

Effectiveness of Pursed Lip Breathing Versus Mouth Mask on Dyspnea and Functional Capacity in Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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ABSTRACT

Background: Chronic Obstructive Pulmonary disease is a growing problem in India and throughout the world. It is major and challenging health problem that results in chronic morbidity and mortality throughout the world. Dyspnea is one of the cardinal features of COPD due to which functional capacity of the patient reduces. This study aimed to evaluate the effectiveness of pursed lip breathing and mouth mask on dyspnea and functional capacity in COPD patients.

Methods: Thirty male and female subjects of age group 40-65 years diagnosed with COPD were assigned into two groups. In addition to the medical treatment given for all patients, patients in Group A (n=15) performed Pursed Lip Breathing and patients in Group B(n=15) performed Pursed Lip Breathing through Mouth Mask. All the patients underwent clinical evaluation including chest X-ray, spirometry before the procedure. Outcome measures in the form of level of dyspnea according to Modified Borg scale and functional capacity (6MWD test) were assessed at baseline, after 4 and 8 weeks.

Result: Subjects of Group B who performed Pursed Lip Breathing through Mouth Mask showed more significant improvement in relieving dyspnea and increasing functional capacity compared to subjects of Group A Who performed pursed lip breathing.

Conclusion: Result of the study proved that pursed lip breathing through Mouth Mask showed significantly higher improvement in relieving dyspnea and in increasing the functional capacity.

Key Words: COPD, Pursed Lip Breathing, Acute Exacerbation, Mouth Mask, Dyspnea, Functional capacity, 6MWD

INTRODUCTION

Chronic Obstructive Pulmonary disease is a progressive disorder which affects 4% to 6% population and is a major cause of morbidity throughout the world, currently it is the fourth leading cause of death in the world. ^[1]

According to Global Initiative of Obstructive Pulmonary Diseases guidelines, "Chronic obstructive pulmonary disease is defined as a common preventable and

treatable disease and is characterized by persistent airflow limitation that is usually progressive. Due to the significant exposure to noxious particles or gases airway or alveolar abnormalities occur which will further lead to persistent respiratory symptoms and airflow limitation. The airflow limitation is usually progressive and is associated with abnormal inflammatory response of the lungs to noxious particles or gases, which in turn is due to the presence

of specific structural abnormalities of both the airways (bronchitis and bronchiolitis) and the pulmonary parenchyma (Emphysema). [2,3]

Degree of expiratory airflow limitation defines the severity of COPD. Decline in forced expiratory volume in first second (FEV₁) and airflow limitation provides a useful description of the severity of the pathological changes in COPD and are essential in the diagnosis of COPD. [4]

Dyspnea, productive cough, reduced maximum expiratory flow, slow expiratory volume and dyspnea are the cardinal features of COPD. [5] It has been reported that in chronic obstructive lung disease patients respiratory muscle weakness is observed which will further contribute hypercapnia, nocturnal desaturation and reduced walking distance. [6]

Dyspnea or shortness of breath is a subjective experience of labored breathing or breathing discomfort that is comprised of qualitatively distinct sensations that vary in intensity. [7] It has been observed that dyspnea get worsened during acute exacerbation of COPD. Acute exacerbation of COPD is defined as an event in the natural course of the disease characterized by worsening of patient's respiratory symptom including dyspnea, cough, and sputum that is beyond day-to-day variations and lead to changes in medication of the patient. [8]

The therapeutic goal of symptomatic management of dyspnea is to relieve patient's increased work of breathing. This can be achieved by pursuing one or more strategies including pharmacological and non-pharmacological interventions. Non-pharmacological interventions include ventilator support, relaxation techniques and different kind of breathing techniques which specifically includes pursed lip breathing. [9]

Pursed Lip Breathing is a very popular and excellent rescue technique for dyspnea resulting from COPD, it is a way of exhaling air through the lungs such that it let out through the pursed lips (voluntary puckered lips). This manner of exhalation

creates a back pressure in the airways throughout the expiration, thereby producing a stent like effect to maintain the patency of airways during expiration, assisting complete emptying of lung. [10]

