

 <p>ISSN NO. 2320-5407</p>	<p>Journal Homepage: - www.journalijar.com</p> <p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</p> <p>Article DOI: 10.21474/IJAR01/11710 DOI URL: http://dx.doi.org/10.21474/IJAR01/11710</p>	
---	--	---

RESEARCH ARTICLE

EFFECT OF DIAPHRAGMATIC BREATHING WITH AND WITHOUT PURSE-LIPS BREATHING IN SUBJECT WITH EMPHYSEMA DISEASE

Dr. Minhaj Tahir, Dr. Tahzeeb Fatima and Dr. Devendra Kumar Trivedi
Assistant Professors Dept of Physiotherapy, Rama University, Kanpur, India.

Manuscript Info

Manuscript History

Received: 15 July 2020

Final Accepted: 18 August 2020

Published: September 2020

Abstract

Background: Breathing exercise such as purse-lip breathing and diaphragmatic breathing play a role in some individual with Emphysema and might be considered for those patients who are unable to exercise. However, in this study is report of some adverse effect of diaphragmatic breathing in patient with Emphysema disease. Thus the purpose of the study was to assess the effect of diaphragmatic breathing and diaphragmatic breathing combined with purse-lip breathing on chest wall kinematics, breathlessness, and chest wall asynchrony in subject with obstructive disease, and also assess the whether the combination of both exercise reduce the adverse effect of diaphragmatic breathing while maintaining its benefits.

Methods: Fifteen Subjects with pulmonary obstructive disease, mean 60 to 65 year age group, with a history of smoking and clinical stability without hospitalization or symptoms of exacerbation in the past 4 week, were evaluated. On day 1, participant's characteristics were collected, and they learnt diaphragmatic breathing. On day 2, the participants were evaluated by spirometry with the participants in the seated position while performing breathing exercise.

Results: Diaphragmatic breathing and diaphragmatic breathing plus pursed-lip breathing promoted a significant increase in chest wall tidal volume of the chest wall. A significant increase in inspiratory-expiratory phase ratio was observed during diaphragmatic breathing and diaphragmatic breathing plus purse-lip breathing compared with quiet breathing, with no difference observed between the exercises.

Conclusion: Despite the increase the inspiratory-expiratory phase volume, both breathing exercise were able to improve chest wall volume without affecting Dyspnea. The combination of exercises maintains the benefit but did not reduce the adverse effect of diaphragmatic breathing.

Copy Right, IJAR, 2020,. All rights reserved.

Introduction:-

It is one of the diseases that make up chronic obstructive pulmonary disease. This is a set of disease where the flow of air in the lungs is obstructed. Emphysema is most often caused by smoking but can be caused by other diseases or has not known cause at all. It occurs when very small air sacs (called the alveoli) at the ends of the airways in lungs start to breakdown from many sacs to form much bigger sacs. The alveoli are the areas of the lungs where oxygen

and carbon dioxide are exchanged into and out of the blood. Emphysema makes it hard for people to blow air out of the lungs because air gets trapped inside the broken alveoli due to the collapse of the walls. The traps air in the lungs creates the characteristic "barrel chest" of emphysema.

Emphysema is characterized by air-filled cavities or spaces, in the lungs, that can vary in size and may be very large. The spaces are caused by breakdown of the walls of the alveoli and they replace the spongy lung parenchyma. This reduce the total alveolar surface available for gas exchange leading to a reduction in oxygen supply for the blood.² Emphysema usually affects the middle aged or older population. This is because the disease takes time to develop with the effect of smoking, and other risk factors. Alpha-1 antitrypsin deficiency is a genetic risk factor that may lead to the condition presenting earlier.³

It is a typical feature of chronic obstructive pulmonary disease (COPD), types of obstructive lungs characterized by long term breathing problems and poor airflow.^{4,5} Even without COPD, the finding of the pulmonary emphysema on a CT lung scan confers a higher mortality in tobacco smokers.⁶ A study on the effect of tobacco and cannabis smoking showed that a possibly cumulative toxic effect could be a risk factor for developing emphysema, and spontaneous pneumothorax.⁸ there is an association between emphysema and osteoporosis.⁹

