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Relationship between Sarcopenia and Respiratory Functions in Geriatric Male COPD Patients

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ABSTRACT

Introduction: Sarcopenia can be defined as the loss of skeletal muscle mass and strength, especially with aging. In total, 21.6% of patients with chronic obstructive pulmonary disease (COPD) have sarcopenia. In our study, we investigated whether the evaluation of respiratory muscles can be correlated with peripheral muscle measurement and what kind of relationship is between sarcopenia and pulmonary function tests.

Methods: A retrospective observational study conducted in a single center included 75 male COPD patients admitted to the pulmonary rehabilitation unit. The data were obtained from the hospital information management system and patient files.

Results: The mean age of 75 male patients included in the study was 65±9 years, 76% had a history of smoking, and 46% had comorbidities. Sarcopenia was detected in 20 patients, 16 of whom were over 65 years of age. While the mean Handgrip was 50, Quadriceps 36, and Pinchmeter 17 in all age groups, it was 58, 38, and 17 in the over 65 age group, and 21, 21, and 12 in the 65 age group with cachexia, respectively. There was no statistical relationship between sarcopenia and forced expiratory volume 1 (FEV1), forced vital capacity, FEV1/FEV, Global Initiative for Chronic Obstructive Lung Disease stages, modified Medical Research Council, and COPD assessment test scores in patients over 65 years of age ($p>0.05$).

Conclusion: Although it was observed that the frequency of malnutrition and sarcopenia was higher than normal in the COPD patient group over 65 years of age, a decrease in pulmonary function tests and a decrease in effort capacity due to sarcopenia were observed, a statistically significant result was reached due to the insufficient number of cases.

Keywords: COPD, sarcopenia, pulmonary function tests, geriatrics male

Introduction

With the gradual increase in the elderly population worldwide, geriatric syndromes and chronic diseases due to aging are increasing. Geriatric syndromes are defined as clinical conditions that are seen in elderly patients, impair quality of life, progress with atypical symptoms that cannot be revealed by disease definitions, and increase morbidity and mortality rates. In addition to sarcopenia, conditions such as delirium, syncope, falling, fragility, incontinence, polypharmacy, dementia, dehydration, and pressure sores are also called geriatric syndromes (1,2).

Sarcopenia can be defined as the loss of skeletal muscle (SM) mass and strength, especially with aging. It was first defined by Rosenberg (3) as a decrease of muscle mass associated with aging, and most recently with European Working Group on Sarcopenia in Older People 2 (EWGSOP2) in 2019. It is a syndrome characterized by progressive and widespread decrease of SM strength and mass, which increases the risk of negative consequences such as limitation in physical movement, low quality of life, and death. It has been redefined as muscle disease that is common in older individuals but can also occur early in life (3,4). Its prevalence varies widely, from 6.8% to 19.1% by country, according to the EWGSOP (5,6).

Previous investigations have shown that diaphragm muscle strength (MS) and mass decrease with age. Transdiaphragmatic pressure measurement was used to measure the diaphragmatic strength. In some studies, it was determined that there was a slight correlation between the strength of the RM and that of the other muscles, and that RM strength was slightly correlated with extremity MS or hand grip strength in the elderly (7,8). In a study examining young people, a slight correlation was found between the diagnosis of sarcopenia and the SM mass index, knee extensor strength, and hand grip test (9).

In our study, we investigated whether the evaluation of RM, which is an indirect way of evaluating sarcopenia in COPD, which is common in the geriatric population, can be correlated with peripheral muscle measurement and what kind of relationship is between sarcopenia and pulmonary function tests.

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Methods

A retrospective observational study conducted in a single center included 75 male COPD patients admitted to the pulmonary rehabilitation unit of a training and research hospital between January 2021 and June 2022. Patients with demographic data, comorbidities, modified Medical Research Council (mMRC), and COPD assessment test (CAT) scores, respiratory function values, Handgrip, Quadriceps and Pinchmeter values from the hospital information management system and patient files were included in the study.

The study was approved by the University of Health Sciences Turkey, Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital Clinical Research Ethics Committee (approval number: 2023 - 451, date: 28.12.2023). Verbal and written consent was obtained from the patients in accordance with the Declaration of Helsinki and our hospital practice.

Height measurement: Height was measured with a stadiometer with the weight of the participants distributed on both feet, heels together, and head in a Frankfort plane, arms hanging freely from the shoulders to the sides. A single measurement was taken from the participants.

Body weight and body fat percentage measurement: A bioelectric impedance measurement device (Tanita Body Composition Analyzer) was used to determine the body fat and body weight percentage of the patients. Measurements were performed while the patients were upright and motionless, ensuring that both feet stood equally on the scales. Patients were informed about the measurement procedures before the test and were instructed to avoid heavy exercise and alcohol consumption for the last 24 h, caffeine for the last 4 h, and food for the last 2 h (10).

Body mass index (BMI) = weight (kg)/height (m^2) was calculated using the formula.