According to a study Mouth Taping is an another technique which simply mimicked pursed lip breathing, worked on similar mechanism as Pursed Lip Breathing done by the application of tape around and over the lips with a small opening at the centre, which created a central aperture. It has been proved helpful in maintaining the sustained effect of Pursed Lip Breathing. It is known to add more uniform resistance to the expiratory flow, prolonging the breathing cycle, avoiding the perioral muscles fatigue, giving a continuous feedback, and therefore easier to administer and helpful during high intensity tasks. It can be used as adjunct to Pursed lip breathing in order to relieve dyspnea and in patients who have difficulty in maintaining the mouth position while performing pursed lip breathing. [11]

Practically it appears to be unconventional and inconvenient approach. It seems an uncomfortable for the patient to apply and remove mouth taping regularly as mouth tape will cause lot of pain while removing and patient will find it difficult to apply the tape twice a day regularly, so we designed a mouth mask which work on the same principle as mouth taping. Therefore it will be easy for the patient to use this mask by himself/herself and can be used as adjunct to pursed lip breathing to relieve dyspnea.

METHODOLOGY

This prospective comparative study was carried out in SGT Hospital and research institute, Budhera, Gurugram. Ethical research committee approved the study.

Thirty male and female subjects between 40- 65years old with moderate to severe COPD with acute exacerbation having dyspnea as the primary symptom that

limited daily activities and ex-smokers were recruited in this study.

The severity was classified according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) into stage II and III based on post bronchodilator forced expiratory volume in one second (FEV_1)/ Forced vital Capacity(FVC) <0.70 . Patients on domiciliary oxygen therapy, with any other co-morbid medical or surgical condition like restrictive pulmonary disease or asthma limiting activity regimen performance, decreased level of consciousness, any musculoskeletal deformity limiting the performance of activity regimen performance, unstable cardiac disease, uncontrolled hypertension, recent pneumothorax and recent abdominal or thoracic surgery, known progressive neuromuscular disorders, advanced liver diseases, or renal impairment, known connective tissue diseases, or significant endocrinal abnormalities were excluded from the study.

Patients who fulfilled the inclusion and exclusion criteria were divided into two groups by using Convenience random sampling method i.e, Group A included 15 patients who performed the pursed lip breathing exercise and Group B included 15 patients who performed the pursed lip breathing through mouth mask. All the patients assessment including thorough history taking, clinical evaluation, plain chest x-ray, BMI, dyspnea level (MBS) and functional capacity (6MWD) were taken. All patients received regular treatment with inhaled bronchodilators, inhaled steroids, and other medication according to the prescription of caring. Whole procedure of the training was explained to all the subjects and a written informed consent was obtained.

Both the group follow the protocol at the baseline, last day of 2nd week, last day of 4th week and last day of 6th week.

Procedure-

Group A- Pursed Lip Breathing

Patients were given only pursed-lip expiration exercise for 6 weeks (5 days in a week, 2 times per day for 20 minutes per session). The patients were asked to relax his or her shoulder muscles and were asked to breathe in (inhale) slowly through his or her nose for two counts, keeping mouth closed. Then he/she will be asked to pursue their lips as if they were going to whistle or gently flicker the flame of a candle. Finally breathe out (exhale) slowly and gently through pursed-lips while counting to four. [12]



Fig -1 – Subject performing pursed lip breathing

Group B- Mouth Mask-

Subjects of this group were given a mouth mask, this mask was designed in such a way that only central aperture, i.e., only 1/4th of the total lip length is kept open. Then subject were asked to wear the mask and demonstrate the breathing pattern, like pursed lip breathing group. After the confirmation of the breathing pattern, subjects were asked to walk on treadmill and advised to inhale from nose and exhale through the mouth right from beginning of the test. Before making this mask, the mouth impression of the subject was taken by using alginate impression material on the Plaster of Paris (POP) cast then with the use of heat over acrylate sheet (Poly Methyl-Methacrylate- PMMA), the impression is adapted on this sheet with the help of heat, then by keeping 1/4th of the total lip length open aperture was created so that it holds the position of the lip similar to that of pursed lip breathing. [13]



Fig-2 Subject breathing through mouth mask

RESULT

Data analysis was performed with the software package SPSS 21 for window version. Mean and standard deviation of all the variables were calculated. Comparison between the groups for variable (functional

capacity) on baseline, 2nd week, 4th week and 6th week was done using independent sample t test. Comparison of effect of treatment within the group on baseline, 2nd week, 4th week and 6th week for functional capacity was done using paired t test. For dyspnea data was analyzed by using Man Whitney U-test on baseline, last day of 2nd week, 4th week and 6th week. The significant level was set at 95% ($p \leq 0.05$).

