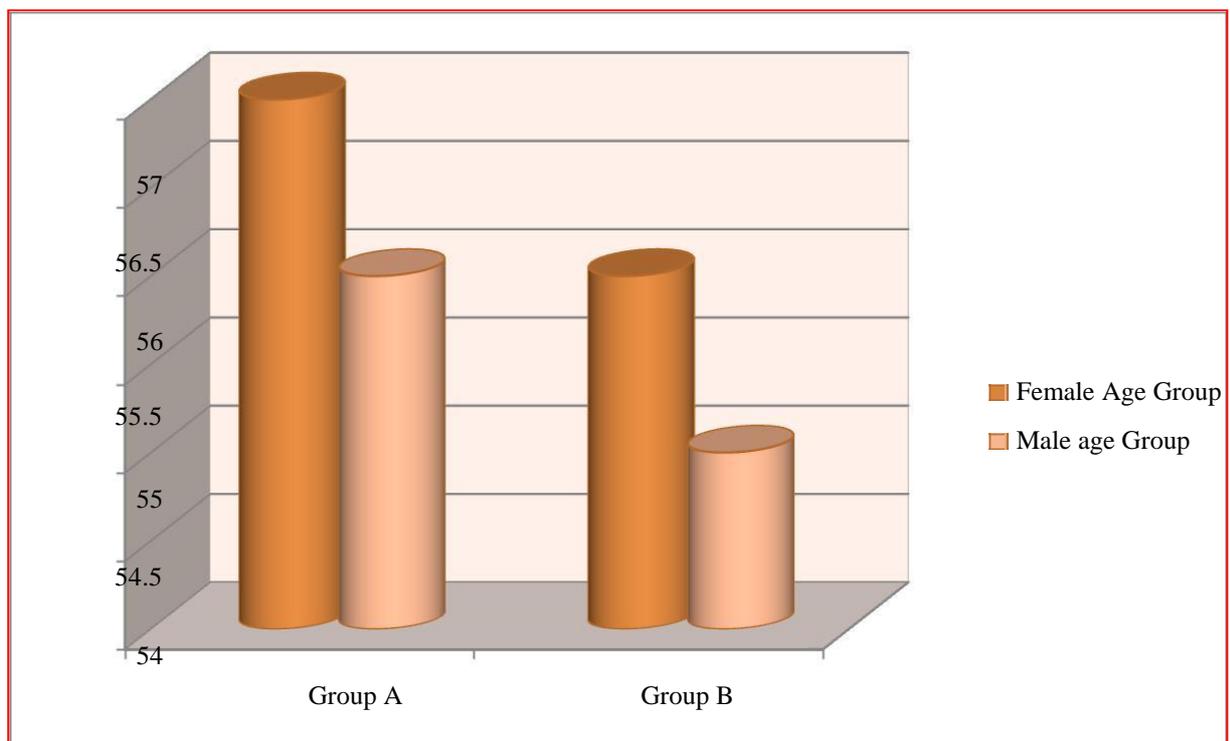
FIG-4.1(MEAN AVERAGE AGE OF GROUP A AND GROUP B)**GENDER DISTRIBUTION OF GROUP A AND GROUP B**

Table 4.2 and Figure 4.2 show the gender distribution among the study. There are 60% of males and 40% of females in both Groups.

