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"Peak expiratory flow rate: Effect of body positions in patients with chronic obstructive pulmonary disease."

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Abstract:

Background: This study aimed to distinguish which position generates higher peak expiratory pressure. And provide framework for clinical decision making in the management of patient with COPD with special emphasis on body positions. Study was performed with two groups that is group I & II. (COPD & non COPD subjects) selected for the study. PEFR measured with explanation in eight different positions (Standing, Forward bend sitting, Chair sitting, Recline sitting, Supine lying, Side lying (right), Side lying (left), Head down.) In each position three reading taken out of three best one was taken for the study.

Results: In normal subject standing PEFR (437 ± 16 L / min) and head down PEFR (371 ± 15 L /min) were significantly reduced than all other positions. In COPDs standing PEFR (189 ± 8 L / min) & head down PEFR (130± 6L /min) were significantly reduced than all other positions. Body position has significant effect on peak expiratory flow rate in patients with chronic obstructive pulmonary disease and normal subjects. Generally, the more upright position, the higher peak expiratory flow rate .There was strong correlation between PEFR & body position.

Conclusion: Patients should encourage adapt more upright position to maximize the strength of coughing & huffing.

Key words: COPD, PEFR, Body position, Peak flow meter.

INTRODUCTION:

Patients with chronic obstructive pulmonary disease (COPD) often exhibit flow limitation that may cause dynamic pulmonary hyperinflation.[1] Patients with severe chronic obstructive pulmonary disease (COPD) often exhale along the same flow-volume curve during quiet breathing as during a forced expiratory vital capacity maneuver, and this has been taken as indicating flow limitation at rest.[1,3]

COPD is characterized by reduced FEV1 and PEFR.[2]

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Serial spirometry is important in assessing the rate of declining of FEV1. [3] Peak expiratory flow rate is the maximum rate of airflow that can be generated during forced expiratory maneuver starting from total lung capacity [4,12]. The simplicity of the method is its main advantage. It is measured by using a standard Wright Peak Flow Meter or mini Wright Meter [5].

With this background in consideration, present study was planned to study the effect of body position on peak expiratory flow rate in patients with chronic obstructive pulmonary disease.

Materials & Methods:

Patients with diagnosed COPD (FEV1/FVC) 50 to 60 % i.e. moderate obstruction) were included in present study. Normal subjects who were willing (voluntary) to participant in the study included as control in age rage 35 to 65 years from routine OPD from Department of Medicine. The subjects were excluded with having any diseases of cardiac origin, Neurological condition involving respiratory muscles or diaphragm, History of recent thoracic surgery or abdominal surgery, history of dyspnea at rest, musculoskeletal injuries to the chest wall etc.

All the subjects participating in the procedure were informed with the proper details of apparatus and test protocol and sign informed consent have been taken, prior to undergoing procedure. Afterwards detail clinical examination was done with proper history prior to testing. The subjects were informed to blow Fast Hard Blast rather than Slow Blowing until they had emptied out nearly all of the air from their lungs. The test was performed in eight different body positions as follows. Before each use the sliding marker or arrow on the peak flow meter was at the bottom of the numbered scale (i.e. zero on the scale).

- **Standing:** The subjects were allowed to adopt comfortable stance.
- **Chair sitting:** The subjects sat in the chair with no arm rest and were instructed not to slouch forward OR lean to either side. Chair with back support at 90 degree was taken.
- **Recline sitting** : The subjects were positioned on a padded plinth, the top part of which was positioned at 45 degree angle (approx). The subjects sat with their hip the bend at the plinth and the upper body resting back on a segment of plinth that is angled. This meant that the upper body forms an angle of approximately 135 degree with legs.
- **Forward bend sitting:** the subjects sat on a chair bending forward with support of pillow.
- **Supine:** the subjects took position of lying on back on a padded plinth with knees extended. A pillow was placed under the head.
- **Side lying (right):** the subjects were positioned lying on the right side on padded plinth. The hips were flexed at 45 degree and knees were at 45 degree. A pillow was placed under the head.
- **Side lying (left):** the subjects were positioned lying on the left side on padded plinth. The hips were flexed at 45 degree and knees were at 45 degree. A pillow was placed under the head.
- **Head down**: The subjects were positioned as for the right side lying position on a padded plinth. The head end of plinth was lowered with the help of wooden blocks at approximately 25-30 degrees.

