Research Article

A cross sectional study to assess the nutritional status of Chronic Obstructive Pulmonary Disease Patients

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) is a preventable and treatable disease, is a major public health concern. Therefore, the present study was conducted to assess the nutritional status in COPD patients by using anthropometric, biochemical and bioelectric impedance analysis. **Methods:** This cross-sectional study conducted in the Department of Pulmonary Medicine, Medical College, Thiruvananthapuram, India from March 2013 to November 2014. A pulmonary specialist diagnosed all subjects. Using revised GOLD 2011 criteria they were divided into four groups (A, B, C, D). Anthropometric and biochemical indices, body composition analyses by bioelectric impedance, spirometry test, and determination of disease severity were performed in all subjects. **Results:** A total of 435 COPD patients included 287 men (60.0%) and 148 women (34.0%), with a mean age of 60.2 (SD11.2) yr in disease stages A to D. Of all COPD patients, BMI was less than 18.5 kg/m2 for 37.9%. This Prevalence of under nutrition based on BMI was found to be statistically significant among study participants with p<0.001. Mean value of BMI, MAC, MAMC and TSF significantly lowered as the severity of COPD increased with p<0.001. Decreased mean values of FM, FMI, and FFM were significantly associated with increasing severity of COPD with p <0.001. Plasma albumin was less than 3.5 g/l among 72 (17%) patients. Total protein, less than 6 g/l was founded in 58 (13%) of patients. Plasma levels of albumin, total protein, urea, creatinine were lowered with the increase in the severity of disease. **Conclusion:** The study findings highlight the importance to consider body composition in addition to body mass index as the only criterion of malnutrition, because patients do show frequent alterations in body composition, affecting the muscle store, the fat and total body water as the disease became more severe.

Keyword: Chronic Obstructive Pulmonary Disease, malnutrition, Body mass index, bioelectric impedance analysis, Mini-nutritional assessment.

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a preventable and treatable disease, is a major public health concern [1]. Globally the morbidity and mortality of COPD are alarming increase. It is estimated to be the third leading cause of mortality and the fifth leading cause of disability by 2020 worldwide [2]. It is typified by progressive, persistent airflow limitation [3]. It occurs due to chronic inflammatory response in the airways and the lung to noxious particles or gases [4]. Exacerbations and associated co-morbidities contribute to the severity in patients [1]. Smoking is the most important cause of COPD [4]. The use of solid fuel for cooking and heating, particularly in developing countries increases the risk of COPD by three to four times [5,6]. Other important factors are air pollution, occupational smoke or dust and genetic factors [7].

Weight loss frequently occurs in patients of COPD. The reasons of loss of weight, and fat mass are

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unambiguous. Enhanced metabolic rate and decreased caloric consumption among patients may play an important role in it. Other critical factors are tissue hypoxia, release of systemic inflammatory mediators, oxidative stress, drugs, and sedentary life. The occurrence of malnutrition is lethal to COPD patients, leading to respiratory failure due to decreased respiratory muscle strength, and decreased immunity [8,9]. Malnutrition directly affects both the respiratory muscles and the lung parenchyma, thereby contributing to worsening of the underlying disease [10].

Previous studies had documented increased COPD-related mortality rates in underweight and normal-weight patients than in overweight and even obese patients [11]. Studies have shown that dietary intervention in patients with COPD increased energy intake and body weight [10,12], improved pulmonary function [13], enhanced exercise capacity and improved body composition [14]. Therefore maintenance of optimum nutritional status in patients with COPD is vital.

However, the use of body weight as the only criterion of malnutrition may lead to an underestimation. Assessment of body composition in addition total body weight is very important as normal weight or overweight patients also show muscle depletion. MAMC is a rapid indirect and quite simple to perform a method for measuring body composition, muscle mass and protein stores. Triceps skin fold thickness is an another estimate of the body's fat stores. A low TSF had documented in patients with COPD [15] and it prognostic factor. This measurement is not affected by fluid retention often seen in COPD patients, which might mask weight loss. Hence, the present study was conducted to assess the nutritional status in COPD patients by using anthropometric, biochemical and bioelectric impedance analysis.

