

## Acute Effect of Active Cycle Breathing Techniques (ACBT) and Autogenic Drainage for Airway Clearance in Bronchiectasis: Randomized Cross Over Trial

Smriti J. S.\*, Narasimman Swaminathan\*\*, Cherishma D'Silva\*\*\*

### Abstract

**Background:** Impaired airway clearance is the most common problem faced by the subjects diagnosed with bronchiectasis which makes bronchial hygiene a primary concern in the management. Several airway clearance techniques are used in the management of which Active cycle of breathing technique (ACBT) and autogenic drainage are considered to be effective and patient friendly. **Objective:** The objective of this study was to compare the immediate effects of ACBT with Autogenic Drainage for airway clearance in subjects with Bronchiectasis. **Methodology:** Eighteen patients (5 males, 13 females) mean age of 55.39 years with the history of bronchiectasis based on purposive sampling, were recruited for the study. Assessment and familiarization session was conducted following which all participants underwent both ACBT and Autogenic Drainage in a random sequence for continuous 2 days. All the outcomes were compared pre- and post- intervention for the outcome measures, except sputum quantity, which was measured immediately after the intervention. Subjects' treatment preference was recorded at the end of the 2<sup>nd</sup> day. **Results:** None of the outcome measures showed statistically significant difference except patient preference. ACBT was preferred by most of the (11/18) patients than Autogenic drainage, hence showed statistically highly significant values between the techniques. **Conclusion:** ACBT was found to be easier technique to perform and was more effective in clearing out the secretions than Autogenic Drainage which requires more concentration to become compliant with the treatment.

**Keywords:** Bronchiectasis; Active Cycle of Breathing Techniques; Autogenic Drainage.

### Background

Bronchiectasis is characterised by repeated pulmonary infections requiring antibiotics, disabling productive cough, shortness of breath and occasional haemoptysis. Retention of mucus is one of the primary problems of this disease which leads to

chronic cough, airway obstruction and bacterial infection [1,2].

Airway clearance techniques (ACTs) are an important component of the management of patients with bronchiectasis. They are regarded as a lifelong process and the compliance to these techniques is of prime importance in these patients [3]. Various airway clearance techniques are used in the management of bronchiectasis includes postural drainage, percussion, vibration, Active Cycle of Breathing Techniques (ACBT), Autogenic drainage (AD), positive expiratory pressure therapy, flutter, A capella, high-frequency airway oscillation, and chest wall oscillation therapy. The effectiveness of airway clearance regimen is influenced by mucus viscosity and disease severity [4]. Out of these techniques ACBT and AD are considered as simple techniques which do not require any equipment.

Active cycle of breathing technique is a form of airway clearance that improves lung function without decreasing oxygenation. The rationale by which ACTs may improve sputum clearance includes changes in lung volumes, pulmonary

**Author Affiliation:** \*D.Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune (Deemed University) Accredited by NAAC with 'A' Grade Sant Tukaram Nagar, Pimpri, Pune- 411018, Maharashtra & Department of Physiotherapy Father Muller Medical College, Mangalore, Karnataka, India. \*\*Faculty of Health Sciences, INTI – International University, Nilai, Malaysia & Department of Physiotherapy Father Muller Medical College, Mangalore, Karnataka, India. \*\*\*Department of Physiotherapy Father Muller Medical College, Mangalore, Karnataka, India.

**Reprint Request:** Smriti J. S., D.Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune (Deemed University) Accredited by NAAC with 'A' Grade Sant Tukaram Nagar, Pimpri, Pune- 411018, Maharashtra  
E-mail: [jsmritiphysio@gmail.com](mailto:jsmritiphysio@gmail.com)

pressures and expiratory flow, use of gravity and the application of direct compressive or vibratory forces 4.

Autogenic drainage uses controlled breathing to maximize expiratory flow with minimal airway closure, starting with the small airways and moving secretions from smaller to larger airways. The advantages of AD are that it can be performed independently and even in cases with airway hyperactivity [5].

Autogenic drainage has been found to be as good as ACBT at clearing mucus in patients with cystic fibrosis and is therefore an effective method of home physiotherapy. Both methods have showed improved ventilation [6].