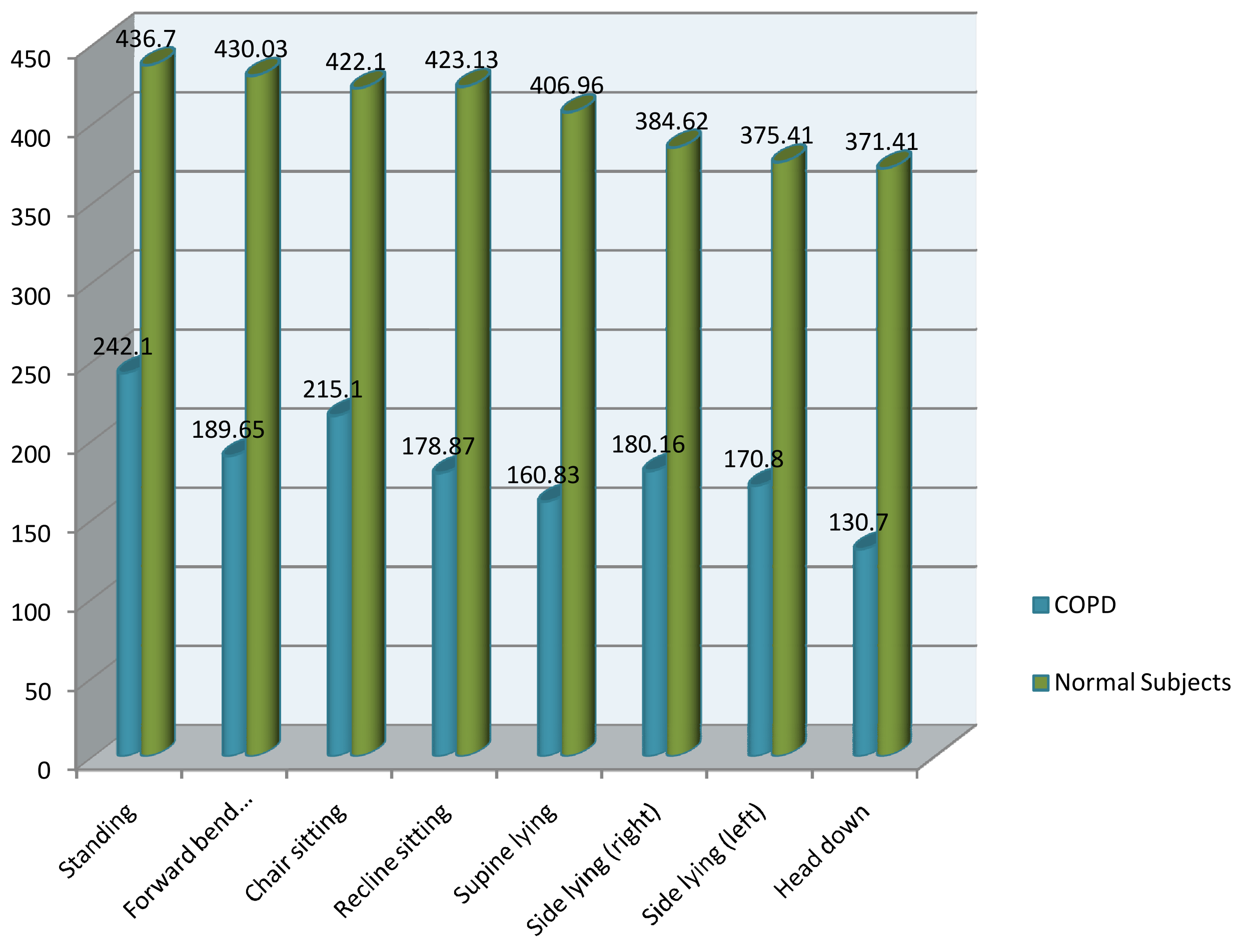
Each subject attended one session lasting approximately for one hour. Each subject was placed randomly in any one position and allowed to rest in this position for five minutes. Following this the subjects performed the three sets of test with as much as rest desired by subjects between each trial. After completing the test, the subjects moved into the next randomly assigned position. They were again given five minutes to rest procedure. This process was continued until peak expiratory flow rate is taken in all above mentioned positions

