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Original Article

Physiotherapy Section

Immediate Effect of the Autogenic Drainage over the Active Cycle of Breathing Technique in Airway Clearance in Subjects with Chronic Bronchitis- A Quasi Experimental Study

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ABSTRACT

Introduction: Chronic Bronchitis (CB) is an obstructive pulmonary disease in which there is obstruction in airways due to excessive mucous secretions. Chest physiotherapy is effective in clearing secretions from the lung of the patients with copious secretions. This includes some newer techniques like Autogenic Drainage (AD) and Active Cycle of Breathing Technique (ACBT) which is effective as well as have less deleterious effect when compared to conventional physiotherapy management.

Aim: To know the effectiveness of AD over ACBT in airway clearance in CB.

Materials and Methods: The study was a quasi experimental study which included 30 subjects in the study. They were equally divided into two groups. One group received AD technique for 30 minutes and other received ACBT for 30 minutes. The outcome measures were compared and evaluated by Visual Analogue Scale (VAS) for breathlessness, Peak Expiratory Flow Rate (PEFR) and expectorated sputum volume to compare effect on dyspnea and airway clearance. VAS for breathlessness, PEFR and expectorated sputum volume was measured before the session and after 30 minutes following the session. Paired t-test, Wilcoxon's signed rank test and Mann-Whitney U test was done using SPSS software to compare the outcome measures.

Results: Paired t-test showed that there is a significant difference in pre and post-PEFR and VAS for breathlessness in both the groups. Wilcoxon's signed rank test also showed significant difference in pre and post-sputum volume in both groups. However, Mann Whitney test shows that there is no significant difference between the groups for PEFR (p=0.348), VAS for breathlessness (p=0.910) and sputum volume (p=0.123).

Conclusion: The study showed that there was no significant difference in effect of AD technique over ACBT on mucus clearance and level of dyspnea. Both the airway clearance techniques can be used effectively in CB based on patient and therapist preference.

Keywords: Chronic obstructive pulmonary disorders, Dyspnea, Peak expiratory flow rate, Respiratory therapy

INTRODUCTION

Chronic Bronchitis (CB) is one of the components of Chronic Obstructive pulmonary diseases. It is defined as chronic cough and expectoration, when other specific causes of cough can be excluded, which persists for at least a 3-month period for at least 2 consecutive years [1]. CB occurs because of excessive production and secretion of mucus by the goblet cells causing further obstruction by luminal smaller airways obstruction, and a change in the airway surface tension putting it at risk to collapse [2].

CB is more common in men than in women and is more prevalent in middle aged individual than in younger individuals [3,4]. The prevalence of CB varies throughout the world. The prevalence ranges from 3.4%-22.0% in the general population and 74.1% in patients with COPD [5].

CB is an airway disease which is distinguished by mucus secretion and productive cough. The pathophysiology of CB is characterised by a number of impairments that contribute to overall disease process [2,3]. Repeated inhalation of pollutants irritates the airway lining causing inflammation, excessive mucus secretion and at times bronchospasm. Inflammation induces narrowing first in the distal small airways and then in the proximal large airways. Acute inflammation resolves however, chronic inflammation may precipitate in fibrotic changes and scarring. When the pulmonary tissues are destroyed, it further causes the loss of normal recoiling attribute. Destruction of the pulmonary tissue results in further loss of normal elastic recoiling property of the lung. Premature airway collapse causes hyperinflation and reduced expiratory flow rates [6].

Productive cough and exertional dyspnea are the prominent features in CB patients. Cough and expectoration appear insidiously. Dyspnea is first experienced during exertion. Later as the disease advances, the patients may be dyspneic even at rest. Increased secretions that partially obstruct the bronchi may result in expiratory wheezing. Crackles may also be present. A significant and progressive increase in airway obstruction is reflected by decrease in expiratory flow rates especially FEV1 and also peak expiratory flow rate [6,7].

Physiotherapy is potential in evacuating the secretions from the lung [1]. The traditional treatment for ages has been postural drainage with chest manipulation. However, detrimental effects have been associated with manual techniques which includes increased oxygen consumption, atelectasis, arterial desaturation, bronchospasm, and metabolic and haemodynamic disturbances [7,8].

The conventional techniques which includes Postural drainage, chest manipulation and coughing, in most parts of the world, has been replaced by various newer techniques like the ACBT, AD, Flutter, PEP mask, high-frequency chest wall oscillation and intrapulmonary percussive ventilation [8].

