Original Article

Effect of Blow Bottle Device and Flutter on Functional Capacity, Dyspnea, Fatigue, and Peak Expiratory Flow Rate in Mild-to-Moderate COPD Patients: A Comparative Study

Samaradnyi Hichkad, B. R. Ganesh[1]

Department of Cardio Respiratory Physiotherapy, KAHER Institute of Physiotherapy, [1]Department of Cardiopulmonary Physiotherapy, KLE Institute of Physiotherapy, Belagavi, Karnataka, India

Abstract

Background: Chronic obstructive pulmonary disease (COPD) is expected to rank third among the sixth largest leading causes of death by 2020 and sixth most debilitating condition. Positive expiratory pressure techniques such as flutter and blow bottle devices are usually used to improve respiratory function. **Objective:** The objective of this study is to compare the effect of blow bottle device and flutter device on functional capacity, dyspnea, fatigue, and peak expiratory flow rate (PEFR) in participants with mild-to-moderate COPD. **Patients and Methods:** Forty-five participants, between 40 and 70 years were screened for the study. Of these, 32 participants were included and 27 completed the study. They were classified into two groups. Group A was given blow bottle device and Group B flutter device. A 1-week intervention protocol was given to the participants. **Results:** There was a significant postintervention improvement in mean walking distance in both Group A and Group B, (128.07 ± 15.48 m to 141.53 ± 16.75 m, 163.92 ± 48.2 m to 177.64 ± 55.3 m), respectively, and in PEFR ([Group A 180 ± 83.46 L/min to 195.76 ± 92.91 L/min and in Group B 138.57 ± 39.39 L/min to 158.57 ± 33.30 L/min]). Dyspnea and fatigue decreased significantly postintervention in both groups. **Conclusion:** Both blow bottle and flutter devices are effective as adjunct therapy in the improvement of functional capacity, dyspnea, fatigue, and PEFR in participants with mild-to-moderate COPD. Flutter device is more effective in improving functional capacity, dyspnea, and fatigue, whereas the blow bottle device is more effective in increasing PEFR.

Keywords: Blow bottle device, COPD, flutter device, peak expiratory flow rate

Introduction

According to Gold Initiative of Chronic Obstructive Lung Disease (GOLD), chronic obstructive lung disease (COPD) is a natural, avoidable, and treatable disorder. COPD is a primary cause of death and illness worldwide posing a substantial impact on patients as well as the health system. Therefore, it is one of the causes of mortality and morbidity, needing a multidisciplinary approach.[1] It is identified by recurrent respiratory symptoms due to airway and alveolar irregularities.[2] In COPD, irregular inflammatory response of the lungs to toxic substances or gases over time leads to airflow restriction.[3]

One of the vital treatment alternatives for patients experiencing shortness of breath related to COPD is pulmonary rehabilitation. Chest physiotherapy includes postural drainage, chest percussion, vibrations, etc. Along with these, breathing exercises such as blowing out against resistance through positive expiratory pressure (PEP) devices are recommended, which can be incorporated by several techniques. There is the prevention of airway closure, better clearance of secretions, improvement in functional residual capacity, and oxygenation when expired through a PEP resistance.[4] It is recommended that flutter, a breathing device can also be used as an option to expel the secretions. This device combines two separate approaches, namely PEP and oscillations, into one device.

Access this article online

Quick Response Code:

Website: www.ijrc.in

DOI: 10.4103/ijrc.ijrc_70_21

Address for correspondence: Ms. Samaradnyi Hichkad, Department of Cardiorespiratory Physiotherapy, KAHER Institute of Physiotherapy, Belagavi, India.
E-mail: samaradnyi123@gmail.com

How to cite this article: Hichkad S, Ganesh BR. Effect of blow bottle device and flutter on functional capacity, dyspnea, fatigue, and peak expiratory flow rate in mild-to-moderate COPD patients: A comparative study. Indian J Respir Care 2021;10:294-8.

Received: 09-06-2021 **Revised:** 29-07-2021
Accepted: 30-07-2021 **Published:** 13-09-2021

The PEP aids the expulsion of secretions by raising the alveolar pressure, helps to keep airways open while potentially decreasing apposition of peripheral airway.[5-8] PEP techniques such as flutter and blow bottle device, mainly enhance airflow and exchange of gases to conserve pulmonary function. In subjects with acute exacerbation who breathe close to total lung capacity, PEP helps to move equal pressure point to more central and solid airways and avoid air trapping. This reduces hyperinflation of lungs and enhances expectoration in participants with COPD. Some studies have shown that conventional physiotherapy, along with PEP techniques on the other hand is time-efficient and requires less manual labor.