Table 5.1- Subject's baseline characteristics represented as Mean \pm SD

Variables	Group A (n=15) Mean \pm S.D	Group B (n=15) Mean \pm S.D	t-value
Age (Years)	58.60 \pm 3.56	61.13 \pm 3.33	1.1 ^{NS}
Gender			
Male, n(%)	9(60%)	9(60%)	1.07 ^{NS}
Female, n(%)	6(40%)	6(40%)	
BMI (Kg/m ²)	24.21 \pm 5.7	24.57 \pm 4.5	0.18 ^{NS}
Height	165 \pm 5.9	165 \pm 5.2	0.39 ^{NS}
Weight	62.73 \pm 11.6	66.7 \pm 11.5	0.9 ^{NS}
NS – Non significant			

Table 5.2- Baseline values and changes in dyspnea grade at 2nd, 4th and 6th week in both the groups by using Man Whitney U-test

Groups	Baseline	2 nd week	4 th week	6 th week
PLB	Median 3, IQR 0	Median 2, IQR 1	Median 2, IQR 0	Median 1, IQR 0
MM	Median 3, IQR 1	Median 2, IQR 1	Median 2, IQR 0	Median 0, IQR 0
U value	105.0	112.1	105.2	18.1
p value	<0.05	1.0	<0.05	<0.001*
IQR: interquartile range, PLB: Pursed lip breathing, MM: Mouth Mask *Highly significant				

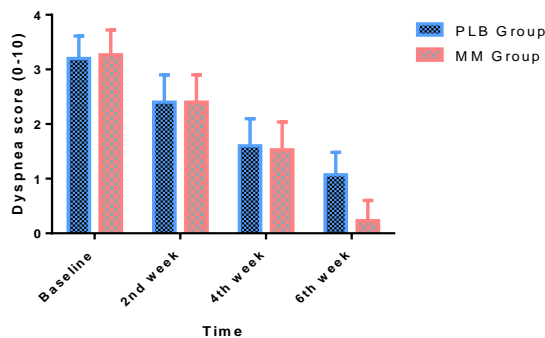


Fig-3 Comparison of Dyspnea between the groups

Table 5.3: Changes in Group A for functional capacity for values of Baseline, 2nd, 4th and 6th week within the groups by using paired sample t test

Pair	Time	Mean \pm SD	t-value	p-value
Pair 1	Baseline	195.93 \pm 13.16	6.8	0.003*
	2 nd week	202.73 \pm 11.20		
Pair 2	Baseline	195.93 \pm 13.16	7.5	0.002*
	4 th week	206.47 \pm 10.12		
Pair 3	Baseline	195.93 \pm 13.16	8.8	0.001*
	6 th week	209.80 \pm 9.7		
Pair 4	2 nd week	202.73 \pm 11.20	5.4	0.003*
	4 th week	206.47 \pm 10.12		
Pair 5	2 nd week	202.73 \pm 11.20	7.6	0.002*
	6 th week	209.80 \pm 9.7		
Pair 6	4 th week	206.47 \pm 10.12	12.3	0.003*
	6 th week	209.80 \pm 9.7		
*Highly significant				

Table 5.4: Changes in Group B for functional capacity for values of Baseline, 2nd, 4th and 6th week within the groups by using paired sample t test

Pair	Time	Mean \pm SD	t-value	p-value
Pair 1	Baseline	200.27 \pm 12.90	6.6	0.001*
	2 nd week	209.00 \pm 13.78		
Pair 2	Baseline	200.27 \pm 12.90	9.9	0.000*
	4 th week	215.73 \pm 14.86		
Pair 3	Baseline	200.27 \pm 12.90	12.3	0.001*
	6 th week	221.00 \pm 15.06		
Pair 4	2 nd week	209.00 \pm 13.78	9.1	0.003*
	4 th week	215.73 \pm 14.86		
Pair 5	2 nd week	209.00 \pm 13.78	11.1	0.002*
	6 th week	221.00 \pm 15.06		
Pair 6	4 th week	215.73 \pm 14.86	7.2	0.003*
	6 th week	221.00 \pm 15.06		
*Highly significant				

