

Effect of lung flute and peak flow meter on bronchial hygiene, pulmonary function and quality of life in mild to moderate chronic obstructive pulmonary disease - a randomized clinical trial.

¹Aarzu Bhavanagri (Noorani), Post Graduate Student – Department of Cardio Vascular and Pulmonary Physiotherapy, KLE University Institute of Physiotherapy, Belagavi, Karnataka, India

²Dr.Ganesh. B.R, Professor, Head of the Department of Cardio Vascular and Pulmonary Physiotherapy, KLE University Institute of Physiotherapy, Belagavi, Karnataka, India

Correspondence Author: Aarzu Bhavanagri (Noorani), Post Graduate Student – Department of Cardio Vascular and Pulmonary Physiotherapy, KLE University Institute of Physiotherapy, Belagavi, Karnataka, India

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Chronic obstructive diseases (COPD) is characterized by breathlessness, wheeze, mucus hypersecretion, cough, weight loss, fatigue and sleep which have a very significant effect on quality of life. Hence the effectiveness of peak flow meter and conventional physiotherapy with lung flute and conventional physiotherapy on bronchial hygiene, pulmonary function and quality of life of in mild to moderate COPD patients was measured. 38 Subjects with mild to moderate COPD between the age group 45-65 were included in the study. 19 patients in each group were randomly allocated, where Group A and Group B was given lung flute and conventional Physiotherapy .Peak flow meter and conventional physiotherapy respectively , for 2 times/day for 5 days/week. Amount of sputum was measured everyday, pulmonary function, Dyspnea and quality of life was measured on the 1st and the 5th day of the treatment. The pulmonary function showed significant changes ,the amount of sputum that was collected post treatment also had significant changes ,the SGRQ-C score also showed statistical improvement in both the groups But between

groups analysis showed no significant changes in all the parameters when tested using Mann- Whitney U test.

Conclusion: Present study concluded that peak flow meter can be used as an adjunct to lung flute as a treatment tool. Peak flow meter serves as a diagnostic and therapeutic tool which also helps to give a positive feedback to the patient and improve the quality of life.

Keywords: COPD, Lung flute, Peak flow meter, Bronchial hygiene, Pulmonary function

Introduction

One leading cause of mortality and morbidity worldwide is COPD, by 2020; it would be ranked as 3 among the all causes of death.^[1-3] A study conducted in India COPD is more in males than in females.^[4] In a country like India where 70% of the people live in rural areas, the risk of chronic obstructive pulmonary disease increases because there is a lot of exposure to biomass combustion flues due to poorly ventilated homes. Poorly regulated occupational exposures also contribute to an increased prevalence of COPD.^[5]The Global Initiative for Chronic Obstructive Lung Disease (GOLD) in 2016 defined COPD as “a common preventable and treatable disease characterized by persistent airflow limitation that is usually progressive

and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and co-morbidities contribute to the overall severity in individual patient.^[6] In COPD the major pathological changes are seen in central airways, small airways and alveolar space.^[7] Hence as a result of excess mucus secretion, edema formation and cellular infiltration there is airway narrowing, which rapidly reduces the FEV1 (forced expiratory volume in 1 sec) to FVC (forced vital capacity) ratio to <0.70 .^[8] Physiotherapy aims at reducing the work of breathing, improving ventilation, increasing function and enabling relief of dyspnea. The oscillatory positive expiratory device (OPEP) produces vibrations or oscillations along with above mentioned benefits. These oscillations reportedly decrease the viscoelastic properties of the mucous which makes it easier to mobilize mucous which makes it easier mobilize mucous up the airways which can later be cleared using huffing or coughing techniques.^[9] Lung flute is the oscillatory positive expiratory pressure device.^[10] It can create sound waves with a frequency 18-22 HZ with a minimal pressure of 1.0cmH₂O. Wright's peak flow meter is a device used to measure the lung function, full inspiration and forced expiration is used to measure the peak expiratory volume (forced expiratory flow rate).^[11] In this technique secretions are mobilized from the lower to the upper airways and then expectorated and the process is repeated for a few times.^[12] To improve the abnormal breathing patterns, breathing retraining exercises are given which include.^[13] Due to lack of research material on peak flow meter, data concerning its usage as a treatment approach is not widely available. Hence this present study has been undertaken to evaluate the effectiveness of lung flute and peak flow meter on bronchial hygiene pulmonary function and quality of life in mild to moderate COPD patients.