TABLE-4.2

Gender Distribution	Group A	Group B
Male's	10	9
Female's	5	6

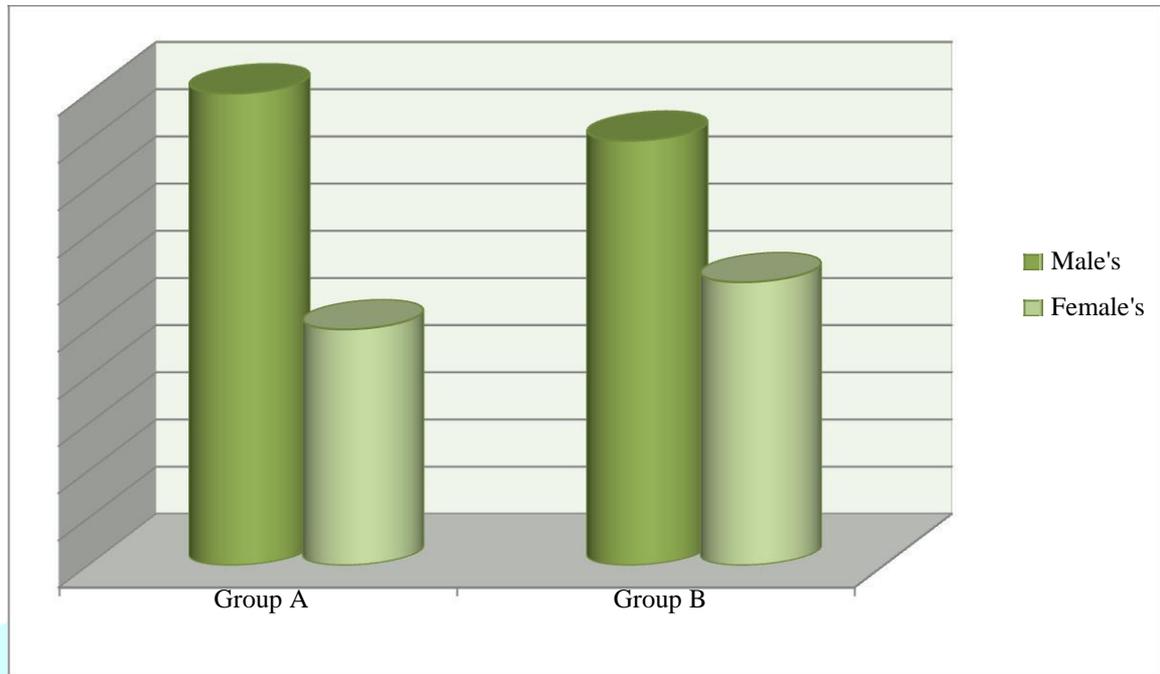