Although there are studies that have demonstrated the effect of blow bottle devices and flutter on respiratory conditions such as atelectasis, bronchiectasis, asthma, etc., very few studies have studied the effect of these devices in COPD participants. Thus, the present study is undertaken to determine these devices individually and to compare the effect of these two PEP devices on dyspnea, fatigue, functional capacity, and peak expiratory flow rate (PEFR).

Patients and Methods

This was a randomized clinical trial, conducted from April 1, 2020 to March 31, 2021. The data were collected from COPD participants in and around Belagavi city, Karnataka, India. Ethical clearance was given by the Institutional Research and Ethics Committee India-727/08/08/20. The study was also registered under the Clinical Trials Registry of India (CTRI no-CTRI/2020/11/028983). Informed consent was obtained from the enrolled patients.

Forty-five participants were screened for the study. Of these, 32 were included and 27 participants completed the study. To be included, participants were required to have a diagnosis of mild-to-moderate COPD (according to GOLD criteria) of either gender, aged between 40 and 70 years. Participants were excluded if they did not consent, had any cardiovascular impairment, musculoskeletal dysfunction, or neurological disease. The enrolled participants were divided randomly using the envelope method into either of the two groups, A or B, each consisting of 16 participants. Group A received a blow bottle device and Group B received a flutter device [Figure 1].

The study was conducted for 1 week in which the data of outcome measures such as fatigue, dyspnea, functional capacity, and PEFR pre- and post-intervention were collected. Six-minute walk test was used for assessing functional capacity. Modified Medical Research Council (mMRC) dyspnea scale which is a self-rating tool or a five-point scale was used to assess the degree of disability that breathlessness poses. Fatigue was assessed using Fatigue Severity Scale (FSS) and PEFR meter which is a simple flow gauge device was used to measure the PEFR in L/min.

Group A: A blow bottle device

In this intervention, a 1-L plastic bottle was filled with water to a height of 10 cm. A 30 cm long tube was inserted to a depth of 8 cm into the water in the bottle [Figure 2]. The device was kept in front of the participants and they were asked to:

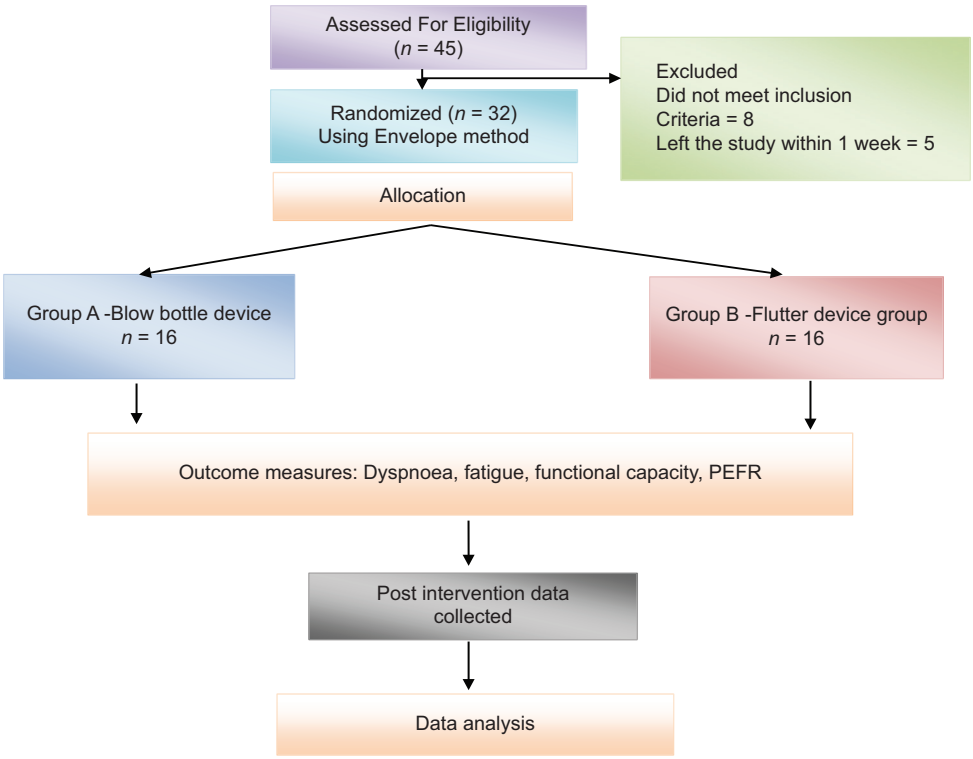

Figure 1: Consort flow diagram

Figure 2: Blow bottle device

Figure 3: Flutter device

(1) Close their mouth around the tubing and expire with a little force for 3 s to generate bubbles, (2) Do this for a total of 10 breaths, (3) Perform two huffs, and (4) Cough. Two sets of 10 such exhalations were performed with a 5-min break in between the sets. A new disposable tube and bottle were used for each subject.[9]

Group B: Flutter device

Initially, participants were asked to be relaxed and sit in a position with their head straight. The flutter device [Figure 3] was held at a right angle with the head level, i.e., parallel to the ground in a relaxed position. They were asked to take a deep inhalation and hold their breath for 2–3 s, then expire slowly through the Flutter valve, which caused the steel ball within the cone of the Flutter to oscillate. Over 15–20 min, three sets of 15 exhalations were performed. Later, the participants were advised to "huff" and cough after each sequence of exhalations, thereby encouraging expectoration.

Results

The mean age of the population is 60.06 ± 7.20 for Group A and 58.87 ± 8.34 for Group B, and there was no statistical significance seen in between group comparison ($P = 0.75$). In the Blow bottle group, 63% were men, whereas the Flutter group comprised 50% men. The mean value for height for Group A was 157.18 ± 5.83 cm and Group B was 157.31 ± 3.68 cm. The mean weight of participants in Group A was 58.43 ± 4.42 kg and 56.68 ± 4.49 kg in Group B. The mean body mass index of the participants in Group A was 23.7 ± 2.10 kg/m^2 and Group B was 22.8 ± 2 kg/m^2 [Table 1].

Functional capacity

The result showed that the mean walking distance (WD) value in Group A preintervention was 128.07 ± 15.48 m and the postintervention value was 141.53 ± 16.75 m. In Group B, the preintervention WD value was 163.92 ± 48.20 m and the postintervention value was 177.64 ± 55.3 m. Within-group analysis revealed showed a highly statistically significant increase in the functional capacity in both groups, postintervention. Between-group analysis showed a high statistically significant increase in the functional capacity, with Group B intervention being more effective than Group A in improving functional capacity [Table 1].

Dyspnoea modified Medical Research Council

The result showed that in Group A preintervention value was 2.69 ± 1.18 and postintervention value was 1.53 ± 1.05. In Group B, the mMRC score preintervention was 2.92 ± 0.47 and postintervention was 2.07 ± 0.61. Within-group analysis revealed that there was a statistically significant reduction in dyspnea observed in both groups. The mean difference in Group A was 1.16 and in Group B was 0.85. However, when the mMRC score was compared between the groups, there was no meaningful difference observed. The result of the between-group analysis of the mean difference of the mMRC score signifies that Group B intervention was more effective than Group A in reducing dyspnea [Table 1].

Fatigue

The result showed that the mean FSS score in Group A preintervention was 40.61 ± 13.87 and postintervention was 35.15 ± 14.57. In Group B, the mean FSS preintervention value was 41.42 ± 9.23 and postintervention value was 36.78 ± 9.12. When comparing within the group changes of FSS score in Group A as well as Group B, the statistical analysis showed statistically significant reduction in severity of fatigue ($P < 0.001$). Between-group however, showed no statistical difference. Between-group analysis of the mean difference of the FSS score showed that Group B intervention was more effective than Group A in reducing fatigue [Table 1].

Peak expiratory flow rate

In Group A, the preintervention value for PEFR was 180.00 ± 83.46 L/min and the postintervention value was 195.76 ± 92.91 L/min. Therefore, there was a highly significant improvement within-group analysis ($P < 0.001$). In Group B, the preintervention value for PEFR was 138.57 ± 39.39 L/min and the postintervention value was 158.57 ± 33.30 L/min. The within-group analysis of PEFR revealed high statistical significance ($P < 0.001$) [Table 1]. Between-group analysis did not show any statistically significant difference between groups.