To our knowledge little research is done to study the effects of Autogenic drainage in comparison with other airway clearance techniques and none comparing it with ACBT in Bronchiectasis. This study compared the immediate effects of ACBT and Autogenic Drainage for airway clearance in subjects with Bronchiectasis and patients preference.

## Methodology

### Methods

Subjects diagnosed with bronchiectasis aged between 20–60 were recruited for this study from a tertiary care hospital. Subjects with haemoptysis, active tuberculosis and undergone lung surgeries were excluded from the study. A total number of 18 subjects met the inclusion criteria during the study period. Ethical clearance was obtained from the Institutional review board prior to the commencement of the study. All the included participants were explained about the study and a written informed consent were obtained.

All the participants were provided ACBT and AD for the continuous two days in a random order. The randomisation of the techniques was done by using [www.randomization.com](http://www.randomization.com) [7]. The wash out period between the techniques was 24 hours. The subjects were demonstrated both the techniques and they were instructed to perform the technique early morning. A same therapist trained with the techniques supervised the sessions.

### ACBT

During this procedure the subjects were seated in relaxed position and instructed to relaxed diaphragmatic breathing several times followed by which they were encouraged to take deep inspiration

with tactile and vocal stimulus from the therapist. This was repeated till the subject could feel the movement of the sputum and then they were instructed to do forced expiratory technique.

### AD

During this procedure the subjects were asked to take low volume breaths, from expiratory reserve volume in relaxed sitting position. They were asked to repeat this for 10 – 20 times followed by which they were asked to take larger breath until secretions were felt gathering in the airways. Then they were instructed to take even larger breaths followed by several huffs. The subjects were instructed to suppress the cough during the entire procedure.

Quantity of sputum expectorated immediately following the administration of each techniques and 30 minutes after was measured by using a calibrated volumetric jar. Oxygen saturation was also measured by using Pulse oximeter (VIAMED Ver. 2.2 D) before and after the sessions. Perceived exertion was assessed by modified Borg scale. On the second day after the sessions the subjects were asked about their preferred method of choice and the reason for in their own language, which was documented.

### Data analysis

All statistical testing was performed using the Statistical Package for social science version 13.0 software. Mann–Whitney test was used to compare the outcome measures between both the techniques. Wilcoxon Signed Rank Test was used for within group analysis between pre and post treatment parameters. A p value of <0.05 with confidence interval of 95% was considered statistically significant.

## Results

18 subjects with mean age of 35.39 years completed the study out of which 13 were females and 5 males.

The sputum volume expectorated post ACBT was 6.33 ml and post AD was 5ml. The mean difference for sputum quantity between ACBT and Autogenic Drainage was not significant but the mean score for ACBT was higher (Table 1).

The mean score for perceived exertion following ACBT showed a reduction from 1.67 to 1.39 with a mean difference of 0.28 where as breathlessness score following AD showed a reduction from 1.11 to 1.08

**Table 1:** Sputum quantity post intervention

Technique	Mean (SD)	Mann Whitney test z-value	p-value
ACBT	6.33 (0.72)	0.773	0.439
AD	5.00 (0.61)		NS

with a mean difference of 0.03. The mean HR score increased from 83.67 to 85.50 with a mean difference of 1.83 post ACBT treatment but there was no change in mean HR post Autogenic Drainage. There was an increase in SpO2 levels from 96.67 to 97.61 with a mean difference of 0.94 post ACBT, along with the

increase in SpO2 score from 97.17 to 97.61 with a mean difference of 0.94 post AD. The data showed that there was no effect of either of the treatment on breathlessness, heart rate, respiratory rate and oxygen saturation. Out of the 18 subjects 11 preferred ACBT over Autogenic Drainage (table 2).