AD is a breathing exercise which was developed by Jean Chevalier in the year 1967 in Belgium [7]. The purpose of AD is to sequentially obtain the maximum possible expiratory flows to advance the mucus secretions from peripheral to central airways, without forceful expiration.

AD is found to minimally create oxygen desaturation than postural drainage and chest manipulation. AD is a well-suited technique for people with chronic hypersecretory diseases as well as for hospital

patients who develop acute secretions due to fear of pain and stitches [9].

The ACBT is a breathing cycle which includes performing huffs from different lung volumes along with deep breathing and relaxed abdominal breathing [7,8]. In ACBT, when performing huffing, the Equal Pressure Point (EPP) goes down to the segmental bronchi. From this point towards the mouth, the pressure outside the airway is higher than inside thereby squeezing the airway by a process known as dynamic compression. The squeezing of the airways allows the secretions to be mobilised even though it may limit the airflow [7].

Performing huffing alone may reduce the airflow, thus ACBT involves a deep breathing phase along with huffing. A normal relaxed breathing is also included to the cycle to ensure relaxation and reduce the episodes of bronchospasm, coughing and desaturation [7].

Conventional airway clearance techniques form the main stay for routine rehabilitation of patients with CB. However, incorporating breathing techniques that are effective, comfortable and performed independently by the patients without much assistance, help the patients to participate actively in their own health care. Studies support the use of ACBT as well as AD technique in airway clearance [9-12]. Most of the studies have been on short term and long-term effects of the techniques [11,13,14]. Understanding the immediate effect of AD over ACBT in airway clearance can give a better choice of technique to be preferred for providing immediate treatment for patients with CB thus arising the need of the study.

The present study was aimed to determine the immediate effect of AD over ACBT in airway clearance and dyspnea in CB.

MATERIALS AND METHODS

The study was a quasi-experimental study conducted in Krupanidhi College of Physiotherapy, Bangalore, Karnataka, India. The study duration was from August 2017 to December 2018. Sampling was done by Block randomisation with 30 subjects divided in two groups. After taking the general cardio-pulmonary assessment, the subjects were divided into two groups. Group A were given AD technique and group B received ACBT. The eligible subjects included male and female aged between 30 to 50 years and clinically diagnosed with CB and with acute exacerbation of symptoms. Subjects with a recent history of angina, neurological deficits, uncontrolled hypertension and diabetes mellitus, haemodynamic instabilities, ventilator support, hernia and prolapsed uterus were excluded from the study. Ethical clearance was taken from the institute prior to the study. The institutional ethical clearance number is EC-FAC/17/PHY/011.

Materials Used

The materials used included PEF meter apparatus, copy of VAS for Breathlessness, measuring jar, chairs and cushions, treatment bed or couch.

Procedure

Subjects clinically diagnosed with CB were considered for the study. An informed consent was taken from them. The subjects were then divided into two groups based on block randomisation. They were evaluated before the therapy and after 30 minutes of the therapy for:

PEFR: PEFR was measured using the Wright's peak flow meter [15]. The Peak flow meter was set to zero. Subjects were to inhale completely, quickly place the peak flow meter into the mouth and to make a seal around the mouthpiece with the lips. The subjects then immediately exhaled completely with maximal force and the reading was taken as shown in the Peak flow meter. This measurement was repeated for two more times. The highest value obtained in PEFR was taken as the final reading [15,16].

VAS for breathlessness: VAS for breathlessness is a scale which gives the subjective measure of breathlessness [17]. In this, breathlessness was measured by a 100 mm scale ranging from No to greatest breathlessness. Subjects were asked to mark the point in the scale that they feel represents the perception of their current breathlessness. The distance of the mark in mm above the point of No breathlessness was recorded as the VAS Score for Breathlessness [18,19].

Expectorated sputum: The subject was asked to cough out the sputum before starting the treatment and the sputum was collected in a measuring jar (labeled ml scale). After the technique, the subject was asked to huff. The expectorated sputum was collected in another measuring jar (labeled mL scale).

After initial evaluation, the subjects received one of the two interventions. Group A received AD and Group B received ACBT.