Table 5.5: Changes in values for functional capacity in comparison to Baseline for 2nd, 4th and 6th week between the group by using Independent sample t test

	Group	N	Mean	S.D	t- value	p-value
Baseline	A	15	195.93	13.16	6.8	0.3
	B	15	200.27	12.90		
2 nd week	A	15	202.73	11.2	5.4	0.1
	B	15	209.00	13.7		
4 th week	A	15	206.47	10.1	7.2	0.004
	B	15	215.73	14.8		
6 th week	A	15	209.80	9.7	2.7	0.2
	B	15	221.0	15.0		

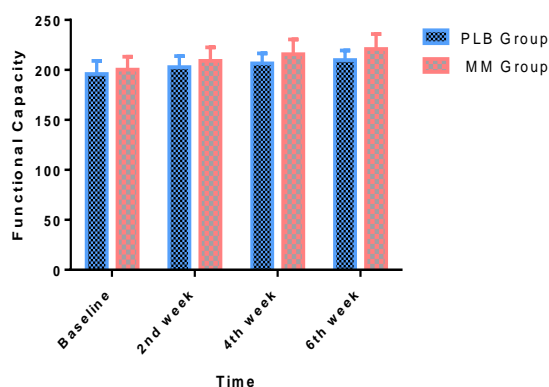


Figure 4: Comparison of functional capacity between the groups.

DISCUSSION

Chronic Obstructive Pulmonary Disease is defined as a chronic condition characterized by airflow limitation which is progressive and associated with symptoms such as dyspnea, excessive sputum production and chronic cough. During COPD exacerbation, Dyspnea is an important and debilitating symptom. In acute exacerbation of COPD dynamic hyperinflation occur due to the decrease in inspiratory to expiratory ratio and increase in airway resistance which will further decreases the efficiency of the respiratory muscles. [14] Weakness of respiratory muscle in COPD patients lead to hypercapnia, dyspnea and decreased functional capacity. [15]

The main aim of the treatment for COPD patient is to relieve dyspnea. Various pharmacological and non- pharmacological interventions are used to relieve dyspnea such as bronchodilator therapy, oxygen therapy, breathing techniques are used to alleviate symptoms and improve respiratory complications by ameliorating the adverse physiological effects. [16]

Pursed lip breathing is one of the breathing techniques which is used to overcome the shortness of breath. It is a technique whereby exhalation is performed through a resistance created by constriction of the lips and can overcome airflow limitation and impaired gas exchange in COPD. Although this breathing technique is often spontaneously adopted by COPD patients, it is also routinely taught in pulmonary rehabilitation programs as a breathing-retraining exercise because it has been observed that it helps in reducing dyspnea. [17]

Mouth Taping is one of the latest techniques which was found to be effective in reducing the dyspnea grade in normal subjects. In 2015, Gaurav Maind et.al has done a study and they suggested that mouth taping can be use as an alternative to pursed lip breathing, especially when patients find it difficulty in pursing their lips voluntarily to exhale effectively or even when pursed lip breathing is required for a prolonged duration. [11]

In the current study Mouth Mask has been used instead of mouth taping because application of mouth taping twice a day regularly can be very difficult for the patient and removal of the tape can be painful for the patient due to its adhesive effects. So, in this study we designed a mask which works on the same principle as pursed lip breathing and can be used as an adjunct to pursed lip breathing.

A prior pilot study was done on normal individual in whom it was found to be effective in reducing dyspnea. In this study a comparison was done between the pursed lip breathing and mouth mask to see their effect on dyspnea and functional capacity. [13]

Results of our study revealed that there was statistically significant improvement in Dyspnea by 66% and in functional capacity by 7.07% in the Group A who received Pursed Lip Breathing for six weeks.