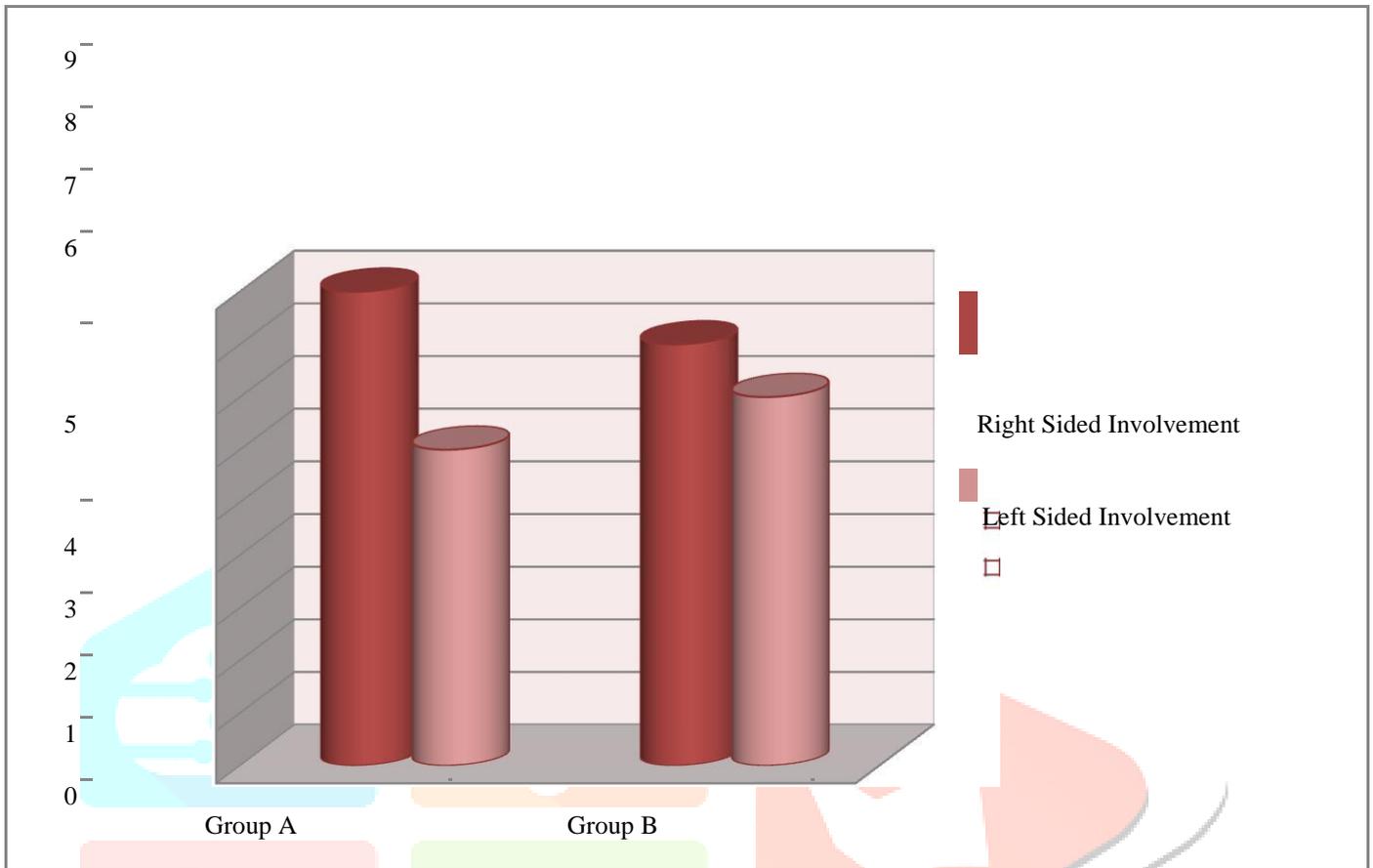
FIG 4.2 (GENDER DISTRIBUTION OF GROUP A AND GROUP B)**SIDE INVOLVEMENT BETWEEN GROUP A AND GROUP B**

