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Case Report

Bendopnea and COPD in Stable Phase

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ABSTRACT

Bendopnea is defined as dyspnea that occurs with anterior flexion of the trunk, such as when putting on shoes. In patients with Chronic Obstructive Pulmonary Disease (COPD), particularly those with severe airflow obstruction and thoracic insufflation, anterior flexion may hypothetically increase lung insufflation and produce dyspnea during this maneuver, referred to as bendopnea.

This study aimed to investigate the possible relationship between bendopnea, the degree of bronchial obstruction, thoracic insufflation and quality of life in COPD patients during a stable phase.

A total of 45 COPD patients in a stable phase were prospectively studied. They underwent simple spirometry to assess thoracic volumes, completed the Chronic Obstructive Pulmonary Disease Assessment Test (CAT) and participated in a bendopnea test.

The results revealed a significant relationship between baseline dyspnea and bendopnea. However, no relationship was found between bendopnea and the degree of bronchial obstruction, degree of thoracic insufflation, or desaturation during the maneuver. An almost significant relationship was noted between Forced Vital Capacity (FVC) and quality of life in relation to bendopnea.

In conclusion, there is no relationship between bendopnea and the severity or degree of thoracic insufflation in COPD patients during a stable phase.

However, a relationship exists between bendopnea and baseline dyspnea, with an almost significant correlation between thoracic restriction and quality of life in these patients.

Keywords: COPD, Bendopnea, Lung inflation, Dyspnoea, FVC

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INTRODUCTION

Bendopnea is defined as dyspnea that occurs with anterior flexion of the trunk, such as when putting on shoes. This sign is typically associated with severe systolic cardiac dysfunction in patients with heart failure classified as New York Heart Association (NYHA) Grade 3 and 4. It results from increased left ventricular filling pressure, a pathological increase in pulmonary capillary pressure PCP ≥ 22mm Hg and a decrease in cardiac index to less than 2.2 liters/min/m² during this maneuver (Thibodeau JT, *et al*., 2014).

In patients with COPD, particularly those with severe airflow obstruction and thoracic insufflation, anterior flexion of the trunk may hypothetically increase lung insufflation and produce dyspnea.

Additionally, in obese patients with an increased abdominal perimeter, the abdominal contents can be projected toward the thorax during the anterior flexion maneuver, reducing diaphragmatic mobility and consequently leading to bendopnea.

Based on these considerations, we conducted a study on patients with COPD in a stable phase with the following objectives: To assess the relationship between bendopnea, the degree of bronchial obstruction, air trapping (thoracic insufflation), baseline dyspnea, transcutaneous O_2 desaturation during this maneuver, abdominal circumference and the degree of O_2 desaturation during the six-minute walk test.

LITERATURE REVIEW

Patients and methods

A cohort of 45 patients with COPD in a stable phase was prospectively studied, all of whom were receiving bronchodilator treatment according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria (Baeza Trinidad R, *et al*., 2017). Patients diagnosed with structural cardiac pathology were excluded based on the following criteria: An echocardiogram showing a left ventricular ejection fraction equal to or greater than 50%, absence of valvular disease and a normal N-terminal pro-B-type Natriuretic Peptide (proBNP) blood level.

Each patient underwent several assessments, including spirometry with plethysmography measuring FVC, Forced Expiratory Volume (FEV1) in 1 second, Residual Volume (RV), RV/Total Lung Capacity (TLC) and Inspiratory Capacity/TLC, a six minute walk test, a bendopnea test, quantification of abdominal perimeter in cm, assessment of dyspnea using the Medical Research Council (MRC) scale and evaluation of health-related quality of life using the CAT. The CAT is a self-administered, standardized questionnaire designed to assess the quality of life in COPD patients. It consists of eight items measuring cough, expectoration, chest tightness, dyspnea, domestic activities, self-confidence, sleep and energy. Each item is scored from 0 best to 5 worst, resulting in an overall score ranging from 0 to 40 points. A higher score indicates greater deterioration in health status or poor COPD control: Low impact ≤ 10, moderate impact 11-20, high impact 21-30 and very high impact 31-40.

To conduct the bendopnea test, patients were instructed to flex their trunk while seated, bringing their upper limbs toward their feet. They remained in this position until dyspnea appeared or for a maximum of 30 seconds. Changes in O_2 saturation were quantified while sitting and during this maneuver.

The results are expressed as medians with 25th-75th percentiles.

STATISTICAL ANALYSIS

For statistical analysis, the Mann-Whitney U test was used.

RESULTS AND DISCUSSION

The clinical and demographic characteristics of the patients studied are summarized in *Table 1*. A significant relationship was found between the presence of bendopnea and baseline dyspnea p:0.03 (*Figure 1*).

