Effect of Abdominal Binder on Physiological Cost Index in Chronic Obstructive Pulmonary Disease

Sir,

Chronic obstructive pulmonary disease (COPD) is the major cause of mortality in India. Lung hyperinflation is a classic sign caused by incomplete emptying of the lung which flattens the diaphragm placing it at mechanical disadvantage, making the accessory muscles of respiration work more. Therefore, the oxygen cost of breathing increases several folds.[1] Activities such as walking also abnormally elevate oxygen consumption in these patients. They present with reduction in walking intensity and self-selected walking speed. Abdominal binder has been found to optimize the respiratory mechanics by reducing the biomechanical work of breathing and improving the ventilatory muscle efficiency. Thus, the therapeutic intervention can improve walking deficits and oxygen consumption. Hence, this study aims to test the use of abdominal binder on oxygen cost by studying physiological cost index (PCI).

This crossover study was carried out in an outpatient department of pulmonology setup of a tertiary care hospital after obtaining ethical approval from local ethics committee. Patients (n = 24) were recruited on the basis of Stage 2 and 3 COPD according to GOLD criteria and their ability to ambulate without any external aid. Those who had any musculoskeletal, neurological, and cardiac condition which hindered their ambulation, patients on oxygen support, and hemodynamically unstable patients were excluded from the study. Written informed consent was taken from patients willing to participate in the study. They were taught and made to perform diaphragmatic breathing exercise. Heart rate (HR) was recorded at rest by radial palpatory method. Later, patients were asked to walk on a 15-m level surface for 2 min. Distance covered and HR were recorded at the end of 2 min. Then, patients were seated comfortably for 30 min and resting HR was noted at the end. After performing the same breathing exercise, elastic abdominal binder was applied in sitting position during normal breathing with the upper edge of the binder below the costal margin so that it would interfere minimally with the rib cage movement. Then, patients were asked to walk with abdominal binder for 2 min and distance covered and walking HR was assessed at the end. Distance walked was noted as to calculate the speed of walking by the formula: distance (m)/time (min). Primary outcome used was PCI (beats/m), which was calculated by the formula:

$$\frac{\text{Walking heart rate (bpm)} - \text{Resting heart rate (bpm)}}{\text{Speed of walking (meters / min)}}$$

Data analysis was done using the SPSS software. Two-tailed paired t-test was done to examine the difference in measurements of PCI, change in HR, walking speed, and walking distance. The level of significance for the statistical test was set at $P \leq 0.05$. All 24 patients included, completed the study. The baseline characteristics of whom are mentioned in Table 1. Abdominal binder had no significant effect on PCI ($P = 0.255$). Moreover, it also had no significant effect on change in HR ($P = 0.494$). However, with abdominal binder, there was a significant improvement in speed of walking ($P = 0.0001$) and distance covered in 2 min ($P = 0.0001$) mentioned in Table 2.

Flattening of diaphragm and loss of zone of apposition have been found to be independent predictors of reduced walking distance in 6-min walk test.[2] The improvement in speed of walking is due to the fact that abdominal binder increases the intra-abdominal pressure and displaces the diaphragm cranially, enhancing its force-generating capacity by lengthening it. Hence, it contracts at an effective length-tension relationship, thus initiating the inspiratory contraction at a more favorable length. It also increases lower rib cage expansion by increasing the zone of apposition. This off-loads the accessory muscles of respiration to some extent and shifts tidal breathing to lower lung volumes.[3] This may reduce the ventilatory demand during

Table 1: Demographic data (n=24)

Characteristic	Mean±SD
Age (years)	60.54±12.36
FEV1/FVC (percentage predicted)	65±6.69
FEV1 (percentage predicted)	55±15.96

SD: Standard deviation, FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1 s

Table 2: Mean±standard deviation and P value of the parameters measured (n=24)

	Without abdominal binder	With abdominal binder	P
PCI (beats/m)	0.3433±0.20	0.3092±0.12	0.255
Change in HR (walking HR - resting HR)	12.20±6.05	12.83±4.75	0.494
Speed of walking (m/min)	37.50±6.52	42.37±7.14	0.0001*
Distance walked in 2 min (m)	75±13.04	84±14.29	0.0001*

*P<0.05 which indicates significant difference. PCI: Physiological cost, HR: Heart rate

walking leading the patient to increase the self-selected speed of walking to cover more distance in a fixed time of 2 min. The potential explanation for lack of significant difference between the changes in HR (walking HR − resting HR), may be because a lesser load is placed on ventilatory system in 2-min walk test which is insufficient to evoke a significant hemodynamic response in patients with COPD.[4] Although this study is limited by a small sample size, the result highlights the benefit of an abdominal binder in COPD patients when used as an adjunct to conventional therapies, as they are able to walk faster and cover greater distance in a particular time period with an external support to their abdomen. As these patients often show impaired walking performance, abdominal binder, an external aid with a relatively low cost, could be used as an adjunct to conventional therapies in keeping these patients more active and independent.

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Conflicts of interest

There are no conflicts of interest.

Chaitali Kadam, Raziya Nagarwala[1], Rachana Dabadghav[2], Ashok Shyam[3], Parag Sancheti[4]

MPT Student, Sancheti College of Physiotherapy, [1]Department of Cardiovascular and Respiratory PT, Sancheti college of Physiotherapy, [2]Research Co-ordinator, Sancheti College of Physiotherapy, [3]Research Officer, Sancheti Institute of Orthopedics and Rehabilitation, [4]Chairman, Sancheti Institute of Orthopedics and Rehabilitation, Pune, Maharashtra, India

Address for correspondence: Dr. Raziya Nagarwala, Sancheti College of Physiotherapy, 11/12, Thube Park, Shivajinagar, Pune - 411 005, Maharashtra, India.
E-mail: rnagarwala@yahoo.com

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People's Health: It Matters on YouTube Channel: Citizen Health

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- You can reach us by writing at academia.iapsm@gmail.com or can directly contact Ms. Reetu (7800009733) for further details.