Table 4.3 and Figure 4.3 show the information relating to the side involvement among the patients in the study. The Group A consists of 9 right side lung involvement patients and 6 left side lung involvement patients respectively. The Group B consists of 8 right side lung involvement patients and 7 left side lung involvement patients. Right Sided involvement is statistically higher among two groups.

TABLE-4.3

Side Involvement	Group A	Group B
Right Side	9	8
Left Side	6	7

FIG-4.3 (SIDE INVOLVEMENT BETWEEN GROUP A AND GROUP B)

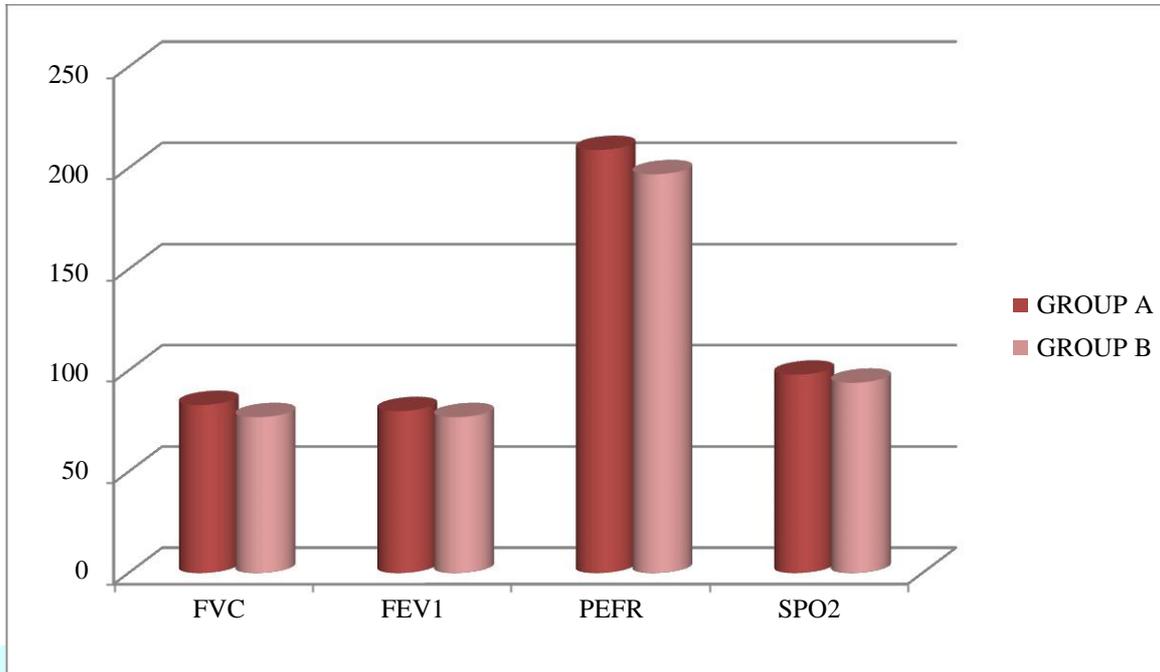


COMPARISON OF VARIABLES MEAN DIFFERENCE BETWEEN GROUP A AND GROUP B OF PFT AND PULSE OXYMETRY

TABLE-4.4

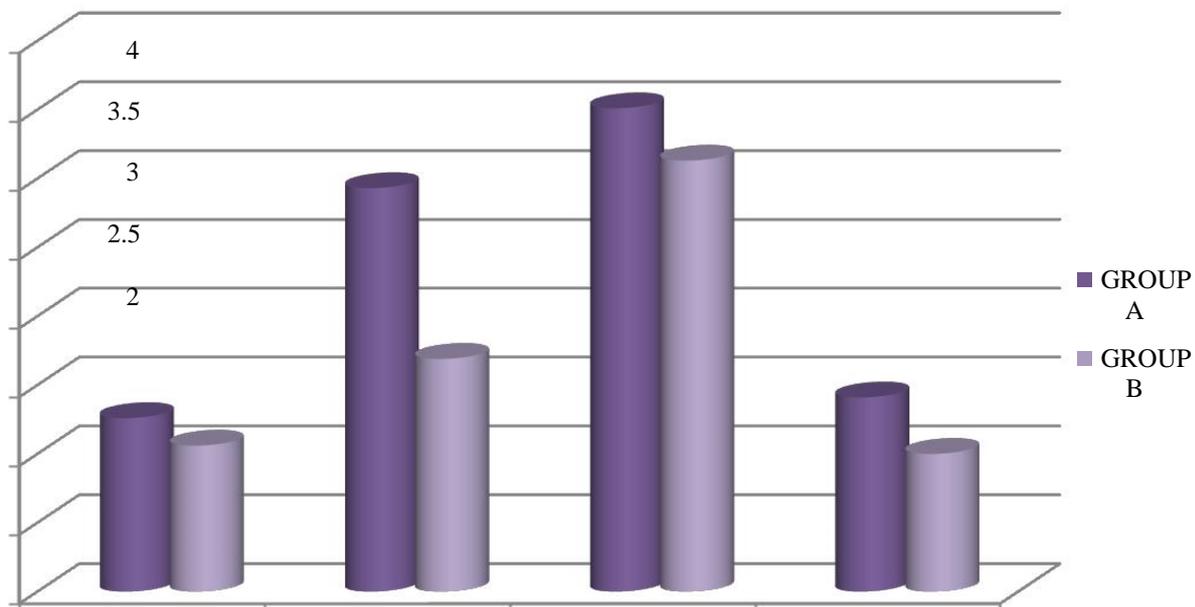
VARIABLES	GROUP A	GROUP B
FVC	83	77
FEV1	80	77
PEFR	209	197
SPO2	98	94

FIGURE-4.4 (MEAN DIFFERENCE OF FVC, FEV1, PEFR AND SPO2)