Table 1: Clinical and demographic characteristics of patients based on bendopnea

Parameter	Bendopnea No (n=20)	Bendopnea Yes (n=18)	p-value
Age (years)	70 ± 8,9	72 ± 7,0	0,67
GOLD	3 ± 0,8	3 ± 0,6	0,99
FVC	3 ± 0,9	2,5 ± 0,6	0,23
FVC%	74 ± 20,2	62 ± 11,1	0,07
FEV1	1,3 ± 0,49	1,2 ± 0,43	0,61
FEV1%	47 ± 16,5	45 ± 11,2	0,89
RV/TLC%	55 ± 11,3	55 ± 9,1	0,71
Distance (mt)	389 ± 182	417 ± 117	0,99
Sat. basal	96 ± 1,4	95 ± 2,3	0,40
Sat. final	92 ± 4,4	90 ± 6,4	0,24
Sat. 1 min	95 ± 3	94 ± 3	0,81
Baseline dyspnea	1.8 ± 0.99	2.1 ± 0.70	0,03*
Abdominal P (cm)	102 ± 10	105 ± 8	0,37
CAT	13 ± 7	20 ± 7	0,06

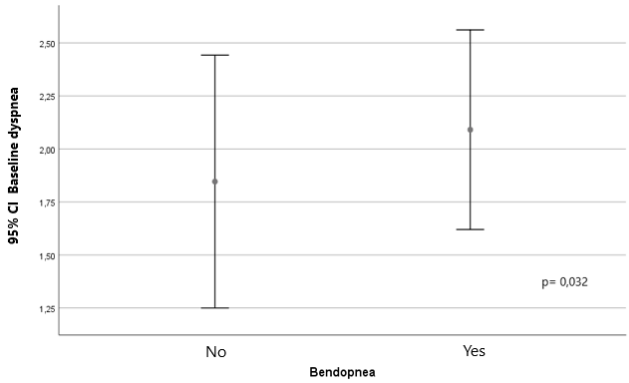

Figure 1: Relationship between bendopnea and basal dyspnea

However, no relationship was observed between bendopnea and the degree of bronchial obstruction, degree of air trapping, oxygen desaturation during the maneuver or walking test, or abdominal perimeter.

COPD patients with bendopnea exhibited a lower percentage of FVC percentage compared to those without bendopnea, although this difference did not reach statistical significance p<0.07. Similarly, patients with bendopnea had a higher CAT score compared to those without it, with this difference being almost significant p<0.06 (*Figures 2 and 3*).

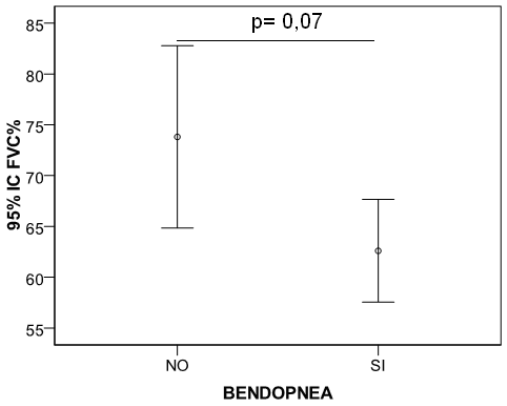

Figure 2: Relationship between bendopnea and Forced Vital Capacity (FVC) percentage

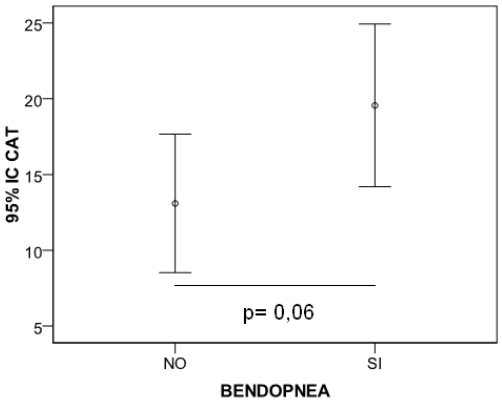

Figure 3: Relationship between bendopnea and quality of life as measured by the Chronic Obstructive Pulmonary Disease Assessment Test (CAT)

In our study, we observed a significant relationship between bendopnea and baseline dyspnea; specifically, patients with bendopnea had significantly higher baseline dyspnea than those without it. Other authors have also reported a significant relationship between dyspnea and bendopnea in patients with heart failure. This relationship may be attributed to the fact that during the maneuver, the baseline dyspnea experienced by these patients increases (Niu F, *et al*., 2017; Brandon N and Mehra MR, 2013; Thibodeau JT, *et al*., 2017).

Conversely, we found no relationship between the degree of obstruction, lung inflation, desaturation during the maneuver or six-minute walk test, or abdominal perimeter. An almost significant direct relationship was noted between quality of life as measured by the CAT and bendopnea in COPD patients; that is, patients with COPD and bendopnea had a worse quality of life. One dimension assessed by the CAT includes dyspnea and limitations in activities of daily living (Rostamzadeh A, *et al*., 2022; Halpin DM, *et al*., 2021).

Domestic activities that involve trunk flexion maneuvers such as making a bed or bending over to put on shoes can create situations similar to bendopnea, potentially justifying this almost significant association.

Additionally, we observed that COPD patients with bendopnea had a lower FVC than those without it. This could suggest a restrictive phenomenon secondary to obesity present in these patients. However, our study did not find a relationship between abdominal perimeter an indirect measure of obesity and bendopnea.

In contrast, another study involving patients with severe obstructive sleep apnea syndrome found a significant relationship between bendopnea, obesity and respiratory diseases such as COPD, asthma and heart failure (Jones PW, *et al*., 2009; Pranata R, *et al*., 2019).

CONCLUSION

In conclusion, our study identified a relationship between bendopnea and dyspnea in a population of COPD patients in a stable phase. An almost significant relationship was also found between thoracic restriction and quality of life in these patients; however, no significant associations were observed with severity, degree of air trapping (lung inflation), oxygen desaturation during the maneuver or exercise, or abdominal perimeter.

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