**Table 2:** Effect of acbt and autogenic drainage on various parameters

			Mean score	S.D	Wilcoxon signed ranks test Z-value	p- value
Perceived exertion	ACBT	Pre	1.67	.372	1.85	.064
		Post	1.39	.568		
	AD	Pre	1.11	.278	.111	.913
		Post	1.08	.141		
HR	ACBT	Pre	83.67	18.036	t- value 1.33	2.00
		Post	85.50	15.401		
	AD	Pre	85.06	14.594	0.00	1.000
		Post	85.06	14.169		
	AD	Pre	24.56	6.784	1.62	.124
		Post	22.22	6.015		
AD	Pre	23.56	7.139	1.71	.105	
	Post	24.56	6.784			
SpO2	ACBT	Pre	96.67	4.472	1.71	.105
		Post	97.61	2.500		
	AD	Pre	97.17	2.749	1.29	.215
		Post	97.61	2.330		

**Discussion**

The present study aimed to compare the immediate effects of ACBT with Autogenic Drainage in airway clearance in Bronchiectasis. There will be increased production of mucus in Bronchiectasis with impaired mucociliary system. Improper airway clearance will lead to atelectasis, infection, and increased airway resistance, increased work of breathing and ultimately hypoxemia and tissue hypoxemia [5]. Airway clearance is the combination of the mucociliary escalator and coughs that is the natural, mechanical defence mechanism of the lung. ACTs are safe and effective in acute and stable Bronchiectasis [8].

There is little research done to study the effects of Autogenic drainage in comparison with other airway clearance techniques and none comparing it with ACBT in Bronchiectasis. The outcome measures used

in this study were sputum weight, breathlessness, HR, RR, SpO2 and patient preference. None of the outcome measures showed significant difference between both the groups except for the patient preference.

ACBT showed more sputum clearance than Autogenic Drainage as mean sputum quantity for ACBT and Autogenic drainage was 6.33 ml and 5.00 ml respectively, but it was not statistically significant. This may be due to small sample size and lack of homogeneity in those subjects. In another randomised crossover trial done in 30 COPD subjects to compare the effects of ACBT and Autogenic Drainage, both the treatments were found equally effective in sputum clearance however, no significant difference was found in sputum volume between the treatments. Sputum volume was measured by using a plastic beaker because it is a simple non- invasive short-term clinical outcome measure of the effectiveness of airway clearance technique. The mean volume of the

sputum was not specified by the authors [9]. It has been suggested that sputum volume or weight is misleading, as unknown quantity of saliva may be included [10]. Similar observations have been reported by Miller et al comparing AD with ACBT in 18 cystic fibrosis patients, observed no significant difference in sputum weight between the two methods as the mean difference between Autogenic Drainage and ACBT was -0.4 (1.8) g. The reason for this is not explained in the study except for ventilation [6].

Perceived was reduced on Modified Borg scale post treatment with both ACBT and Autogenic Drainage but the mean difference score was higher post ACBT (0.28) when compared with post Autogenic Drainage (0.03). This may be due to the components of breathing control and thoracic expansion in ACBT. Moreover both the techniques have a component of relaxed diaphragmatic breathing. The mean perceived exertion score between ACBT and Autogenic drainage was statistically not significant. In a similar study done by Moiz et al [9] in COPD patients, breathlessness reduced after removal of secretions with both the treatments but the reduction was more with Autogenic Drainage but explanation for this is not specified in the study.

The mean score for HR between ACBT and Autogenic drainage did not show significant change. HR was found to be increased post ACBT technique with a mean difference of 1.83 but there was no change in HR post Autogenic Drainage (0.00). The reason of this increase in heart rate can be explained by this theory which says that 'at low level of exercise, heart rate increases almost exclusively via vagal withdrawal, with little evidence for systemic increases in sympathetic nerve activity until the intensity of exercise is at or above the maximal steady state [11,12] .

The mean RR score was statistically not significant when compared between both the techniques (mean difference post ACBT and Autogenic drainage was 0.56 and 1.34 respectively). In a similar study by Moiz et al [9], subjects were found to have no significant change in respiratory rate during both ACBT and Autogenic Drainage techniques in COPD, but there was a significant decrease seen 30 minute post treatment both with Autogenic drainage and ACBT ( $p=0.001$  and  $p=0.016$  respectively) when compared to their baseline values.