Autogenic Drainage

Subjects were made to sit upright or supine (if subject prefers). The subjects were then asked to blow their nose and the throat was cleared. The technique involves three phases which are the unsticking phase, collecting phase and evacuating phase. The first stage involved subject to take a deep breath, then breathing out completely. After this the subjects had to take a small breath and breathe out completely. When the subject feels the movement of the secretions, the subject moved to the collecting phase in which the subject took a deeper breath, however the expiration didn't go very deep into the expiratory reserve volume. Once the subjects felt the secretions moving to the more central airways, they were asked to take very deep breathes so as to reach the inspiratory reserve volume and enter the evacuating phase. As the subjects felt that the secretions have reached high in the central airways, they were asked to cough out the sputum. The subjects were asked to control the cough during cycle of breathing exercise [7]. The breathing cycle was repeated for 30 minutes.

ACBT: Subjects were positioned in upright sitting. ACBT involves three stages which are breathing control, deep breathing exercise and Forced Expiratory Techniques (FET). The cycle involved in a sequence breathing control in which subject was made to do quiet relaxed abdominal breathing, deep breathing exercise in which the subject took 3 or 4 deep breaths in order to expand the thoracic region. The first two stages were repeated for five to six times before reaching the third stage which is the FET in which the subject performed 1 or 2 huffs, from low lung volume followed by huff from high lung volume and relaxed abdominal breathing [7]. The entire technique was continued for 30 minutes.

Evaluation was done at the end of the session for both the groups within 30 minutes. The pre and post-therapy values of both the groups were statistically compared.

STATISTICAL ANALYSIS

The statistical analysis was done using SPSS version 11.5 software. Paired t-test and Wilcoxon's signed rank test was used to compare the pre and post-outcome measures within the group. Mann-Whitney U test was done to compare the outcome measures between the groups.

RESULTS

A significant increase was seen in PEF rate in both group A receiving AD and group B receiving ACBT [Table/Fig-1]. Analysis by the Mann Whitney test shows no significant difference on PEFR between the two groups [Table/Fig-2].

Parameter	Group	Mean	Std. deviation	Median	Paired t-test	p-value
PEFR (L/min)	Group A					
	Pre	167.33	21.536	160.00	8.718	<0.001 HS
	Post	192.67	16.242	190.00		
	Group B					
	Pre	161.33	22.636	150.00	7.750	<0.001 HS
	Post	182.00	26.241	180.00		

[Table/Fig-1]: Effect of treatments on PEFR in both groups.

Parameter	Group	Mean difference	Std. deviation	Mann Whitney U test, Z-value	p-value
PEFR(L/min)	Group A	25.33	11.255	0.939	0.348 NS
	Group B	20.67	10.328		

[Table/Fig-2]: Comparison of effect on PEFR between both groups.

Paired t-test shows that there is a significant decrease in VAS in both group A and group B [Table/Fig-3]. Mann-Whitney test shows that there is no significant difference on effect on VAS between the two groups [Table/Fig-4].

Parameter	Group	Mean	Std. deviation	Median	Paired t-test	p-value
VAS for breathlessness (mm)	Group A					
	Pre	62.00	6.761	60.00	7.897	<0.001 HS
	Post	43.33	8.997	40.00		
	Group B					
	Pre	63.33	7.237	60.00	11.297	<0.001 HS
	Post	44.67	5.164	40.00		

[Table/Fig-3]: Effect of treatment on VAS in both groups.

Parameter	Group	Mean difference	Std. deviation	Mann Whitney U test, Z-value	p-value
VAS for breathlessness (mm)	Group A	18.67	9.155	0.113	0.910 NS
	Group B	18.67	6.399		

[Table/Fig-4]: Comparison of effect on VAS between both groups.

There was a significant increase found in sputum volume in both group A and group B [Table/Fig-5]. On comparison using Mann-Whitney test, no significant difference was seen between the two groups on the effect on sputum volume [Table/Fig-6].

Parameter	Group	Mean	Std. deviation	Median	Wilcoxon signed rank test Z-value	p-value
Sputum volume (mL)	Group A					
	Pre	0.33	0.488	0.00	3.436	<0.001 HS
	Post	4.40	1.121	4.00		
	Group B					
	Pre	0.67	0.488	1.00	3.431	<0.001 HS
	Post	4.07	0.961	4.00		

[Table/Fig-5]: Effect of treatment on sputum volume in both groups.