Methods

Study was approved by institutional review committee and was concluded in conformity with the principles outlined in declaration of Helsinki.

Participants: Thirty eight subjects were recruited from the tertiary care hospital, 19 in each group was allocated by the envelope method. Subjects between the age of 40 to 65 with mild to moderate COPD were included in the study and the patients who are willing to participate. The exclusion criteria included Predominant asthma and bronchiectasis by clinical assessment. History of cough syncope, Pregnant or nursing women, Inability to comply with the study procedures.

Intervention

Group A was given lung flute and conventional therapy and Group B was given peak flow meter and conventional therapy. The conventional therapy included, percussion, vibration, deep breathing exercises, the patient were in semi fowler's position, and was asked to slowly inspire in the lung flute, slightly greater than the normal outside the device and then 2 prolonged exhalations into the device through the mouthpiece. After which the subject was asked to take 5 relaxed normal breaths followed by 3 huffs and coughs. This was one cycle, 5 cycles were given in one session.^[14] For the peak flow meter the patient was asked to take a deep breath, outside the device and then exhale as forcefully as possible in the device through the mouthpiece. After which the subject was asked to take 5 normal breaths followed by 3 huffs and coughs. This will be one cycle, 5 cycles will be given in one session^[15]. This treatment for both the groups was given 2 times a day for 5 days.. Sputum was collected everyday pre and post treatment, pulmonary function was tested by vitalograph COPD-6TM, FEV1, FVC and FEV1/FVC ratio; the quality of life was measured by St. George Respiratory questionnaire (SGRQ-C) and the Modified Medical Research Council scale was taken on the 1st and 5th Day.

Result

Statistical analysis for the present study was done manually as well as using statistical package of social sciences (SPSS) version 23. The test of Normality for the both the groups was done using Kolmogorov – Smirov test. Wilcoxon matched pairs test was used to measure the pre and post intervention outcome measures in the form of pulmonary function (FEV₁, FVC, FEV₁/FVC), Amount of sputum produced, the improvement in dyspnea and change in quality of life and the between groups comparison was done by using Mann- Whitney U test. Probability values >0.05 was considered statistically significant and probability values >0.001 was considered highly significant. The mean age of the subjects in Group A was 54.42 ± 7.64 years. The mean age of the Group B was 61.42 ± 4.28 years, Where Group A had 26.3% and Group B had 47.4% of farmers. For Pulmonary function the within group analysis showed statistically significant results , where group A, FEV1% pretest was(67.73 ± 10.93) and post test (71.84 ± 11.091)results , (p=0.003). Group B pretest to post test changes were 66.89 ± 11.67 and 70.73 ± 11.47, (p= 0.002). For FVC changes from pretest (64.73 ± 7.14) to post test (68.21 ± 7.35) in Group A (p = 0.012) and Group B pre treatment results were 64.15 ± 8.26 and post treatment results were 67.47 ± 8.11,(p= 0.001). The results between the groups showed no statically significant results, where Group A score was 3.47 ± 1.89 and Group B score 3.31 ± 2.28 ((p =0.858). For FVC, for comparison between the groups where Group A score was 3.36 ± 1.92 and Group B score was 3.00 ± 2.18(p= 0.656). The sputum measured on the 1st, 3rd and the 5th day were analyzed where the pre-post treatment scores were as follows, day 1 pre treatment scores were of Group A were 3.84 ± 2.18 and post treatment scores were 6.02 ± 1.84, Similarly the pretreatment score for Group B was 4.05 ± 2.06 and post

