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Original Article

Nutritional assessment via anthropometric and biochemical measurements with stable COPD

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Aim: Nutritional assessment is important for the management of chronic obstructive pulmonary disease (COPD). This study aims at investigating the relation between the anthropometric and biochemical parameters for nutritional assessment with pulmonary function tests in COPD.

Materials and methods: This is a prospective, cross-sectional study. Thirty-nine patients with stable COPD were enrolled the study. We evaluated the anthropometric [body mass index (BMI), skinfold thickness (SFT), and arm muscle circumference (AMC)], biochemical [serum total protein, albumin, transferrin, and blood urea nitrogen (BUN)], and spirometric [forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), and FEV1/FVC] measurements, as well as the correlations among them.

Results: There was a significant positive correlation between BMI and the other anthropometric parameters. There was no statistically significant correlation between the spirometric measurements and the biochemical parameters. We detected a positive correlation between SFT and serum albumin and total protein, and a negative correlation between BUN and AMC.

Conclusion: Anthropometric and biochemical parameters may be used for nutritional assessment and nutritional support as criteria in stable COPD patients.

Key words: Nutrition, COPD, anthropometric and biochemical measurements

Introduction

Although chronic obstructive pulmonary disease (COPD) is an airway disease, its consequences may affect organs and systems. Hypoxia, which develops due to airway obstruction, causes abnormalities in the muscular, cardiovascular, gastrointestinal, and nervous systems (1–3). Nutritional depletion may develop in COPD as a result of reduced food intake (due to gastrointestinal pathologies and dyspnea), an increase in resting energy expenditure, and inflammation (4). It has been reported that there would be a presence of nutritional depletion in stable COPD, mostly during acute attacks (4,5). Gaultier and Crapo (6) reported that undernutrition led to alterations in breathing control, an increase in ventilatory response, tissue damage in the lung parenchyma, and impairment in the functions of the respiratory muscles. Therefore, international and national guidelines for COPD have advised nutritional assessment and nutritional support if necessary (1–3). With the correction of nutritional depletion, it has been detected that the functions of the respiratory muscles, especially the diaphragm, have improved (7,8). Undernutrition results in a loss of peripheral muscle function, a decrease in the performance of exercise, and a worsening of quality of life (9).

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Various anthropometric and biochemical criteria are used in the assessment of nutrition in COPD (10). The most suitable one for assessment may be different for each disease, as the rationalist mechanisms may be different. The best criterion should be the one most correlated with the functional condition related to the pathology. Skinfold thickness (SFT), arm muscle circumference (AMC), body mass index (BMI), and fat-free mass index (FFMI) are the most frequently used anthropometric parameters. In the evaluation of nutritional status, it has been recommended that the measurement of the serum levels of albumin, prealbumin, transferrin, and retinol-binding protein should be used. Electrophysiological studies on peripheral muscles and immunological evaluations (total lymphocyte number, their subgroups, and delayed hypersensitivity response) are also available (4). In clinical practice, exact criteria and their cut-off values for nutritional support are not clear.

This study aims at investigating the relation between the anthropometric and biochemical parameters for nutritional assessment with pulmonary function tests in stable COPD.

Materials and methods

Thirty-nine patients with COPD who applied to the outpatient unit of our department for routine monitoring were included in the study. Exclusion criteria were accompanying disease with acute attacks within the last 2 months and oral or intravenous steroid use within the last 6 months. First, we recorded the demographic data of the patients. Next, the triceps SFT and AMC were measured, and the BMI and AMC were calculated. In addition, the BMI was divided into 3 categories as low, normal, and high (11). The SFT and AMC were evaluated as normal and abnormal using specific percentile tables and references. The levels of serum total protein, albumin, transferrin and blood urea nitrogen (BUN) were measured (Cobas® 8000 Modular Analyzer Series, USA). Spirometric evaluation of the patients was performed using a computerized spirometer (Sensor Medics Vmax22, USA), according to the American Thoracic Society standards for spirometry (12). Values of the forced expiratory volume in the first second (FEV_1), forced vital capacity (FVC), and FEV_1/FVC were recorded as percent predicted values according to European Coal and Steel Committee reference tables.

The study was planned according to the ethics guidelines of the Helsinki Declaration and the study protocol was approved by the local ethics committee.

Statistical analysis

The data were analyzed using SPSS 18 (SPSS Inc., USA) with the chi-square test, and Pearson's and Spearman's correlation tests were used to determine the mean values, the differences between the groups, and the significance of the differences. $P < 0.05$ was considered statistically significant.

Results

Enrolled in this study were 24 men and 15 women (mean age: 63 ± 9 years) with moderate–severe stable COPD. Mean predictive values were 41.29 ± 13.91% for FEV_1 and 52.52 ± 15.1% for FEV_1/FVC. The percentage of patients with normal BMIs (scores of 21–27) was 44%. BMI values lower than 20 and higher than 27 were detected in 15% and 41% of the cases, respectively. The mean values of our patients are listed in Table 1.

Table 1. Means of the investigated values in our patients.