Parameter	Group	Mean difference	Std. deviation	Mann Whitney U test, Z-value	p-value
Sputum volume (mL)	Group A	4.07	1.100	1.541	0.123 NS
	Group B	3.40	1.121		

[Table/Fig-6]: Comparison of effect on sputum volume between both groups.

DISCUSSION

The present study was designed to determine the immediate effect of AD over ACBT in airway clearance in subjects with CB.

In this study, both the techniques showed significant increase in PEFR. The mean increase in PEFR following AD is more compared to ACBT but this difference between the two techniques was not statistically significant. There was no significant difference in VAS between the two techniques of airway clearance. Both were equally effective. The mean change in expectorated sputum volume was more in AD than ACBT however this difference was not statistically significant.

Thus, the study results suggest that there was no overall difference between both the techniques of airway clearance. Both the techniques were effective in mucus clearance and reducing the level of dyspnea.

Comparison with the existing studies also supports that both the techniques are equally effective. Moiz JA et al., in his study indicates that similar effectiveness between ACBT and AD in patients with acute exacerbation of COPD [1].

Savci et al., in their study on comparison of ACBT and AD in patients with COPD have also found both the techniques to be effective in mucus clearance as well as to improve lung functions [20].

Melam GR et al., in their study on short term comparison of ACBT and AD in COPD found significant improvements in FEV1, FVC and PEFR following either of the techniques with no significant difference between both the treatments. Thus, suggesting both to be equally good [21].

Systemic review on ACBT by Lewis LK et al., supports the use of ACBT over other alternatives for short term improvements in airway clearance [22].

However, in a cochrane systemic review on AD in cystic fibrosis patients, AD was challenging technique requiring commitment from the patient. It was not found to be better than any other airway clearance techniques [23].

ACBT opens up the collateral airways by including deep breathing exercises with brief hold period in between the FET. Breathing control phase in ACBT is said to prevent bronchospasm thereby improving the ventilation. The deep breathing along with a hold period done during the second phase helps to open up collateral airways which further enhances the ventilation. An enhanced ventilation by itself helps in loosening the secretions. Performing FET or huffing along with deep breathing exercise also shifts the EPP lower in the respiratory tract. This shift of EPP results in secretion clearance [22].

AD may also help in opening up of collateral airways by breathing in different volumes with a brief hold period which would have resulted in a significant improvement in the dyspnea, PEFR and mucus clearance in the present study. Breathing in low lung volume, mid lung volume and high lung volume with breath hold may have developed collateral filling among the alveoli, enhanced ventilation and mobilised secretions which eventually reduced dyspnea, improved PEFR and mucus clearance [22].

ACBT involves active participation of the patients thus it can be used for airway clearance in conscious oriented patients suffering from various obstructive and restrictive lung disorders, and to prevent and treat various pulmonary complications post-lung and post-abdominal surgeries.

When compared to ACBT, AD is difficult to understand and learn. AD involves the patient to breathe actively in different lung volumes which makes AD difficult to be understood by patients easily. Once the patient follows the commands properly, AD becomes a very effective intervention for mucus clearance in conscious oriented patients suffering from various obstructive and restrictive lung disorders, and to prevent and treat various pulmonary complications post-lung and post-abdominal surgeries. It is especially beneficial in conditions affecting the lower respiratory airways as breathing in different lung volumes allows secretions to be targeted even in the lower airways.

Stated Preference (SP) methods using Survey and questionnaire can be used in this regard to understand patient preferences with both the techniques.

LIMITATION

The study presented with few limitations. Generalisation to the population with CB cannot be made as the sample size was small. The study showed the immediate effect of both the techniques in airway clearance in CB. Thus, the long-term effects of these techniques could not be known. All the subjects were not able to perform the techniques for the prescribed duration which might have affected the results.

CONCLUSION

The study shows that there was significant improvement in mucus clearance and dyspnea in CB on giving ACBT as well as Autogenic Drainage. However, no significant difference exists in the effect of AD over ACBT on mucus clearance and level of dyspnea. Both therapies can be used for airway clearance in CB depending on patient and therapist preference.

REFERENCES

[1] Moiz JA, Kishore K, Belsare DR. 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).

[2] Susan B. O'Sullivan, Thomas J Schmitz. Physical Rehabilitation. Assessment and treatment. 4th edition. F.A. Davis Company; 2001, Pp. 448,289-291.

[3] Kim V, Criner GJ. Chronic bronchitis and chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2013;187(3):228-37.