There are three subtypes of pulmonary emphysema- centrilobular, Panlobular and Paraseptal emphysema, related to the anatomy of the lobules of the lungs.^{10,11} These are not associated with fibrosis. A Fourth type known as irregularly and is associated with fibrosis.¹¹ only the first two types of emphysema-centrilobular and Panlobular are associated with significant emphysema around 20 times more common than Panlobular.¹¹

Centrilobular Emphysema

Centrilobular emphysema also called centriacinar emphysema, affects the centrilobular portion of the lung, the area around the terminal bronchiole, and the first respiratory bronchiole, and can seen on imaging as an area around the top of the visible pulmonary artery. Centrilobular emphysema is the most type usually associated with smoking, and with chronic bronchitis.⁷ The Disease progresses from the centrilobular portion, leaving the lung parenchyma in the surrounding region preserved.⁸ Usually the upper lobes of the lungs are affected.⁷

Panlobular Emphysema

Panlobular emphysema also called panacinar emphysema can involve the whole lung or mainly the lower lobes.¹⁰ This types of emphysema associated with alpha-1 antitrypsin¹⁰ and are not related to smoking.⁹

Paraseptal Emphysema

Paraseptal emphysema also called distal acinar emphysema relates to emphysematous change next to a pleural surface, or a fissure.^{12,11} The cystic spaces known as blebs or bullae that form in Paraseptal emphysema typically occur in just one layer beneath the pleura. This distinguishes it from the honeycombing of small cystic spaces seen in fibrosis that typically occurs in layers.¹¹ This types of emphysema is not associated with airflow obstruction.¹²

Diaphragmatic breathing consist of a smooth and deep nasal inspiration with anterior displacement of the abdominal region, which emphasize the action of the diaphragm.^{13,15,16} for the patient of emphysema, the immediate benefits of diaphragmatic breathing are in increase in the tidal volume and oxygen saturation, reduction in breathing frequency, and improvements of ventilation and hematosis.¹⁶ Adverse effect include an increase in the asynchronous and paradoxical movement of the chest wall as well as increase work of breathing and Dyspnea in the subject with the most severe conditions.^{13,15,16}

Purse lip breathing consist of a soft exhalation performed for 4 to 6 second against the resistance of partially closed lips and clenched teeth.^{13,15,14} It is frequently adopted spontaneously and voluntarily by some subject with emphysema to control and relieve Dyspnea and can be performed at rest or during exercise.^{14,16} Several study shown that the benefit of purse lip breathing in subject with emphysema include decrease frequency and lung hyperinflation, improvement of the Pco₂ and oxygen saturation.^{13,15,14,17} However Dyspnea relief remain poorly consistent, because this response is different among subject.

With regards to the combination of these techniques in subject with emphysema, a significant decrease on breathing frequency and oxygen consumption during the combined exercise compared with the spontaneous breathing. The breathing frequency was significantly lower during diaphragmatic breathing plus purse lip breathing, even in

relation in each technique in isolation, although there was no difference in oxygen consumption among 3 exercises.¹⁴ According to these findings, a combination of these techniques seemed to be more effective than performing the exercise separately.

Methods:-

Participation who met the following inclusion criteria: diagnosis of emphysema confirmed by pulmonary function test, history of smoking. Between 40 to 70 of age, clinically stable, no report of neurological or psychiatric disorder, body mass index between 18 and 29.99 kg/m²,¹⁸ and no previous participation in a pulmonary rehabilitation program. The entire participant signed a written consent form.

Data were collected over 2nd day, with a maximum interval of 1 week between them. Initially, clinical and demographic data were collected. The participants performed the pulmonary function test. After that, the participants learned how to performed diaphragmatic breathing and the diaphragmatic breathing plus purse-lip breathing.