COMPARISON OF VARIABLES STANDARD DEVIATION BETWEEN GROUP A AND GROUP B OF PFT AND PULSE OXYMETRY**TABLE-4.5**

VARIABLES	GROUP A	GROUP B
FVC	1.26	1.06
FEV1	2.93	1.69
PEFR	3.51	3.13
SPO2	1.41	1.00

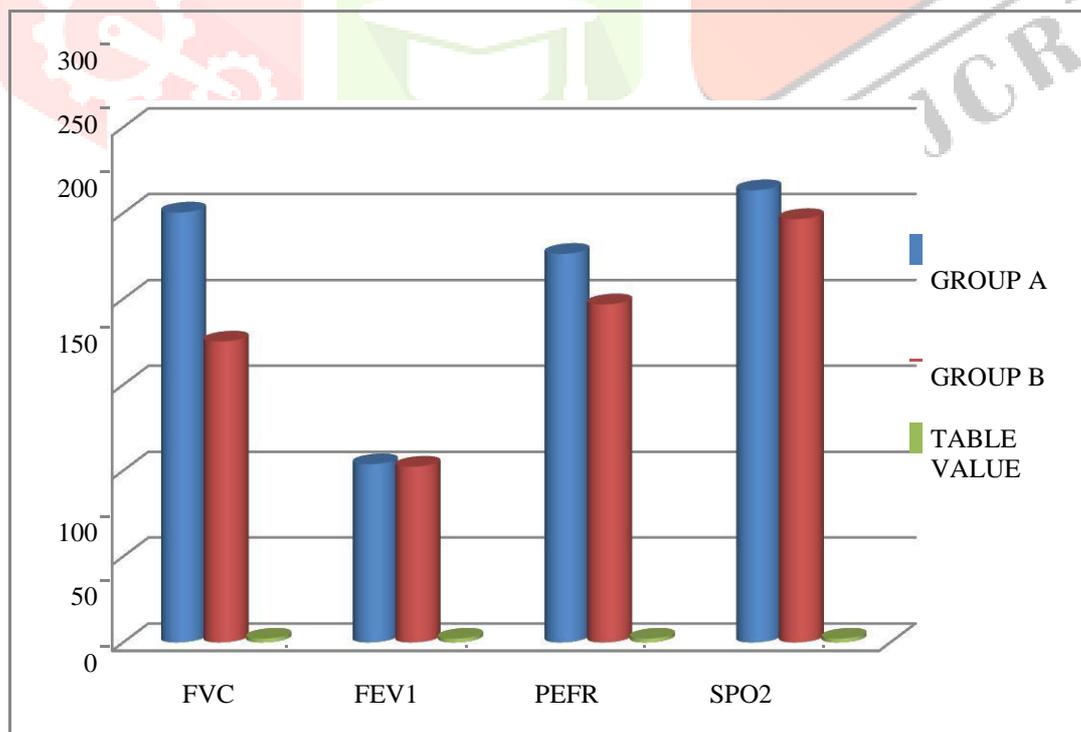
FIGURE-4.5 (STANDARD DEVIATION OF FVC, FEV1,PEFR AND SPO2)

COMPARISON OF THE PAIRED t- TEST AND TABLE VALUE BETWEEN GROUP A AND GROUP B

TABLE-4.6

GROUPS	CALCULATED ' T-VALUE		TABLE VALUE	SIGNIFICANCE
	GROUP A	GROUP B		
FVC	250.31	175.20	2.15	SIGNIFICANT
FEV1	103.75	102.30	2.15	SIGNIFICANT
PEFR	226.26	196.85	2.15	SIGNIFICANT
SPO2	263.30	246.50	2.15	SIGNIFICANT

FIGURE-4.6 (PAIRED T –TEST AND TABLE VALUE OF FVC, FEV1, PEFR AND SPO2)