Evaluation of Malnutrition and Evaluation of Muscle Mass

The diagnosis of malnutrition was made according to GLIM criteria (11). We used the Mini Nutrition Assessment-Short Form questionnaire (MNA-SF) as a malnutrition screening tool, and a score below 12 indicates risk of malnutrition (12). The diagnosis of malnutrition was confirmed when at least one phenotypic and at least one etiological criterion was detected in accordance with GLIM recommendations.

Phenotypic criteria:

1. Unintentional weight loss: decrease of more than 5% of body mass in less than 6 months or decrease of more than 10% in more than 6 months,

2. Low BMI (kg/m^2): BMI <20 under 70 years of age, BMI <22 over 70 years of age,

3. Low muscle mass (LMM): It was evaluated based on appendicular lean mass measurement, Supplementary Lean Mass (ALM) calculation, and an ALM index representing ALM (kg) and height squared (m^2). Appendicular fat-free mass measurement was performed using the electrical bioimpedance method.

Etiological Criteria

Reduction or assimilation of food intake was noticed in subjects who reported any decrease in food intake in the past 3 months on the MNA-SF questionnaire.

Sarcopenia Evaluation

The Find-Assess-Confirm-Significance of Cases (FACS) algorithm was followed, sarcopenia screening was performed with the SARC-F questionnaire (≥4 points indicate the risk of sarcopenia), and all patients were diagnosed with sarcopenia, regardless of the SARC-F results. This protocol complies with EWGSOP2 recommendations for all patients with clinically suspected sarcopenia and is associated with the possibility of the COPD patient group being sarcopenic (13,14).

Evaluation of Muscle Strength

A hand grip test and hand dynamometer were used to measure upper extremity MS. The hand grip test was performed with the patient in a sitting position, with the arms bent 90° at the elbow and arm joints, with an accuracy of 0.1 kg. After both upper extremities were tested twice, all results were averaged. In accordance with the EWGSOP2 recommendations, values of 16 kg for women and 27 kg for men were used as low MS cutoff points (15). The chair standing test was used to evaluate lower extremity MS (16). Patients who repeatedly rose from the chair five times by crossing their arms over their chests. Results shorter than 15 s were considered as low lower extremity MS. According to the FACS algorithm, patients with decreased MS are diagnosed with decreased MS (13).

Hand Grip Force Measurement

A digital hand dynamometer with an adjustable grip handle measuring in the range of 5.0-100.0 kg and an accuracy of 0.1 kg was used to measure the participants' hand grip force (HGF). During the measurements, the participants were asked to look across with their feet shoulder-width apart, in a standing position, with the elbow in full extension. Before the measurement, the dynamometer was adjusted according to the hand sizes of the participants. The user is instructed to hold the dynamometer in a comfortable grip position (not in flexion and extension), with the index finger flexed 90°. Participants were instructed to squeeze the handle with all their strength for 3 s. During the test, they were instructed not to hold their breath and not to shake the dynamometer. The participants' grip strength measurements from both hands were taken three times, and the highest value was taken in "kg" for statistical evaluation. There was a break of at least 60 s between each trial.

Pulmonary Function Tests

Spirometry results were obtained from the hospital's electronic patient data system. The post-bronchodilator forced expiratory volume 1 (FEV 1)/forced vital capacity (FVC) ratio of all patients participating in the study was found to be lower than 70%, in accordance with the diagnostic criteria of COPD specified in the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guide (1). The severity of the obstruction was classified according to the FEV1 value in accordance with the GOLD guideline: In the classification consisting of four categories, FEV1

≥80% was determined in mild obstruction, FEV1 ≥50% in moderate obstruction, FEV1 ≥30% in severe obstruction, and FEV1 <30% in very severe obstruction.

Statistical Analysis

All statistical analyses were performed using SPSS 21.0 (IBM Statistical Product and Service Solutions version 21 Inc., Chicago, USA) program. In the study, descriptive statistics were reported, including the mean (standard deviation), median (interquartile range), and percentage. The Kolmogorov-Smirnov test was used to determine whether the continuous variables showed normal distribution or not. Pearson's chi-square and Fisher's exact tests were used to determine the difference between categorical variables. Values with a p-value of 0.05 were considered statistically significant.

Results

Our study included 75 male patients who visited our chest diseases outpatient clinic, and their mean age was 65±9 (45-86). There was a smoking history in 76% of the patients, and their average cigarette consumption was 22 pk/year. The mean duration of COPD diagnosis was 8 years, and 46% had a comorbid condition. The most common comorbidity is cardiovascular disease (19%). The mean FEV1 was 1.3 lt (44%), FVC 2.2 lt (59%), and FEV1/FVC 59. The groups of patients according to GOLD staging, CAT, and mMRC scores are given in Table 1.