treatment score was 6.05 ± 2.32,the p-value was 0.001 , On the third day the pretest scores of Group A was 3.39 ± 1.84 and the posttest scores was 4.71 ± 1.48, which was statistically significant (p=0.010).and group B score were the pretest score was 3.42 ± 1.98 and posttest score was 4.26 ± 1.62, which indicates that there was significant(p=0.005) change .For the fifth day the pretest and posttest values for group A was 1.63 ± 1.25 and 2.10 ± 0.86 (p=0.080) and group B was 1.78 ± 1.49 and posttest score was 1.68 ± 1.51(p=0.380) . For comparison between the groups where Group A score was 0.47± 1.07 and Group B score was 0.10 ± 0.63 (p=0.035). The dyspnea rating scale was administered on the 1st and the 5th day , and the scores were as follows, Group A pretest score was 2.73 ± 0.80 and post test score was 1.00 ± 0.94; (p =0.305) and Group B scores were 94 ± 0.97 and 1.05 ± 1.11 (p =0.027). Between the groups the scores were Group A =1.73 ± 0.56 and Group B = 1.89 ± 0.54 (p= 0.305). Thus there was significant difference seen within the groups but the between group analysis showed no difference.The Quality of life of the patients showed significant change pre and post treatment, where Group A scores were 59.61 ± 13.20 and 36.63 ± 10.99, p = 0.015and the Group B scores were 59.55 ± 12.76 and 37.12 ± 13.11 and p = 0.021. The between group scores were Group A score was 22.98 ± 16.82 and Group B score was 22.42 ± 12.16 (p=0.693), which showed no statistical difference.

Table 1: Demographic data

	Group A	Group B	P-Value
Age (years)	54.42 ± 7.64	61.42 ± 4.28	0.005*
Gender %			
Male	78.9	57.9	
Female	21.1	42.1	
*Significant at 5% level			
All values in absolute form[ignored negative sign for statistical convenience]			

Table 2: Pulmonary function

	PRETEST	POST	Pre to post Changes	p-values
FEV1				
Within group difference				
Group A	67.73 ± 10.93	71.84 ± 11.091	4.10 ± 2.62	0.003*
Group B	66.89 ± 11.67	70.73 ± 11.47	3.84 ± 1.42	0.002*
Between group difference	0.264	0.249	0.164	0.870
FVC				
Within group difference				
Group A	64.73 ± 7.14	68.21 ± 7.35	3.47 ± 1.89	0.012*
Group B	64.15 ± 8.26	67.47 ± 8.11	3.31 ± 2.28	0.001*
Between group difference	0.308	0.308	0.179	0.858
FEV1/FVC				
Within group difference				
Group A	65.26 ± 5.30	68.63 ± 5.21	3.36 ± 1.92	0.010*
Group B	64.84 ± 6.96	67.84 ± 6.24	3.00 ± 2.18	0.001*
Between group difference	0.118	0.148	0.446	0.656

*Significant at 5% level, *p<0.05,

applied Wilcoxon matched pairs test

All values in absolute form [ignored negative sign for statistical convenience]

Table 3: Bronchial Hygiene (Sputum collection (ml))

	Morning	Evening	Morning – Evening Changes	P-value
1st day				
Within group analysis				

Group A	3.84 ± 2.18	6.02 ± 1.84	2.18 ± 2.08	0.001*
Group B	4.05 ± 2.06	6.05 ± 2.32	2.00 ± 1.78	0.001*
Between group analysis		0.045±	0.252	0.801
	0.192±0.847	0.964		
3 rd day				
Within group analysis				
Group A	3.39 ± 1.84	4.71 ± 1.48	1.31 ± 1.76	0.010*
Group B	3.42 ± 1.98	4.26 ± 1.62	0.84 ±	0.005*
			1.01	
Between group analysis	0.089	0.893	1.144	0.253
5 th day				
Within group analysis				
Group A	1.63 ± 1.25	2.10 ± 0.86	0.47 ± 1.07	0.080**
Group B	1.78 ± 1.49	1.68 ± 1.51	0.10 ± 0.63	0.380
Between group analysis	0.119	1.468	2.103	0.035

*Significant at 5% level, *p<0.05, # applied On the 5th day

*Significant at 10% level, *p<0.10

Wilcoxon matched pairs test

All values in absolute form [ignored negative sign for statistical convenience]

On the 5th day*Significant at 10% level, *p<0.10

Table 4: Dyspnea and Quality of Life

	Pretest	Post test	Pre to post test changes	p-value
MRC GRADING				
Within group analysis				
Group A	2.73 ± 0.80	1.00 ± 0.94	1.73 ± 0.56	0.019*
Group B	2.94 ± 0.97	1.05 ± 1.11	1.89 ± 0.54	0.027*
Between group analysis	0.392	0.046	1.025	0.305
SGQR-C				
Within group analysis				
Group A	59.61 ± 13.20	36.63 ± 10.99	22.98 ± 16.82	0.015*
Group B	59.55 ± 12.76	37.12 ± 13.11	22.42 ± 12.16	0.021*
Between group analysis	0.102	0.657	0.394	0.693