It has been seen that pursed lip breathing helps in reducing dyspnea at rest

by improving the alveolar ventilation and altering the respiratory pattern. It has also been reported that PLB increases exercise tolerance and reduces activity limitation, reducing both peak and mean expiratory flow rates and thereby reducing dyspnea. Greater reduction in non-elastic resistance across lungs is seen with pursed lip breathing. It is used by some patients, typically COPDs automatically and has been considered an important breathing strategy. [18]

Shweta, Damle et.al. concluded that pursed lip breathing is very beneficial and this pattern of breathing is employed spontaneously by many patients with chronic obstructive pulmonary disease during rest and during exercise or physical activity to control obstruction. This technique of breathing improve control of breathing and breathing pattern which will further results in prolonged expiration and hence decrease in respiratory rate at rest and during activity, and also reduces dyspnea and SPO₂. [19]

Narul et. al. in a research reported that pursed lip breathing can reduce the use of oxygen in patients with stable COPD. [20]

According to Kirti saini, Sonia et.al. (2016), COPD patients have decreased exercise capacity and reduced activity level compared to healthy controls. [21]

Jadrane Spahija et.al. stated that Pursed lip breathing can have a variable effect on dyspnea when performed volitionally during exercise by patients with COPD. The effect of pursed lip breathing on dyspnea are related to the combined changes that promotes improvement in the tidal volume and End Expiratory Lung Volume and their impact on the available capacity of the respiratory muscles to meet the demands placed on them in terms of pressure generation. [22]

Results in Group B who received treatment through mouth mask also showed a statistically significant improvement in Dyspnea by 92% and helps in improving functional capacity by 10.3%.

To reduce dyspnea a study was done by Gaurav Maind et.al. in which they compare the effect of the mouth taping and pursed lip breathing on dyspnea in normal individual and he found no significant difference between both the groups. He concluded that the exercise responses, reflected by the treadmill walking time, the dyspnea status reached during exercising and the time for recovery to baseline parameters were similar in both the group; Suggesting that mouth taping can be used as an alternative for pursed lip breathing. [11]

In this study the comparison was done between Mouth Mask and Pursed Lip Breathing, Mouth Mask group showed a more significant difference in relieving dyspnea and improving functional capacity ($p < 0.001$). More improvement in the patients with mouth mask suggested that in COPD patients because of acute exacerbation, there occurs increase in dyspnea and patients are not well oriented and it is very difficult for the patients to hold the aperture of the mouth as in pursed lip breathing and they were unable to follow the command of the therapist. It has been found that the use of Mouth Mask which worked on the same principle as Pursed Lip Breathing helped to hold the aperture of the mouth as of Pursed Lip Breathing and gave the continuous feedback to the patients. So, it helped to reduce dyspnea by reversing dynamic hyperinflation through increased intraluminal pressure in the airways resulting in a shift of equal pressure point from distal to proximal and helped in preventing airway collapse

CONCLUSION

Results of the study showed that in patients with acute exacerbations of COPD, application of the Mouth Mask yielded a clinically significant improvement in Dyspnea and functional capacity in COPD patients. There was significantly higher improvement in dyspnea and functional capacity in patients who received Mouth Mask as compared to the patients who were treated with Pursed lip breathing. These

results offer an exciting new opportunity to provide a non-pharmacological treatment modality to emergency department practice for acute exacerbations of COPD as well. Further research with greater follow period, using randomized control trial and with larger sample population is required for the generalization of the result.

Limitation of study:

A shorter duration of intervention with a small sample size was found to be a limitation of the study. After the intervention the patients were not followed which was a lack of the study.

Relevance to clinical practice:

The Mouth Mask used in this study is found to be very effective and beneficial in relieving dyspnea during acute exacerbation of moderate and severe COPD patients. It is a low cost device with an excellent compliance with the patients which can be easily used during the rehabilitation. It can be prescribed as an additional tool during the pulmonary rehabilitation of these populations even it can also be used for the asthmatic patients and a number of various other respiratory complications. It can be given to the patients for home program to relieve the dyspnea grade during the acute exacerbation.

Future recommendation of the study:

The present study investigated the effect of Pursed Lip Breathing and Mouth Mask on level of dyspnea and functional capacity in COPD patients. It was a first time intervention that the mouth mask has been used to assist pursed lip breathing to the COPD patients. So, there is lack of supportive data for this study. So, there is a need for future research with larger population with longer duration that may be helpful to find out the effect of the intervention on HRQoL (health related quality of life) and level of anxiety and depression of these patients. This intervention can also be done to differentiate the effect between the moderate and severe

grades of COPD patients and may be helpful to find out that which grade of COPD is more relieved with this intervention. In future there is a need to keep an eye on analysis on the Pulmonary Functions to find out the effect of this intervention on these patients.

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