Table 1: Baseline characteristics and effect of intervention

Parameter	Group A	Group B	*P*
Age (years)	60.06±7.20	58.87±8.34	0.57
Males/females	8/10	8/6	0.53
Height (cm)	157.18±5.83	157.31±3.68	0.94
Weight (kg)	58.43±4.42	56.68±4.49	0.46
BMI (kg/cm^2)	23.7±2.10	23.7±2.00	0.92
WD (m)			
Preintervention	128.07±15.48	163.92±48.20	0.001*
Postintervention	141.53±16.75	177.64±55.39	
Dyspnoea mMRC score			
Preintervention	2.69±1.18	2.92±0.47	0.001*
Postintervention	1.53±1.05	2.07±0.61	
FSS score			
Preintervention	40.61±13.87	41.42±9.23	0.001*
Postintervention	35.15±14.57	36.78±9.12	
PEFR (L/min)			
Preintervention	180.00±83.46	138.57±39.39	0.001*
Postintervention	195.76±92.91	158.57±33.30	

Statistical significance (P<0.05). WD: Walking distance, PEFR: Peak expiratory flow rate, FSS: Fatigue Severity Scale, MMRC: Modified Medical Research Council, BMI: Body mass index

The result of between-group analysis of the mean difference of the PEFR values showed that Group A intervention was more effective than Group B in increasing PEFR.

Statistical analysis for the present study was done using the Statistical Package for the Social Sciences (SPSS) software version 23. (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, version 23.0. Armonk, NY, USA: IBM Corp). The normality of different variables in each group was assessed using the Shapiro–Wilk test. The pretest and posttest values of all the variables in both groups were analyzed using paired-sample *t*-test and were analyzed using Wilcoxcon single test when quantitative variables were not normally distributed. The comparison between the groups was done using an unpaired *t*-test. Similarly, Mann–Whitney *U*-tests have been applied to compare between groups. The level of significance was set at 5% and the probability values of <5% were considered statistically significant.

Discussion

In the present study, the number of men exceeded women (males = 18; females = 14). The reason could be that the incidence of COPD in India is found to higher in men than women.[10] Smoking is more among men that leads to COPD.[11] Exacerbations, hospitalizations, and death are all determined by the extent of physical activity a COPD patient may do as well as their functional state. As a result, one of the primary care targets should be to improve their functional status.[12] Various studies have shown that one of the strongest variables that are correlated with decreased physical activity and that is considered as one of the critical elements of poor health is fatigue.[13] Following this, the findings in the present study showed an improvement in the functional capacity in both groups. The probable reason for this could be a decrease in fatigue which in turn would have improved functional capacity. In a study, there was an improvement in dyspnea by the flutter device which was detected not only during exercise but also at rest that suggested that this technique was more efficacious.[14] Furthermore, various studies have shown that the use of the blow bottle in postoperative care increases the pulmonary volume and facilitates the release of pulmonary secretions, but the use of blow bottle for reducing dyspnea in COPD patients has been scarce.[15] Similarly, the findings in the present study have shown that both devices have led to a reduction in dyspnoea postintervention. Increase in fatigue is further associated with a reduction in exercise tolerance. The probable reason could be poor sleep quality, metabolic skeletal muscle tension, the effect of labored breathing, a correlation with frequency of exacerbation, loss of energy and symptoms of depression, and likely systemic inflammation.[16] Therefore, it is essential to decrease the level of fatigue to enhance the functional capacity. With regard to this, the result observed in the present study with respect to fatigue was that the level of fatigue has reduced in both groups postintervention, and this probably would have led to an increase in the functional capacity.

A study showed that there was an increase in PEFR after treatment with flutter device. This could be due to enough clearance of airway mucus.[17] The findings in the present study could also be because of the same reason. A study has shown that positive-expiratory-pressure therapy is effective along with conventional therapy on respiratory parameters in patients with intercostal drain.[18] This can be because, in a PEP device such as blow bottle, length of the tube, the pattern of breathing, and force of expiration are the elements that influence the pressure achieved and the consequent increase in the resting lung volume (functional residual volume).[19] Similar findings were seen in the present study. This improvement was greater in blow bottle as compared to flutter device.