For diaphragmatic breathing, they were instructed to perform a nasal inspiration moving predominantly the abdomen, reducing the movement of the rib cage.^{18,19} for diaphragmatic breathing plus purse-lip breathing, they were instructed to perform a diaphragmatic breathing, and then, exhale the air lips partially closed.²⁰ Initially, tactile stimulus was used by positioning one of the participants hand on his or her abdomen, at the level of the umbilicus, while placing the other hand on the chest, in the sternal notch region, to allow the compression of ventilation between both location.¹⁶ Moreover, during the learning period, 2 bands from the respiratory inductive Plethysmography were placed, one the on the rib cage and another on the abdomen, and participant were positioned in front of a computer screen to follow the movement of the chest wall for the visual feedback. In addition, standard verbal instruction was given to ensure correct techniques performance.

On the second day, the participants were initially reminded about the exercise performance. There are 3 different condition were registered: (1) 6 min of quite breathing (3 sets of 2 min each); (2) 6 min of diaphragmatic breathing (3 sets of 2 min each); (3) 6 min diaphragmatic breathing plus pursed- lip breathing (3 sets of 2 min each).

The exercise was performed in a random order. The dyspnea rating was recorded before and immediately after each condition (quite breathing, diaphragmatic breathing, and diaphragmatic breathing plus pursed-lips breathing) by using the modified Borg scale (0-10 points, with 0, no dyspnea; and 10, maximum dyspnea).²¹ Oxygen saturation and heart rate were continuously assessed during the data collection by using the pulse oximeter. A minimum interval of 10 min between the conditions was given to allow the return of clinical parameters (heart rate, breathing frequency, and dyspnea) to baseline value.

Outcome Variables

The breathing pattern variable analyzed were chest wall tidal volume, end-inspiratory chest wall volume, end-inspiratory rib-cage volume, end-inspiratory abdomen volume, end-expiratory chest wall volume, end-expiratory rib cage volume, end-expiratory abdomen volume, minute ventilation, breathing frequency, inspiratory time, expiratory time, and duty cycle. The chest wall motion variables analyzed were pulmonary rib cage percentage contribution, abdominal rib cage percentage contribution. The phase angle that reflects the delay between the excursion of the compared compartment, the inspiratory phase ratio, the expiratory phase ratio that expresses the percentage of time in which the compartment move in opposite direction during the inspiration and during expiration respectively.²² Perception of dyspnea was assessed by using the modified Borg scale.²¹

Result:-

Initially, 15 participants with emphysema were selected to participate in the study; the demographic, anthropometrics, and clinical characteristic of the participant are shown in the table 1. The sample was composed of subject with moderate to severe emphysema. The breathing pattern data during quite breathing, diaphragmatic breathing, and diaphragmatic breathing plus lips breathing are presented in Table 2. Both breathing exercise promoted significant increases in chest wall tidal volume and end-inspiratory volume of the chest wall and its compartment compared with quiet breathing.

A significant decrease in the breathing frequency and a significant increase in inspiratory time and expiratory time were observed for diaphragmatic breathing and diaphragmatic breathing plus pursed-lip breathing when compared with quiet breathing. From diaphragmatic breathing to diaphragmatic breathing plus pursed lip breathing, a significant increase in the breathing frequency. With respect to the duty cycle, a significant decrease was observed during diaphragmatic breathing plus pursed-lips breathing when compared with quiet breathing and with diaphragmatic breathing.

Table 1:- Characteristic of the participants.

S.No	Characteristics	Value
1.	Male sex, %	77
2.	Age, mean \pm SD Y	60 \pm 7
3.	BMI, Mean \pm SD Kg/m ²	21.0 \pm 2.0
4.	Smoking history, mean \pm SD packs/y	55.3 \pm 30.2
5.	PEV ₁ /FEC, mean \pm SD	0.4 \pm 0.1
6.	FEV ₁ mean \pm SD % predicted	29.5 \pm 8.5
7.	MRC score mean \pm SD arbitrary unit	2.2 \pm 0.7
8.	P _{I_{max}} mean \pm SD cm H ₂ O	80 \pm 28.5
9.	P _{I_{max}} mean \pm SD % predicted	75.5 \pm 25.4
10.	P _{E_{max}} mean \pm SD cm H ₂ O	112.1 \pm 38.0
11.	P _{E_{max}} mean \pm SD % predicted	90.3 \pm 25.2