DATA ANALYSIS AND INTERPRETATION:

Table 1: Mean PEFR in different positions of the study population

POSITIONS	MEAN PEFR(COPD)	MEAN PEFR (Norma subject)
Standing	242.10	436.7
Forward bend sitting	215.10	430.03
Chair sitting	189.65	422.10
Recline sitting	178.87	423.13
Supine lying	160.83	406.96
Side lying (right)	180.16	384.62
Side lying (left)	170.80	375.41
Head down	130.70	371.41

Table 1 shows that Standing position generated highest mean PEFR than all other positions and head down position generated lowest PEFR than all other position in both groups.



Results: Peak expiratory flow rate achieved by normal subjects were significantly affected by body positions. In normal subject standing position PEFR (437 ± 16 L / min) It is higher than all positions and head down which were significantly reduced than all other positions.

In COPDs standing position PEFR Which is higher than all other positions .(all $p < 0.0001$)& head down(130 ± 6 L /m) were significantly reduced than all other positions.($p < 0.0001$) Showing extremely significant.

Body position has significant effect on peak expiratory flow rate in patients with chronic obstructive pulmonary disease. Generally, the more upright position, the higher peak expiratory flow rate..There was strong correlation between PEFR & body position.

Discussion: Various mechanisms contribute the symptoms in COPD patients. Positioning can be specifically directed at the mechanism underlying pulmonary dysfunction wherever possible. Such approach will maximize the efficacy of positioning patients with pulmonary dysfunction to enhance the outcome of medical management overall [6]

(Rubine 1988). Changes in body positions significantly affected PEFR. This can be attributed to the pathology seen in patients (loss of lung elasticity, narrowed airway, mechanical disadvantage of respiratory muscle, changes in muscle fiber type in respiratory muscle) generally as subject becomes more recumbent, the ability to generate PEFR is diminished. Conversely as the subject is moved to less recumbent position, PEFR is improved. Alteration in the body position may allow more effective secretions clearance, which may be especially useful for those patients demonstrating suboptimal coughing or huffing.[5,7]

In our study standing generated significantly higher PEFR (242.10L/min). same findings showed by (Charbel & Mark) standing has been shown to lead to the highest lung volume and next to standing upright sitting resulted in the highest lung volume At higher lung volumes there is greater elastic recoil of the lungs and chest wall and expiratory muscle are at a more optimal part of length tension relationship curve and thus are capable of generating higher expiratory flow (J.E.Haffe). Muscle length may have become less optimal as the lung volume decreased, hence the lower PEFR in sitting than standing and further decrease seen in the other positions.[8,9]

In our study Second, unlike position such as head down (130.07) and supine((160.83) almost near results showed by (Ross & Dean), the bases of lungs are not compressed by the weight of the heart and abdominal content. This allows the alveoli that have been compressed, to reopen and increase the lung compliance. The inspiratory muscles are able to expand the unrestricted thorax in all direction As a result, diaphragm is able to contract even further caudally and thus increase lung volumes.[8,9]

During forced expiration in standing, the greater recoil of lung and chest wall combined with higher pressure generated by abdominal contractions. This combined action pushes the air at high speed through the narrowing airways resulting in higher PEFR. Other factors that may have influenced the result in standing position could include patients comfort, a higher arousal level and the increase in neural drive to breath in the upright position.[10,11]

Forward bending sitting generate more PEFR than chair sitting. The explanation for this is that, in patients with respiratory diseases, there is dysfunction of primary respiratory muscle, especially inspiratory muscle. So that they have to depend on accessory muscle of respiration to generate adequate lung volume [10,11]

When compaired right side lying (180.16) and left side lying,(170.8) right side lying generated higher PEFR value. This can be attributed to larger size of right lung, reduced compression of heart on lung in this position compared with left side lying and unilateral or bilateral lung pathology.The head down position had the lower mean PEFR. Clinically this position is used in specific situation, such as gravity assisted drainage of basal segment of lungs.