Materials and Methods

The present study is a cross sectional study conducted in the Department of Pulmonary Medicine, Medical College, Thiruvananthapuram, India from March 2013 to November 2014. Both in patient and outpatients of COPD were included in the study. All patients were classified based on combined COPD assessment by revised Global Initiative for Chronic Obstructive Lung Disease GOLD 2011. Patients with Chronic renal failure, congestive cardiac failure, liver cirrhosis, Malignancy, Chronic kidney disease, and Presence of other pulmonary disease in addition to COPD were excluded from the present study. The sample size was estimated to be 435.

One of the most common pulmonary function tests is spirometry test. It measures lung function using a device called a spirometer. All patients took the spirometry test with a trained technician. Prior information was given to patients not to use bronchodilator on the day of pulmonary function assessment. All patients were studied in a sitting position. Data from the highest amount of flow volume curve Forced Vital Capacity (FVC) and Forced Expiratory Volume in Second (FEV1) were used for calculations. FEV1 was expressed as FEV1% predicted, based on gender, height and age, using the reference of the American Thoracic Society, and then the severity of disease in accordance to revised GOLD guidelines was determined as follows:

Stage1: FEV1/FVC<%70 and FEV1≥ %80,
Stage2: FEV1/FVC<%70 and 50%≤FEV1<80%,
Stage3: FEV1/FVC<%70 and 30%≤FEV1<50%, and
Stage4: FEV1/FVC<%70 and FEV1<30%.

The occupational history, smoking history and a detailed history of number of exacerbations in last one year, severity of disease based on spirometry, mmrc grading, CAT score was used for grouping the COPD patients in to group A, B, C, D and assessment of nutritional status was done by using anthropometric, biochemical and bioelectric impedance analysis. Body weight was measured with a beam scale to the nearest 0.1 kg with patients standing barefoot and in light clothing. Height was measured by a stadiometer in bare foot. BMI, defined as weight (kg) divided by the square of height (meters), was calculated. The Triceps Skin Fold (TSF) was measured by means of a skin fold caliper. Mid arm circumference (MAC) was measured midway between the olecranon and acromion by measuring tape, then MAMC that indicates body muscle mass was calculated as follows: MAMC= MAC-($\pi \times$ TSF).

Bioelectric impedance is a safe, noninvasive and rapid method for analyzing body composition. We analyzed body composition by FM, FFM and Total Body Water (TBW) by bioelectric impedance.

Blood samples were analyzed for albumin, total protein, blood urea, serum creatinine. Normal ranges of our

biochemistry laboratory are as follows: Albumin: 3.5-5.3g/l, total protein: 6.0-8.3g/l, blood urea: 7- 35 mg/dl and creatinine: 0.6-1.2 mg/dl.

The Institute's Ethics Committee approved the study. Informed written consent was taken from all participants before enrolling them. Data were entered in Microsoft excel spreadsheet and analyzed with SPSS version 17.0 (Chicago, IL, USA). Wherever applicable, proportions and mean (SD) were calculated. ANNOVA was used a test of significance. P value of <0.05 was considered significant.

Results

A total of 435 COPD patients included 287 men (60.0%) and 148 women (34.0%), with a mean age (SD) of 60.2(11.2) yr in disease stages A to D, participated in the study. A 292 (67.1%) were smokers with 256 (89.5%) males and 36 (24.3%) females. The subjects, based on the severity of the disease (GOLD stage) were divided into four groups. 29.2% of the COPD patients were classified in group A, 25.5% in group B, 14.5% in group C and 30.8% in group D. Of all COPD patients, BMI was less than 18.5 kg/m2 for 37.9% [17.7% in group B, 51.6% in group C and 84.3% in group D].

This Prevalence of under nutrition based on BMI was found to be statistically significant among study participants with p<0.001. Mean (SD) of anthropometric indices like BMI, MAC, MAMC and TSF of subjects according to GOLD stages are shown in Table 1. Mean value of BMI, MAC, MAMC and TSF significantly lowered as the severity of COPD increased with p <0.001 [Table 1]. The BIA measurements are shown by disease severity according to GOLD stage in Table 1. Decreased mean values of FM, FMI, and FFM were significantly associated with increasing severity of COPD with p <0.001 [Table 1]. Plasma albumin was less than 3.5 g/l among 72 (17%) patients. Total protein, less than 6 g/l was founded in 58 (13%) of patients. Plasma levels of albumin and total protein were lowered with the increase in the severity of disease. Reduction of urea and creatinine was observed among disease stages with the increase in the severity of disease [Table 1].