BMI = body mass index

MRC = Medical Research council dyspnea scale

P_{I_{max}} = maximum respiratory pressure

P_{E_{max}} = maximum expiratory pressure

The chest wall motion and asynchrony data during quiet breathing, diaphragmatic breathing and diaphragmatic breathing plus pursed lip breathing are presented in Table 3. The contribution of the abdomen compartment was >50% on the 3 conditions. A significant increase in the percentage contribution of the pulmonary rib cage was observed during diaphragmatic breathing and diaphragmatic breathing plus pursed-lips breathing compared with the quiet breathing. No other significant changes were observed among the 3 conditions for any other chest wall contribution variable.

Variable	Quiet breathing	Diaphragmatic breathing	Diaphragmatic breathing combined with pursed lip breathing	P
Chest wall motion				
Pulmonary rib cage % contribution	20.0 \pm 5.5	21.2 \pm 4.9	28.2 \pm 6.0	.01
Abdominal rib cage % contribution	10.5 \pm 3.2	11.8 \pm 8.2	10.2 \pm 8.2	.58
Abdomen % contribution	52.4 \pm 9.2	58.5 \pm 8.8	55.6 \pm 12.4	.20
Asynchrony				
Rib cage \times abdomen phase angle, degree	11.0 \pm 8.2	18.0 \pm 9.4	19.1 \pm 10.2	.10
Pulmonary rib cage \times abdominal rib cage, phase angle, degree	8.9 \pm 6.1	11.5 \pm 9.2	15.4 \pm 8.3	.07
Inspiratory phase ratio rib cage \times abdomen %	11.2 \pm 6.0	29.0 \pm 15.4	25.4 \pm 12.4	<.001
Inspiratory phase ratio pulmonary rib cage \times abdominal rib cage %	10.5 \pm 3.2	18.2 \pm 7.1	18.3 \pm 6.7	<.001
Expiratory phase ratio rib cage \times abdomen %	5.7 \pm 3.1	16.5 \pm 8.7	16.8 \pm 9.2	<.001
Expiratory phase ratio pulmonary rib cage \times abdominal rib cage %	11.0 \pm 4.9	20.1 \pm 8.5	20.1 \pm 7.2	<.001

For the asynchrony variable, no significant differences were observed for the phase angle among the 3 conditions. Whereas the significant increase was observed in the inspiratory phase ratio and expiratory phase ratio between all analyzed compartment during diaphragmatic breathing and diaphragmatic breathing plus pursed-lips breathing compared with quiet breathing, without differences between the breathing exercises. During diaphragmatic

breathing and diaphragmatic breathing plus pursed-lips breathing, the participant shows the significant increase in oxygen saturation compared with quiet breathing.

Discussion:-

The main result of the study were the following: (1) The diaphragmatic breathing and the diaphragmatic breathing plus pursed lips breathing resulted significant increase in chest wall tidal volume compared with quiet breathing, (2) there was no difference in the abdominal contribution among the condition (quiet breathing, diaphragmatic breathing and diaphragmatic breathing plus pursed-lip breathing), (3) there were a significant increase in chest wall asynchrony during breathing exercise, (4) there were no change in dyspnea among the evaluated condition, (5) significant decrease were observed in breathing frequency for both breathing exercise, and (6) diaphragmatic breathing and pursed-lips breathing provided greater changes in breathing parameters, especially for time variables.

The increase in chest wall tidal volume during the breathing exercise were due to significant increases in end-inspiratory rib- cage volume and end-inspiratory abdomen volume, without changes in the end-expiratory chest wall volume. Other study also reported significantly increases in tidal volume during diaphragmatic breathing and during pursed-lips breathing when performed separately. The increase the tidal volume associated with the increase in the end inspiratory chest volume indicates that the subject were able to recruit the inspiratory reserve volume. The same result was observed in a specific group of subject with emphysema who also presented significant increases in tidal volume but no change in the end-expiratory volume. Those subject were considered “responders” to the diaphragmatic breathing were less hyper inflated, had grater inspiratory muscle strength, and presented more synchronous chest wall motion during diaphragmatic breathing.