The biomechanics of side lying position in the head down position need to be considered. The side lying position allows the abdominal contents to fall forward. The dependent hemi diaphragm is stretched to a good length for tension generated, while non-dependent hemi diaphragm is more flattened. The changes in lung volume may thus balance themselves., however, the head down position means that some of the abdominal contents that had fallen forward (in side lying) now rest on diaphragm. This acts to reduce lung volume, by decreasing the ability of the diaphragm to flatten and because of that diaphragmatic fibre may be stretched to a better length.[2,6,15]

The purpose of the study was to provide framework for clinical decision making in the management of patients with COPD with special emphasis on body positioning. In addition physiological and scientific rational for use of body positioning as primary intervention in remediating respiratory impairment will maximize physiotherapy efficacy.

(Ross& Dean 1989)

Conclusion:

Body position has significant effect on peak expiratory flow rate in normal subjects and patients with chronic obstructive pulmonary disease. This study suggests that patient should place more upright positions while removing secretions from larger airways.

References:

1. Potter WA, Olafsson S, Hyatt R. Ventilatory mechanics and expiratory flow limitation during exercise in patient.s with obstructive lung disease. 1971; 50: 910–919.
2. Rossi A, Gottfried SB, Zocchi L, et al. Measurement of static compliance of the total respiratory system in patients with Chronic Obstructive Pulmonary Disease. 1985; 131: 672–677.
3. Am. J. Respir. Wiley-Liss, Inc ,Crit. Care Med., Pulmonol Volume 163, Revised: 8 May 2005; Accepted: 1 June 2005
4. Hyatt RE. The interrelationship of pressure, flow and volume during various respiratory maneuvers in normal and emphysematous patients. 1961; 83: 676–683.
5. Appendini L, Potassio A, Zanaboni S, et al. Physiologic effects of positive end-expiratory pressure and mask pressure support during exacerbations of chronic obstructive pulmonary disease. Am J Respir Crit Care Med 1994; 149: 1069–1076.

6. Pride N, Macklem PT. Lung mechanics in disease. PT,. The Handbook of Physiology. Section 3. Bethesda, American Physiological Society, 1986; pp. 659–692.
7. O'Donnell DE, Sanii R, Anthonisen NR, Younes M. Effect of dynamic airway compression on breathing pattern and respiratory sensation in severe chronic obstructive pulmonary disease. Am Rev Respir Dis 1987; 135: 912–918.
8. D'Angelo, E., E. Prandi, L. Marazzini, and J. Milic-Emili. . Dependence of maximal flow-volume curves on time course of preceding inspiration in patients with chronic obstruction pulmonary disease,1994.
9. Inspiratory Maneuver Effects on Peak Expiratory Flow,.American Journal of Respiratory and Critical Care Medicine, 2140 , Vol 156, 1997
10. Anne E Holand, Brend M Button (2006). Expiratory flow limitation during exercise in patients with obstructive lung disease.
11. Haluszka J, Chartrand DA, Grassino AE, Milic-Emili J. Intrinsic PEEP and arterial PCO2 in stable patients with chronic obstructive pulmonary disease. 990; 141: 1194–1197.
12. E. Tzelepis, M.D., Onassis Cardiac Surgical Ctr, American journal of resp. and critical care medicine. 1997,GR 176 74, 156 ,
13. N.G.Koulouris, P. Valta, A. Lavoie, C. Corbeil, M. Chassé, J. Braidy, J. Milic-Emili. ERS.Journals Ltd Eur. Respir. J 1995., 8, 306–313
14. Aldrich TK, Hendler JM, Vizioli LD, Park M, Multz AS, Shapiro SM. Intrinsic positive end-expiratory pressure in ambulatory patients with airways obstruction. 1993; 147: 845–849.
15. Ingram RH Jr, Schilder DP. Effect of gas compression on pulmonary pressure, flow, and volume relationship. Appl Physiol 1966; 21: 1821–1826.
16. Fairshter RD. Airway hysteresis in normal subjects and individuals with chronic airflow obstruction. J Appl Physiol 1985; 58: 1505–1510.
17. Am. J. Respir. Crit. Care Med., Detection of Expiratory Flow Limitation by Manual Compression of the Abdominal Wall Volume 163, Number 6, May 2001, 1326-1330.

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