Age (years)	63 ± 9
FVC (% pred.)	61.89 ± 20.09
FEV_1 (% pred.)	42.39 ± 14.24
FEV_1/FVC (% pred.)	54.27 ± 13.99
PEF (% pred.)	37.78 ± 15.24
FEF_{25-75} (% pred.)	20.19 ± 11.46
Total lymphocyte units	1603.72 ± 1007.53
Serum albumin (g/dL)	3.62 ± 0.58
Serum transferrin (mg/dL)	246 ± 64
BUN (mg/dL)	21.89 ± 11.01
Triceps SFT (mm)	18.17 ± 8.96
BMI kg/m^2	25.9 ± 4.49
AMC (cm)	28.13 ± 3.8

FVC (% pred.): force vital capacity, FEV_1 (% pred.): forced expiratory volume in the first second, FEV_1/FVC: ratio of forced expiratory volume in the first second to forced vital capacity, FEF_{25-75} (% pred.): forced expiratory flow at 25%–75% of vital capacity, PEF: peak expiratory flow, SFT: skinfold thickness, BMI: body mass index, AMC: arm muscle circumference, BUN: blood urea nitrogen.

There was a significant positive correlation between BMI and the anthropometric parameters. Statistically nonsignificant correlations were found between spirometric measurements and BMI, SFT, AMC, and biochemical parameters (serum total protein, albumin, transferrin, and BUN). Positive correlations were found between the AMC and serum albumin and the SFT and total protein. A negative correlation between BUN and AMC was detected. The results are summarized in Tables 2 and 3.

Discussion

COPD is described as a progressive, irreversible airflow limitation related to chronic bronchitis and/or emphysema. It was reported that nutritional depletion was mostly detected in emphysema and undernutrition resulted in lung parenchymal damage (4,6). It is not clear which criteria were used for the nutritional support, although it has been reported that functions improve with nutritional support. Different results have been obtained in studies that investigated the relationship of nutritional markers and pulmonary function (13,14). Sahebjami et al. (14) demonstrated a correlation between BMI and pulmonary function tests and they recommended BMI as a criterion. In patients with COPD, it has been reported that the percent of ideal body weight (PIBW) and FFMI were also available (4,15). FFMI is determined as the difference between the fat mass and total body weight. It was demonstrated that the FFMI and PIBW were more sensitive than BMI for the estimation of nutritional condition. In our study, we found a positive but insignificant correlation between BMI and FEV_1/FVC. It was demonstrated that albumin, transferrin, and retinol-binding protein, which are hepatic secretory proteins, did not decrease in advanced lung diseases. Therefore, the regular use of these parameters for monitoring was not advised (4). We detected a positive but insignificant correlation between the pulmonary function tests and the levels of serum albumin and transferrin.

Although nitrogen balance is the best method for the assessment of protein balance, its calculation is difficult. A negative nitrogen balance results in a loss of muscle mass (10,16). In our cases, when the anthropometric measurements were correlated with the biochemical markers, a positive and significant correlation was found between SFT and total protein levels and between AMC and BUN. The SFT and AMC values were grouped using specific percentile tables. The SFT and serum albumin were positively correlated.

The determination of anthropometric measurements, fat-free mass, and visceral secretory proteins is intended to designate the size of

Table 2. Relationships of the anthropometric measurements with the pulmonary function tests.

	r	P
BMI and SFT	0.683	0.0001
BMI and AMC	0.585	0.001
BMI and FEV_1	0.58	NS
BMI and FEV_1/FVC	0.332	NS
SFT and FEV_1	0.010	NS
SFT and FEV_1/FVC	0.133	NS
AMC and FEV_1	–0.116	NS
AMC and FEV_1/FVC	–0.047	NS

FVC (% pred.): force vital capacity, FEV_1 (% pred.): forced expiratory volume in the first second, FEV_1/FVC: ratio of forced expiratory volume in the first second to forced vital capacity, SFT: skinfold thickness, BMI: body mass index, AMC: arm muscle circumference, NS: not statistically significant.

Table 3. Relationships of the biochemical parameters with the pulmonary function tests and anthropometric measurements.

	r	P
Serum albumin and FEV_1	0.269	NS
Serum albumin and FEV_1/FVC	0.079	NS
Serum transferrin and FEV_1	0.357	NS
Serum transferrin and FEV_1/FVC	0.020	NS
SFT and serum total protein	0.371	0.047
AMC and BUN	–0.420	0.026
AMC and serum albumin	0.373	0.046

FVC (% pred.): force vital capacity, FEV_1 (% pred.): forced expiratory volume in the first second, FEV_1/FVC: ratio of forced expiratory volume in the first second to forced vital capacity, SFT: skinfold thickness, BMI: body mass index, AMC: arm muscle circumference, BUN: blood urea nitrogen, NS: not statistically significant.

body compartments. Alternatively, a functional evaluation may be more accurate (4). Various indices were developed to increase the sensitivity and specificity of nutritional tools. In a prior study, the relationship of different nutritional parameters with the complication rate in surgical patients was investigated, and 4 parameters were determined and a 'prognostic nutritional index' was developed. Serum levels of albumin and transferrin have been used as objective parameters, along with SFT and delayed hypersensitivity response as partially subjective parameters (17). It was reported that nutritional assessment had considerable rates of false negative and false positive results (18). Most investigators have emphasized the importance of physical examination and functional evaluation aside from anthropometric and biochemical assessment (19–23).

We detected a positive correlation between SFT and serum albumin and total protein, and a negative correlation between BUN and AMC. These parameters can be used in the follow-up of the nutritional status of patients with COPD.

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