*Significant at 5% level, * $p < 0.05$,

applied Wilcoxon matched pairs test

All values in absolute form [ignored negative sign for statistical convenience]

Discussion

In the present study group A was given lung flute and conventional physiotherapy, we found that the sputum production was more post lung flute use and on daily basis as seen in this study the quantity of sputum was reducing which may also indicate that there was clearance of the airways, A study comparison was done between 2 respiratory devices that is flutter and lung flute for sputum clearance in adults with non cystic fibrosis bronchiectasis, they found that both flutter and the lung flute augmented airway clearance effectively but flutter was more preferred as it was easier to use and was faster than lung flute^[16]. Efficiency of lung flute for sputum induction in patients with presumed pulmonary tuberculosis (TB) was seen, and they compared the use of hypertonic saline inhalation (HIS) and lung flute for sputum induction, and they concluded that lung flute was useful for production of high quality sputum for the diagnosis of active pulmonary TB has similar to HIS, they also state that Lung flute is user friendly and is designed for individual use and can be kept contamination free^[17]. When the subject blows in the lung flute device the resonance frequency that is produced inside the device is said to alter the rheology of the mucus making it more thinner and easy to expectorate. Which is also the primary mechanism of the oscillatory devices and it also provides a splinting effect on the airways, improving collateral ventilation, which indirectly affects the rheology of the sputum^[18]. Hence in the present study the sputum clearance along with breathing exercise could have improved the pulmonary function which indirectly affected the quality of life of the

patients. In the present study Group B was given peak flow meter, along with conventional physiotherapy which had improvement post treatment, the sputum production was more after treatment, which in turn improved the pulmonary function and quality of life. A study stated that during forced expiratory technique uses the mechanism of 'equal pressure points', here the pressure within airways is equal to the pleural pressure, there are forces which tend to compress the airways downstream (towards the mouth) of the equal pressure point. These compression points are also known as choke points, these points move upwards (towards the alveoli) as the lung volume decreases, this moves the secretions distally. Hence they mention that forced expiratory technique should always start at mid lung volume and move to low lung volume which will vibrate the posterior membrane of the trachea and main bronchi towards the bronchial tree^[12]. And increased in the expiratory muscle leads to improvement expiratory volume which reduces the residual and improves the pulmonary function, Thus in the present study there was improvement seen in the pulmonary function. As a result of airway inflammation and response to noxious stimuli, there is hypersecretion in COPD patients this will lead to worsening of airway resistance, impaired airflow, increased work of breathing, dyspnea which may lead to acute exacerbation and affect the quality of life. There was a review conducted to see the effect of mucociliary clearance in COPD patients, and they concluded that mechanical devices may help in improving the airways clearance and health related quality of life^[19]. In the present study there was improvement in

both groups post treatment but there was no significant difference between the groups, A study was done to assess the relation between St Georges Respiratory Questionnaire (SGRQ) scores to lung function (FEV1 and FVC) and they showed that there was weak co relation between spirometry ^[20]. Hence we cannot clinically rely on the questioner since the core predictors like weight loss and breathlessness are self reported. In the present study there was a improvement in dyspnea in within group analysis, this could be due the forced expiratory techniques used and the mucus clearance, there was also reeducation of breathing, which would have improved the pulmonary function and reduced the secretions. Since many years the effect of breathlessness on daily activates was measured using Medical research council dyspnea scale. Usually this scale measures perceived respiratory disability. A study was conducted to see the usefulness of Medical Research Council (MRC) Dysponea scale as a measure of disability in patients with COPD and they concluded that, MRC is a valid and simple method of categorizing COPD patients in terms of disability that can be used to compliment FEV1 in the classification of severity of the diseases ^[21].

Conclusion

Hence we can conclude that peak flow meter can be used as an alternative /adjunct to lung flute as a treatment tool. Thus, peak flow meter has beneficial effect over lung flute in terms of cost, easy to adopt and to handle which can be used on a regular basis at home by the patient. Peak flow meter serves as diagnostic and therapeutic tool in the patient management, thus play a role in improving quality of life of patients suffering from mild to moderate COPD.

References

1. Aziz F, Penupolu S. Lung transplant in end-staged chronic obstructive pulmonary disease (COPD) patients: a concise review. *Journal of Thoracic Disease*. 2010; 2(2):111-116.