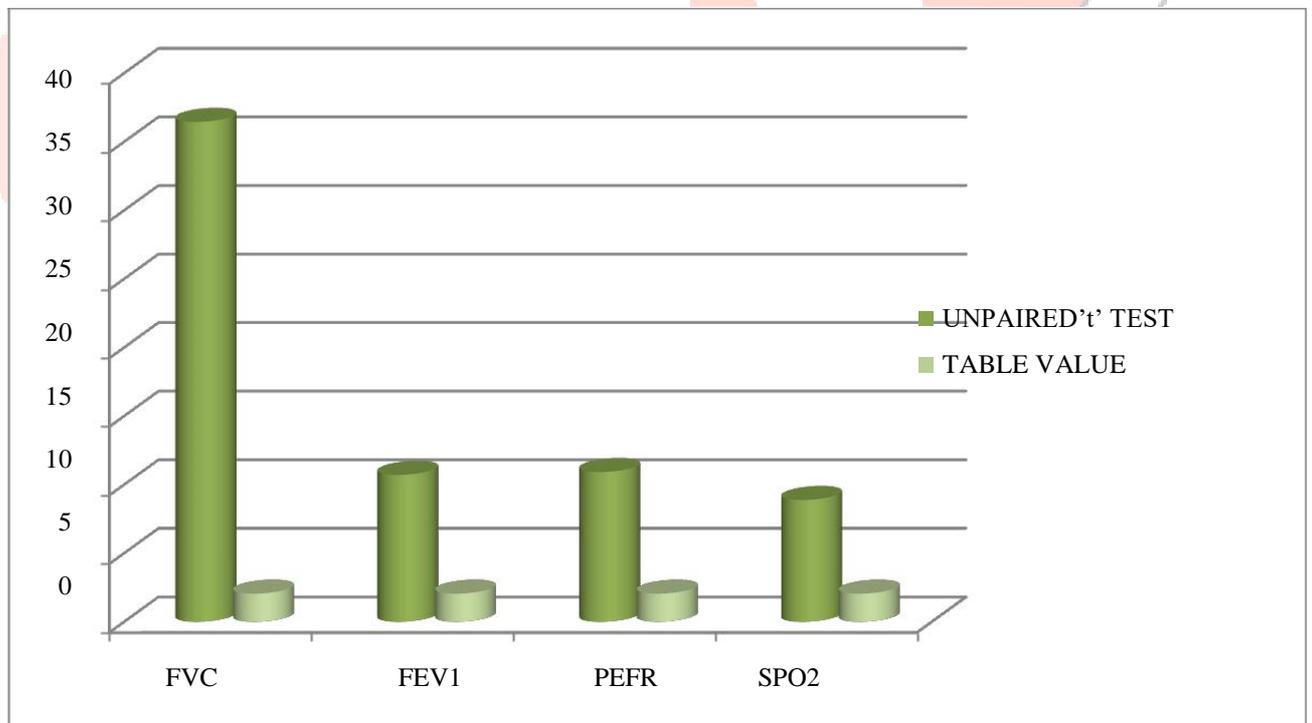


COMPARISON OF UNPAIRED t - TEST AND TABLE VALUE BETWEEN PFT AND PULSE OXYMETRY

TABLE-4.7

VARIABLES	UNPAIRED ' t ' TEST	TABLE VALUE	SIGNIFICANCE
FVC	36.45	2.05	SIGNIFICANT
FEV1	10.71	2.05	SIGNIFICANT
PEFR	10.92	2.05	SIGNIFICANT
SPO2	8.88	2.05	SIGNIFICANT

FIGURE- 4.7 (UNPAIRED t -TEST AND TABLE VALUE FOR FVC, FEV1, PEFR AND SPO2)



RESULTS

The study sample comprised 30 patients, of which 15 were male and 15 were female. The mean age of patients was 56 years. Among 30 patients, 15 were treated with ACBT, and 15 were treated with Postural drainage.

The pre and post test values were assessed by PFT and Pulse Oximetry in group A and group B. The mean difference value of FVC is 83 and 77, FEV1 is 81 and 77, PEFR is 209 and 197 and SPO2 is 98 and 94 respectively. The standard deviation of FVC is 1.26 and 1.06, FEV1 is 2.93 and 1.69, PEFR is 3.51 and 3.13 and SPO2 is 1.41 and 1.00 respectively. The **paired „t“ test** value of FVC is 250.31 and 175.20, FEV1 is 103.75 and 102.30, PEFR is 226.26 and 196.85 and SPO2 is 263.30 and 246.50 respectively. The paired „t“ test value is more than table value 2.15 for 5% level of significance at 14 degrees of freedom.