During the pursed lips breathing, the end expiratory chest wall volume is important, once there is an increase in the expiratory time associated with the reduction of the breathing frequency that may contribute to the reduction of this volume. The effect of pursed lips breathing on expiratory chest wall volumes are not constant because studies demonstrated different effect, such increase, decrease, or no changes, in this volume in subject with emphysema.

With regard to chest wall motion, although both breathing exercise duplicate the tidal volume in relation to quiet breathing, there was no increase in the contribution of the abdominal compartment. It is known that subject with emphysema have diminished diaphragmatic motion and a lower diaphragmatic excursion,²³ and, depending on the severity of these alteration, this may interfere the response to diaphragmatic breathing. Moreover, the subject had a great contribution, of 60%, of the abdomen while they are in sitting position at quiet breathing, similar to finding, who also observed a 60% abdomen contribution in male participant with emphysema while in the setting position at rest. Therefore, it is possible that there was a limitation in the response of the diaphragmatic breathing performed by these subjects. The inclusion of the pursed-lips breathing also did not alter the chest wall motion. Some studies that assessed the effect of pursed-lips breathing showed a similar increase in the tidal volume in both the rib cage and the abdomen; however, the contribution of the compartment to the chest wall was not analyzed.

Although there was a decrease in the breathing frequency and an increase in oxygen saturation during both breathing exercise, no significant difference were observed in dyspnea. The effectiveness of diaphragmatic breathing and pursed-lips breathing in relieving dyspnea varies greatly among subject with emphysema. With regard to diaphragmatic breathing, some studies report increase in dyspnea and suggest that the activity of the other respiratory muscle beyond the diaphragm and the chest wall asynchrony could be responsible. There is found an increase in the recruitment of inspiratory accessory muscle during pursed lip breathing, which would be associated with the increase in dyspnea. However, regardless of the level of pulmonary hyperinflation, the increase in expiratory time and total time provided by pursed lips breathing decrease dyspnea. The subject in our study presented a low level of dyspnea during quiet breathing, according to the modified Borg scale score.

Both breathing exercises promoted a decrease in the breathing frequency due to the increase of inspiratory time and expiratory time. In addition, the result of this study has important clinical implication for symptoms management in individual with emphysema. The assessed breathing exercise was demonstrated to improve chest wall volumes and oxygenation, and to reduce breathing frequency without increasing dyspnea. Therefore this exercise might be helpful for individuals who feel anxious and tense when it is difficult to breathe, as well as individual trying to manage sudden emphysema symptoms. The exercise may play a role in care and symptoms management, and thus may be taught in pulmonary rehabilitation and nursing care programs, and be included in routine care of individual with emphysema.

Conclusion:-

Our result showed that diaphragmatic breathing and diaphragmatic breathing plus pursed lips breathing improved chest wall volume and oxygenation as well as reduced the breathing frequency, which provided more volume hematosis without increasing dyspnea. The addition of pursed-lips breathing to diaphragmatic breathing provided greater changes in breathing parameters, especially in relation to time variables. Therefore, this study supported the positive acute effect of this breathing exercise for subject with emphysema. These breathing exercise are low cost and do not require special instrumentation or continuous assistance for a health care provider, which can improve adherence of the patient to their routine.