Table-1: The anthropometry indices, BIA and Biochemical indices by GOLD stage of COPD among the study participants

Variable	GOLD classification of COPD				P value
	Group A N=127	Group B N=111	Group C N=63	Group D N=134	
Anthropometry Indices					
BMI	24.7(3.2)	20.5(2.0)	18.5(1.6)	16.2(3.3)	<0.001
MAC	26.8(1.2)	24.7(2.6)	23.1(1.9)	20.5(2.7)	<0.001
MAMC	26.2(1.4)	23.6(1.1)	20.1(1.2)	18.3(2.0)	<0.001
TSF	14.2(2.7)	12.1(2.1)	10.2(3.4)	6.7(3.4)	<0.001
Bioelectric impedance analysis					
FM	36.7(7.9)	32.2(6.5)	29.6(6.1)	23.3(8.1)	<0.001
FFM	35.7(4.5)	35.1(4.9)	33.9(33.7)	31.2(3.4)	<0.001
TBW	51.6(2.8)	47.2(4.2)	45.3(7.2)	42.5(7.2)	<0.001
Biochemical Parameters					
Albumin	3.8(0.4)	4.5(5.3)	3.8(0.3)	3.7(0.3)	0.474
Protein	6.7(0.5)	6.4(1.2)	6.6(0.6)	6.4(0.8)	0.043
Urea	38.1(7.1)	36.6(8.2)	39.5(20.3)	36(11.1)	0.113
Creatinine	0.8(0.3)	0.8(0.3)	0.8(0.4)	0.7(0.3)	0.474

*p<0.05 is significant

Discussion

The present study found that mean values of anthropometric indices and body composition analysis in the COPD patients decreased as the disease became more severe. These reductions were much severe in Group D than in any other groups. On the contrary, there was no significant difference between the groups based on biochemical parameters.

These findings were comparable to other studies performed to measure nutritional status in COPD patients. The studies had stated that with the increase in the severity of disease, the patients lose weight, muscle and fat mass. Weight loss and low BMI are related to increased risk of COPD exacerbation, requiring frequent hospitalization, and mechanical ventilation thereby impairing function and exercise capacity and deteriorating the quality of life [10].

The present study found over one third of patients had low BMI and it was least in group D of COPD. Another study found a significant correlation between BMI and the severity of COPD [16]. The underweight patients took a longer duration to improve symptomatically. However, patients with a normal nutritional status improved earlier.

The present study revealed that Mid Arm Circumference, Mid Arm Muscle Circumference, Triceps Skin Fold Thickness decreased with increasing severity of COPD; the reduction in Group D was very severe. These findings were similar to another study that stated the prevalence of low body mass index and mid arm muscle area increased significantly as bronchial obstruction increased [17].

A study found increasing prevalence of malnutrition in outpatients with stable chronic obstructive pulmonary disease [17] and another study reported reduced albumin levels in COPD patients [18,19]. On the contrary in the present study, COPD patients did not show a decrease in mean values of albumin, total protein, blood urea, and creatinine as the severity of the COPD disease increased.

Moreover the biochemical markers, such as albumin, and others, shows bias in assessing nutritional status in patients with COPD as they are also influenced by non-nutritional factors, such as infections and renal or hepatic disease [19].

Conclusion

The present study is analogous to previous studies performed on nutritional status in COPD patients. It is found that with the increase in the severity of COPD disease, the patients are at risk to lose weight, muscle and fat mass. As of which COPD patients are at high risk for malnutrition.

Therefore, it is utmost essential that all COPD patients are assessed for the nutritional status and considered for dietary treatment as required.

The study findings highlight the importance to consider body composition in addition to body mass index as the only criterion of malnutrition, because patients do show frequent alterations in body composition, affecting the muscle store, the fat and total body water as the disease became more severe. The malnutrition and other nutritional complications associated with COPD is critical to be to improve on the quality of life of the patient.

Abbreviations: chronic obstructive pulmonary disease (COPD), FAT MASS(FM), fat free mass(FFM) and total body water(TBW), bioelectric impedance analysis (BIA), triceps skin fold (TSF), mid arm circumference (MAC), mid arm muscle circumference (MAMC)

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