The calculated „t“ values by unpaired „t“ test of FVC is 36.45, FEV1 is 10.71, PEFR is 10.92 and SPO2 is 8.88 respectively. The calculated „t“ values were more than the table value 2.05 for 5% level of significance at 28 degrees of freedom.

The paired „t“ test values have shown that ACBT was more effective than Postural Drainage in improving airway clearance in patients with Bronchiectasis.. The unpaired „t“ test values have shown that there was significant difference between two groups in showing improvement in their quality of life in patients with Bronchiectasis.

DISCUSSION

This was a comparative study between effectiveness of Active Cycle of Breathing Technique and Postural Drainage for improving pulmonary function in bronchiectasis patients. The results shows that, Active Cycle of Breathing Technique is having better effect on clearing the airways in bronchiectasis patients compared with postural drainage. The result of the study supports the hypothesis that there will be a significant effect in airway clearance in bronchiectasis patients using both Active cycle of breathing technique and postural drainage but when both the techniques are compared ACBT is having a better effect than Postural Drainage to improve pulmonary function in Bronchiectasis. In a study by Patterson et al in their article stated that, ACBT is a more effective method of airway clearance in bronchiectasis during single treatment sessions. Other study by **Pryor et al** in their study stated that, a decrease in oxygen saturation caused by chest percussion may be avoided by using the ACBT technique. Similar findings were found in studies done by **Savci S et al** who stated that ACBT is effective in cleaning secretions and improving lung functions in Bronchiectasis. The ACBT increased forced vital capacity, peak expiratory flow rate, arterial oxygenation and exercise performance.

Majority of the patients selected in this study reported to have an earlier medical history of infective disease such as Tuberculosis, Post necrotizing pneumonia etc. Bronchiectasis is one of the most common types of COPD secondary to any other infective diseases. There was an earlier study done by **E Silverman et al** who stated in their study that, known causative factors include post infection bronchial damage, post inhalation injury, hypersensitivity reactions, and congenital airway obstructive disorders. One interesting observation made during this study was about the higher quantity of the secretion removed in the early morning treatment session compared with the other treatment sessions the patient had in the same day which may be because it is done for the first time after a gap of 8-10 hours of previous treatment session. This was also noted by **Willy E. Hammon** and **Scott Hasson** earlier. As per the pathology stated by earlier researchers, that bronchiectasis usually affects the lower lobes of the lung, and mostly unilateral, same distribution of affection were observed in this study too. Majority of the

Cases selected for this study, that's nearly 65% were affected with unilateral

Bronchiectasis. The same findings were found in prior studies done by **Willy E. Hammon** And **Scott Hasson** stated Bronchiectasis usually localized in a few segments or in entire lobe of the lung. Most commonly, it is unilateral and effects basal segments of the lower lobes. There are significant changes seen in FVC, PEFR and FEV1 in this study after the intervention of both ACBT and Postural Drainage in bronchiectasis and this findings were supported by **J.A. Pryor** who stated that there is evidence of an improvement in lung function; including FEV1, FVC and maximum expiratory flow rate at 25% and 50% of FVC following the instigation of the ACBT. There is a need for adequately sized, high-quality, randomized controlled trials with uniform patient populations to examine the effects of ACBT and Postural Drainage in Bronchiectasis.

LIMITATIONS

- The study has been conducted on small sized sample only.
- This study took shorter duration to complete.
- The study limitations include only Bronchiectasis patients alone.

RECOMMENDATIONS

- A similar study may be extended with larger sample.
- The future study can be compared with percussion techniques also.
- The ACBT may be applied to the other COPD conditions also.
- This ACBT may be compared with breathing exercises also.