References:-

1. Page 64 in: Adrian Shifren (2006). The Washington Manual Pulmonary Medicine Subspecialty Consult, Washington manual subspecialty consult series. Lippincott Williams & Wilkins. ISBN 9780781743761.
2. Saladin, K (2011). Human Anatomy (3rd ed.) McGraw-Hill. P.650. ISBN 9780071222075.
3. Murphy, Andrew; Danaher, Luke. "Pulmonary Emphysema". Radiopaedia.org. Retrieved 16 August 2019.
4. Algusti, Alvar G.; et al. (2017). "Definition and overview". Global Strategy for the Diagnosis, management and prevention of COPD. Global initiative for Chronic Obstructive Lung Disease (GOLD). P. 5-17.
5. Roversi, Sara; Corbetta, Lorenzo; Clini, Enrico (5 May 2017). "GOLD 2017 recommendations for COPD patients: toward a more personalized approach" (PDF). COPD Research and practice. 3. Doi; 10.11186/s40749-017-0024-y.
6. Diedra Henderson (2014-12-16). "Emphysema on CT without COPD predicts Higher Mortality Risk". Medscape.
7. ^{a b c d e f} Kumar, V (2018). Robbins Basic Pathology. Elsevier. Pp. 498-501. ISBN 978032335317.
8. Takahashi, M; Fukuoka, J (2008) "imaging of pulmonary emphysema: a pictorial review". International Journal of chronic obstructive pulmonary disease. 3(2): 193-204. Doi; 10.2147/COPD.S2639.PMC 2629965. PMID 18686729.
9. ^{a b} Smith, B (January 2014). "Pulmonary emphysema subtypes on computed tomography: the MESA COPD study". Am J med. 127(1): 94.e7-23. Doi: 10.1016/j.amjmed.2013.09.020. PMC 3882898. PMID 24384106.
10. ^{a b} Weerakkody, Yuranga. "Panlobular emphysema/ Radiology Reference article/ Radiopedia.org". Radiopedia. Retrieved 22 May 2019
11. ^{a b} "chest". Radiology assistant. Retrieved 20 June 2019.
12. Mosenifar, Zab (April 2019). "Chronic obstructive pulmonary disease (COPD)". Emedicine. Medscape. Retrieved 25 July 2019.
13. Dechman G, Wilson CR. Evidence underlying breathing retraining in people with stable chronic obstructive disease. Phys Therapist 2004;84(!@):1189-1197.
14. Jones A Y, Dean R, Chow CC. comparison of the oxygen cost of breathing exercise and spontaneous breathing in patient with stable chronic pulmonary disease. Phys ther 2003;83 (5): 424-4321.
15. Gosselink R. breathing techniques in patients with chronic obstructive pulmonary disease (COPD). Chronic reparatory disorder 2004: 1(3): 167-172.
16. Cahalin LP, Braga M, Matsuo Y, Hernandez ED. Efficacy of diaphragmatic breathing in person with chronic obstructive pulmonary disease: a review of the literature. J cardiopulmonary rehabilitation 2002;22(1): 7-21.
17. Visser FJ, Ramlal S, Dekhuizen PN, Heijdra Y. Purse lip breathing improves inspiratory capacity in chronic obstructive pulmonary disease. Respiration 2011;81(5);372-378.
18. Dechman G, Wilson CR. Evidence underlying breathing retraining in people with stable chronic obstructive pulmonary disease. Phys Ther 2004;84(12):1189-1197.
19. Vitacca M, Clini E, Bianchi L, Ambrosino N. Acute effect of deep diaphragmatic breathing in COPD and emphysema patients with chronic respiratory insufficiency. Eur Respiratory J 1998;11(2):408-415.
20. Spahija J, De Marchie M, Grassino A. Effects of imposed pursed-lips breathing on respiratory mechanics and dyspnea at rest and during exercise in COPD. Chest 2005;128(2):1812-1819.
21. Johnson MJ, Close L, Gillon SC, Malassiotis A, Lee PH, Farquhar MC, Breathlessness research interest Group (BRIG).use the modified Borg scale and numerical rating to measure chronic breathlessness: a pooled data analysis. Eur respiratory J 2016;47(6):1861-1864.
22. Cancelliero- Gaiad KM, Lke , Pantoni CB, Borghi-Silva A, Costa D. Respiratory pattern of diaphragmatic breathing and pilates breathing in COPD subject. Braz j physical Therapist 2014;18(4):291-299.
23. Dos Santos Yamaguti WP, Paulin E, Shibao S, Chammas MC, Salge JM, Ribeiro M, et al.air trapping: the major factor limiting diaphragm mobility in chronic obstructive pulmonary disease patients. Respirology 2008;13(1):138-144.