[4] Mejza F, Gnatiuc L, Buist AS, WM Vollmer, Lamprecht B, Obaseki DO, et al. Prevalence and burden of chronic bronchitis symptoms: Results from the BOLD study. Eur Respir J. 2017;50(5):pii 1700621.

[5] Dotan Y, So JY, Kim V. Chronic bronchitis: Where are we now? Chronic Obstr Pulm Dis. 2019;6(2):178-92.

[6] Gill Kokko, Mandell Ockner, Smith Cecil Textbook of Medicine. 20th edition, vol. 1, WB Saunders Co; 1999; pg.383

[7] Alexandra Hough. Physiotherapy in Respiratory Care, An evidence based approach to respiratory and cardiac management.3rd edition. Nelson Thornes Ltd; 2001.

[8] Pryor JA. Physiotherapy for airway clearance. Eur Respir J. 1999;14(6):1418-24.

[9] Giles DR, Wagener JS, Accurso FJ, Butler-Simon N. Short-term effects of PD with clapping vs. autogenic drainage on oxygen saturation and sputum recovery in patients with cystic fibrosis. Chest. 1995;108(4):952-54.

[10] Pisi G, Chetta A. Airway clearance therapy in cystic fibrosis patients. Acta Biomed. 2009;80(2):102-06.

[11] Van Ginderdeuren F, Verbanck S, Van Cauwelaert K, Vanlaethem S, Schuermans D, Vincken W, et al. Chest physiotherapy in cystic fibrosis: short-term effects of autogenic drainage preceded by wet inhalation of saline versus autogenic drainage preceded by intrapulmonary percussive ventilation with saline. Respiration. 2008;76(2):175-80.

[12] Patterson JE, Bradley JM, Elborn JS. Airway clearance in bronchietasis: A randomized crossover trail of active cycle of breathing technique (incorporating postural drainage and vibration) versus test of incremental respiratory endurance. Chron Respir Dis. 2004;1(3):127-30.

[13] Pryor JA. Physical therapy for adults with bronchietasis. Clinical Pulmonary Medicine. 2004;11(4):201-09.

[14] Phillip GE, Pike SE, Jaffe A, Bush A. Comparison of active cycle of breathing technique and high frequency oscillation jacket in children with cystic fibrosis. Pediatric Pulmonology. 2004;37(1):71-75.

[15] Seema, Verma KB, Goel SK, Ghosh S, Bera C. Correlation of Peak Expiratory flow rate with anthropometric determinants in healthy adult male population of Haryana. Journal of Evolution of Medical and Dental Sciences. 2014;3(30):8355-65.

[16] Dekker FW, Schrier AC, Sterk PJ, Dijkman JH. Validity of peak expiratory flow measurement in assessing reversibility of airflow obstruction. Thorax. 1992;47(3):162-66.

[17] Cullen DL, Rodak B. Clinical utility of measures of breathlessness. Respir Care. 2002;47(9):986-93.

[18] Gupta D, Aggarwal AN, Subalaxmi MVS, Jindal SK. Assessing severity of asthma: Spirometric correlates with Visual analogue scale (VAS). Indian J Chest Dis Allied Sci. 2000;42(2):95-100.

[19] Martinez JA, Straccia L, Sobrani E, Silva GA, Vianna EO, Filho JT. Dyspnea scales in the assessment of illiterate patients with chronic obstructive pulmonary disease. Am J Med Sci. 2000;320(4):240-43.

[20] Savci S, Ince DI, Arikan H. A comparison of Autogenic drainage and the active cycle of breathing technique in patients with Chronic obstructive pulmonary disease. J Cardiopulm Rehabil. 2000;20(1):37-43.

[21] Melam GR, Zakaria AR, Buragadda S, Sharma D, Alghamdi MA. Comparison of autogenic drainage & active cycle breathing techniques on FEV, FVC & PEFR in chronic obstructive pulmonary disease. World Applied Sciences Journal. 2012;20(6):818-22.

[22] Lewis LK, Williams MT, Olds TS. The active cycle of breathing technique: A systematic review and meta-analysis. Respir Med. 2012;106(2):155-72.

[23] McCormack P, Burnham P, Southern KW. Autogenic drainage for airway clearance in cystic fibrosis. Cochrane Database Syst Rev. 2017;2017(10):CD009595.

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