2. Gestel A, Steier J. Autonomic dysfunction in patients with chronic obstructive pulmonary disease (COPD). *Journal of Thoracic Diseases*. 2010; 2; 215-222.
3. Kathiresan G, Jeyaraman S, Jaganathan3 J. Effect of upper extremity exercise in people with COPD. *Journal of Thoracic Disease*. 2010;2: 223-236.
4. Sinha T, Nalli S, Toppo A. A study of clinical profile of patients with chronic obstructive pulmonary disease. *International Journal of Community Medicine and Public Health*. 2017; 4(4):1000-1004.
5. Kalkana T, Moitra S, Jindal SK, Moitra S. Increasing burden of COPD in rural India: an example why India warrants primary healthcare reforms. *ERJ open research*. 2016 Apr 1;2(2):00032-2016.
6. Pocket guide to COPD Diagnosis, Management and prevention, global initiative for chronic obstructive lung disease;2014
7. D Steven, Ingenito Edward. The Pathogenesis of Chronic Obstructive Pulmonary Disease Advances in the Past 100 Years. *American journal of respiratory cell and molecular biology*. 2005; 32:367-372.
8. W Mancee Pathophysiology of Cor Pulmonale in Chronic Obstructive Pulmonary Disease Part Two. *American journal of respiratory and critical care medicine*. 1994; 150:1158-1168.
9. McIlwaine M. Physiotherapy and airway clearance techniques and devices. *Paediatric respiratory reviews*. 2006 Jan 1;7:S220-2.
10. Sethi S, Maloney R.N J, Grove B.S L, K andrson P. comparison of lung flute with Acapella in the treatment of COPD with chronic Bronchitis [M.D] VA WNY Health Care System , Buffalo , NY and University at Baffalo, SUNY, Baffalo,NY ; 2017 .
11. Dowine Patrica , Editor , *Chest, Heart and Vascular Disorders for Physiotherapists* , 4th edn, India ;Jaypee Brothers; 1993.p87.

12. Fink James , Forced Expiratory Technique, Directed Cough, and Autogenic Drainage , respiratory care , Nektar therapeutics , california ; 2007; 52(9):1210-1223.
13. Kisner c, Colby L. therapeutic exercise. 5th ed. new delhi: Jaypee Brothers Medical Publishers; 2007.Chapter 25, Management of pulmonary condition,p.861-864
14. McCool D.F Rosen M.J. Nonpharmacologic Airway Clearance Therapies ACCP Evidence-Based Clinical Practice Guidelines. CHEST. 2006; 129:250S–259S.
15. Gunjal.S.B, Shinde.N.K, Kazi.A.H, Mahajan.A.A. Effectiveness of Deep Breathing versus Segmental Breathing Exercises on Chest Expansion in Pleural Effusion. International Journal of Health Sciences & Research.2015;5(7):234-240
16. Eduard W, Pearce N, Douwes J. Chronic Bronchitis, COPD, and Lung Function in Farmers The Role of Biological Agents. CHEST. 2009;136:716–725.
17. Silva YR, Greer TA, Morgan LC, Li F, Farah CS. A Comparison of 2 Respiratory Devices for Sputum Clearance in Adults With Non-Cystic Fibrosis Bronchiectasis. Respiratory care. 2017 Oct 1;62(10):1291-7
18. Müller M, Kögler H, Glaab T, Welte T. Use of a lung function screening device for identifying patients at risk for COPD in general practice. Pneumologie (Stuttgart, Germany). 2012 Nov;66(11):645-9.
19. Bhowmik A, Chahal K, Austin G, Chakravorty I. Improving mucociliary clearance in chronic obstructive pulmonary disease. Respiratory medicine. 2009 Apr 1;103(4):496-502.
20. Fletcher CM. Standardised questionnaire on respiratory symptoms: a statement prepared and approved by the MRC Committee on the Aetiology of Chronic Bronchitis (MRC breathlessness score). Bmj. 1960;2:1665.
21. Obaseki DO, Erhabor GE, Awopeju OF, Obaseki JE, Adewole OO. Determinants of health related quality of life in a sample of patients with chronic obstructive pulmonary disease in Nigeria using the St. George’s respiratory questionnaire. African health sciences. 2013; 13(3):694-702.