CONCLUSION

Even though both ACBT and Postural Drainage techniques are found to have significant effect in clearing the airways, the Active cycle of breathing technique has a better effect than the postural drainage and thereby improving pulmonary function in patients with bronchiectasis.

Through the results, alternate hypothesis is accepted and also the study could be concluded that there is a significant difference between **active** cycle of breathing technique and postural drainage in patients with bronchiectasis.

REFERENCES:

1. Singleton R, Morris A, Redding G, Bronchiectasis in Alaska Native children: causes and clinical courses. *PediatrPulmonol* 2000; 29:182-187.
2. Stuart B. Porter. *Tidys physiotherapy*, 13th edition.2005, Elsevier.
3. Willy E. Hammon and Scott M. Hasson.Principles and practice of cardio pulmonary physical therapy, Donna Frownfelter and Elizabeth Dean 3rd edition.1996.
4. A.P.I. Textbook of medicine, 6th edition, 1999.Association of Physicians of India.Mumbai.
5. Reid LM. Reduction in bronchial subdivision in bronchiectasis. *Thorax* 1950
6. Nicotra MB, Rivera M, Dale AM, Shepherd R, Carter R. Clinical, pathophysiologic, and microbiologic characterization of bronchiectasis in an aging cohort. *Chest* 1995
7. Hansell DM. Bronchiectasis. *RadiolClin North Am* 1998
8. E Silverman et al. Current management of bronchiectasis: review and 3 case studies, *Heart Lung*. 2003 Mar-Apr; 32(2): 110.
9. Pryor JA. Physiotherapy for airway clearance in adults.*EurRespir J* 1999;14:1418-1424
10. SW Clarke, Rationale of airway clearance, *EurRespir J Suppl*. 1989 Jul; 7:599s-603s.
11. Christensen EF, Nedergaard T, Dahl R. Long-term treatment of chronic bronchitis with positive expiratory pressure mask and chest physiotherapy.
12. JE Patterson , JM Bradley , JS Elborn , Airway clearance in bronchiectasis: a randomized crossover trial of active cycle of breathing techniques (incorporating postural drainage and vibration) versus test of incremental respiratory endurance. *ChronRespir Dis*. 2004.
13. JE Patterson et al. Airway clearance in bronchiectasis: a randomized crossover trial of active cycle of breathing techniques versus Acapella. *Respiration*. 2005 May-Jun; 72(3): 239-42.
14. Denehy L. A randomized controlled trial comparing periodic mask CPAP with physiotherapy after abdominal surgery.*Physiother Res Int*. 2001; 6(4):236-50.

15. Pryor JA, Webber BA, Hodson ME. Effect of chest physiotherapy on oxygen saturation in patients with cystic fibrosis. *Thorax* 1990; 45: 77.
16. Savci S, Ince DI, Arikan H. A comparison of autogenic drainage and the active cycle of breathing techniques in patients with chronic obstructive pulmonary diseases. *J Cardiopulm Rehabil.* 2000 Jan-Feb; 20(1):37-43.
17. Pryor JA, Webber BA. An evaluation of the forced expiration technique as an adjunct to postural drainage. *Physiotherapy* 1979.
18. Cecins NM, Jenkins SC, Pengelley J, Ryan G, The active cycle of breathing techniques to tip or not to tip : *Respir Med.* 1999 Sep; 93(9):660-5.
19. C S Thompson, S Harrison, J Ashley, K Day and D L Smith Randomised crossover study of the Flutter device and the active cycle of breathing technique in non-cystic fibrosis bronchiectasis *Thorax* 2002;57:446-448© 2002 Thorax.
20. Baseler F, Wilde J, Piesch W, Postural drainage and breathing gymnastics-- conditiones sine qua non-before lung resections for bronchiectasis (author's transl), *Z ErkrAtmungsorgane.* 1977 Mar; 147(3):258-63.
21. Vincent Mysliwiec, MD; Joseph S. Pina, in their article Bronchiectasis: the 'other' obstructive lung disease, *MD vol 106 / no 1 / July 1999 / Postgraduate Medicine.*