The mean score for SpO<sub>2</sub> between both the techniques was not significant but the mean score increased post intervention when compared to the pre intervention reading, both during ACBT and Autogenic Drainage (mean difference of 0.94 and 0.44

respectively). Effectiveness of ACBT may be attributed to one of its components of breathing control which increases oxygen saturation post treatment. In a study done Savci found that in AD treatment, the increase in oxygen saturation was significantly higher than in ACBT [13]. In contrast Miller et al in a study comparing Autogenic Drainage and ACBT with postural drainage, both the treatments were found equally effective and there was no much difference in oxygen saturation values in cystic fibrosis patients. However, no patients dropped saturation in either method. Increase in oxygen saturation might have been the results of removal of retained mucus plugs from the airways, lead to improved alveolar ventilation, optimized ventilation- perfusion mismatch, and finally improved oxygen transport to the tissue.

ACBT was preferred by most of the (11/18) patients than Autogenic drainage, hence showed statistically highly significant values between the techniques. ACBT was found to be easier to perform and was more effective in clearing out the secretions. Autogenic drainage requires more concentration to learn the technique as it is to be performed at 3 different lung volumes. In a study by Miller et al in cystic fibrosis, patients who preferred Autogenic Drainage (9/18) to ACBT (8/18) seem to be with better concentrations who were generally more compliant with treatment. The time taken to learn Autogenic Drainage is much longer than the time to learn ACBT [6].

## Conclusion

ACBT was found to be easier technique to perform and was more effective in clearing out the secretions than Autogenic Drainage which requires more concentration to become compliant with the treatment.

### *Limitations of the study*

The limitations of this study were smaller sample size with lack of homogeneity in subjects. Moreover the quantification of the sputum produced was done using the volumetric jar, instead of which measurement of dry sputum weight could have been done.

## Reference

1. Barker A. Medical progress Bronchiectasis. N Engl J Med 2002; 346: 1383–1393.

2. King P T, Daviskas E. Pathogenesis and diagnosis of Bronchiectasis. *Breathe* 2010; 6: 342-351.
  3. Currie D C, Pavia D, Agnew J E, Lopez- Vidriero M T, Diamond P D, Cole P J, Clarke S W. Impaired tracheobronchial clearance in Bronchiectasis. *Thorax* 1987; 42: 126-130.
  4. Prior J A. Physiotherapy for airway clearance in adults. *Eur Respir J*. 1999; 14: 1418-1424.
  5. Schoni M H. Autogenic drainage: a modern approach to Physiotherapy in Cystic Fibrosis. *J Royal Soc Med*. 1989; 82(suppl 16): 32-37.
  6. Miller S, Hall D O, Clayton C B, Nelson R. Chest physiotherapy in cystic fibrosis: a comparative study of autogenic drainage and the active cycle of breathing techniques with postural drainage. *Thorax* 1995; 50: 165-169.
  7. [www.randomization.com](http://www.randomization.com); seed no. 22031; Randomized on 12/10/2011 (7).
  8. Lee A L, Burge A, Jones A P, Rowe B H, Holland A E. Airway clearance techniques for Bronchiectasis. *The Cochrane Library* February 2010. (8).
  9. Moiz J A, Kishore K, Belsare D R. A comparison of autogenic drainage and the active cycle of breathing techniques in patients with acute exacerbation of chronic obstructive pulmonary disease. *Indian Journal of Physiotherapy and Occupational Therapy*. 2007; 1(2).
  10. Rossaman C M, Waldes R, Sampson D, Newhouse M (1985). Effect of chest physiotherapy on the removal of mucus in patients with cystic fibrosis. *Am Rev Respir Dis*; 126: 131-135 (11).
  11. Fagard R, Broeke C, Amery A (1989). Left ventricular dynamics during exercise in elite marathon runners. *J Am Coll Cardiol*; 14: 112
  12. Fisher A G, Adams T D, Yanowitz F G et al (1989). Non- invasive evaluation of world- class athletes engaged in different modes of training. *Am J Cardiol*; 63: 337.
  13. Savci, Sema, Ince, Inal D, Arikan, Hulya. A Comparison of Autogenic Drainage and the Active Cycle of Breathing Techniques in Patients with Chronic Obstructive Pulmonary Diseases. *Journal of Cardiopulmonary Rehabilitation*. January/February 2000; 20(1): 37-43 (13).
-