The present study was done over a short duration. Perhaps, the benefits would be greater with the use of these devices over a longer duration. The study did not consider smoker and nonsmoker individuals separately and any possible difference in the benefits has not been evaluated.

Conclusion

Both blow bottle device and flutter device are effective devices and can be used as adjuncts for subjects with COPD. The flutter device is more effective in improving functional capacity, dyspnea, and fatigue, whereas the blow bottle device is more effective in increasing PEFR. The blow bottle device, being a home-made device, requires less equipment and therefore can be used very easily at home which makes it cost-effective as compared to a flutter device.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Ghanbari A, Shirmohamadi N, Paryad E, Bazghale M, Mohammadpourhodki R. Effect of breathing exercises on fatigue dimensions in patients with COPD. Med Sci Discov 2018;5:174-9.
2. MacNee W. ABC of chronic obstructive pulmonary disease. Pathology, pathogenesis, and pathophysiology. BMJ 2006;332:1202-4.
3. Fagevik Olsén M, Westerdahl E. Positive expiratory pressure in patients with chronic obstructive pulmonary disease--a systematic review. Respiration 2009;77:110-8.
4. Liverani B, Nava S, Polastri M. An integrative review on the positive expiratory pressure (PEP)-bottle therapy for patients with pulmonary diseases. Physiother Res Int 2020;25:e1823.
5. Gastaldi AC. Flutter device review: Effects on secretion and pulmonary function. J Nov Physiother 2016;6:1-6.
6. Lindemann H. The value of physical therapy with VRP 1-desitin(’flutter). Pneumologie 1992;46:626-30.
7. Chatburn RL. High-frequency assisted airway clearance. Respir Care 2007;52:1224-35.
8. Bhowmik A, Chahal K, Austin G, Chakravorty I. Improving mucociliary clearance in chronic obstructive pulmonary disease. Respir Med 2009;103:496-502.
9. Nyberg A, Törnberg A, Wadell K. Correlation between limb muscle endurance, Strength, and functional capacity in people with chronic obstructive pulmonary disease. Physiother Can 2016;68:46-53.
10. Mannino DM, Buist AS. Global burden of COPD: Risk factors, prevalence, and future trends. Lancet 2007;370:765-73.
11. Barnes PJ. Sex differences in chronic obstructive pulmonary disease mechanisms. Am J Respir Crit Care Med 2016;193:813-4.
12. Kocks JW, Asijee GM, Tsiligianni IG, Kerstjens HA, van der Molen T. Functional status measurement in COPD: A review of available methods and their feasibility in primary care. Prim Care Respir J 2011;20:269-75.
13. Al-Shair K, Kolsum U, Singh D, Vestbo J. The effect of fatigue and fatigue intensity on exercise tolerance in moderate COPD. Lung 2016;194:889-95.
14. Üzmezoğlu B, Altıay G, Özdemir L, Tuna H, Süt N. The efficacy of Flutter® and active cycle of breathing techniques in patients with bronchiectasis: A prospective, randomized, comparative study. Turk Thorac J 2018;19:103-9.
15. Jacobs RC. Evaluation of positive expiratory pressure (PEP) devices as an adjunct to cardio-respiratory physiotherapy in patients following open abdominal surgery Available from: https://open.uct.ac.za/bitstream/handle/11427/16681/thesis_hsf_2015_jacobs_rene_catherine.pdf?isAllowed=y&sequence=1.
16. Breslin E, van der Schans C, Breukink S, Meek P, Mercer K, Volz W, *et al.* Perception of fatigue and quality of life in patients with COPD. Chest 1998;114:958-64.
17. Burioka N, Sugimoto Y, Suyama H, Hori S, Chikumi H, Sasaki T. Clinical efficacy of the FLUTTER device for airway mucus clearance in patients with diffuse panbronchiolitis. Respirology 1998;3:183-6.
18. Ansari H, Dhake S, Ahmed S. Positive expiratory pressure (PEP) therapy in patients with diseases of the pleura. Int J Health Sci Res 2017;7:132-8.
19. Purushothaman S, Kumar PG, Jasmine JB, Subramanyan PV, Rasitha M. Efficacy of self designed positive expiratory pressure device on lung function in geriatric population. Drug Invent Today 2019;12:412-5.