HGF measurement was below 33 in 16 (37%) of 43 patients over 65 years of age. There was no statistically significant decrease in HGF in patients aged 65 years with a diagnosis of COPD for 5 years or more. When the reference value for sarcopenia was taken as 33, a statistically significant decrease was found ($p<0.05$). When patients over 65 years of age with and without sarcopenia were compared, FEV1, FVC, FEV1/FEV, GOLD stages, mMRC and CAT score, hospitalization in the last 1 year, number of attacks in the last 1 year, admission to the emergency department in the last 1 year, and emphysema and emphysema on thorax computed tomography. There was no statistical difference between bronchiectasis and peripheral blood eosinophilia ($p>0.05$). When patients over 65 years of age with sarcopenia were compared with those under 65 years of age without sarcopenia, no statistical difference was found between FEV1, FVC, FEV1/FEV, GOLD staging, mMRC, and CAT ($p>0.05$).

While the number of patients under 65 years of age with sarcopenia was found to be 4, and the number of patients who needed nutritional support was 2 (6.5%), 16 patients over 65 years of age with sarcopenia and who needed nutritional support were found to be 6 (13.6%). No statistically significant relationship was found between sarcopenia and nutritional support ($p>0.05$). While the mean FEV1 of the group receiving nutritional support was 1.05 lt, the mean FEV1 of the patients with sarcopenia was 1.26 lt. Respiratory function tests of patients who were malnourished and started on nutritional support were lower than those in the sarcopenia group, but no statistically significant difference was detected ($p>0.05$). While 72% of patients over 65 years of age with sarcopenia had GOLD stages 3 and 4, this rate was 54% in the group without sarcopenia.

Groups according to the GOLD staging of COPD patients aged 65 years and over, mMRC and CAT scores, PFT parameters, Handgrip, Quadriceps and Pinchmeter measurement results are given in Table 2.

Discussion

With the gradual increase in the elderly population worldwide, geriatric syndromes and chronic diseases due to aging are increasing. Geriatric syndromes are defined as clinical conditions that are seen in advanced age, impair quality of life, progress with atypical symptoms that cannot be revealed by disease definitions, and increase morbidity and mortality rates. In addition to sarcopenia, conditions such as delirium, syncope, falling, fragility, incontinence, polypharmacy, dementia, dehydration, and pressure sores are also called geriatric syndromes (1,2). The inflammatory nature of COPD brings with it increased sarcopenia and fragility in the advancing age group.

While sarcopenia can be defined as a loss in SM mass and strength that occurs especially with aging, according to EWGSOP2, it is a syndrome characterized by progressive and widespread loss of SM mass and strength, which increases the risk of adverse outcomes such as limitation in physical movement, low quality of life and death, and in the elderly. It has been redefined as muscle disease, which is common in individuals but can also occur in the early stages of life (3,4).

Studies have shown that diaphragm MS and mass decrease with age. In the literature, it was determined that there was a slight correlation between the strength of the RM and the strength of the other muscles, and that RM strength was slightly correlated with extremity MS or

Table 1. mMRC and CAT scores of groups according to GOLD staging

	n	% (valid)
GOLD stage	(16 missing)	
1	1	2
2	22	37
3	22	37
4	14	24
CAT scores	16.1±8.3 (2-24)	
Symptom score according to the CAT		
≥10	23	77
<10	7	23
mMRC scores	2.5±1.2	
mMRC scores	(7 missing)	
0	1	2
1	19	28
2	11	16
3	22	32
4	15	22
Handgrip average	50.7±20.8 (9-92.5)	
Quadriceps average	36.4±14.1 (15.5-105.5)	
Pinchmetre average	17.5±4 (9.7-26.2)	

GOLD: Global Initiative for Chronic Obstructive Lung Disease, mMRC: modified Medical Research Council, CAT: COPD assessment test

Table 2. Patient characteristics according to age groups

	<65 ages (n=31)	≥65 age (n=44)	p
BMI	26.6±5.6	25.1±4.4	0.246
BMI			
Normal	21 (67)	30 (81)	0.431
Cachectic	5 (16)	4 (11)	
Obese	5 (16)	3 (8)	
COPD diagnosis duration	7.5±4.9	8.7±5.1	0.326
FEV1	1.4±0.6	1.3±0.5	0.3944
FEV1 (%)	42±16	45±17.9	0.489
FVC	2.4±0.9	2.1±0.7	0.160
FVC (%)	41±12	35±7.2	0.817
FEV1/FVC	57±12	56±12	0.826
GOLD stage	(26)	(35)	
1	0	1	0.765
2	9	13	
3	9	13	
4	8	8	
CAT score	14.6±6.4	17.2±9.6	0.405
Symptom score according to the CAT	(13)	(17)	
≥10	11	12	0.427
<10	2	5	
mMRC score	2.4±1.2	2.6±1.2	0.563
Handgrip average	58.3±21	45.8±19.5	0.013
Quadriceps average	38.5±17	34.3±10.2	0.333
Pinchmetre average	17.6±4.4	17.4±3.7	0.915

BMI: Body mass index, COPD: Chronic obstructive pulmonary disease, FEV1: Forced expiratory volume 1, FVC: Forced vital capacity, GOLD: Chronic Obstructive Lung Disease, CAT: COPD assessment test, mMRC: modified Medical Research Council

hand grip strength in the elderly (5,7,8). In a study conducted with young people, a slight correlation was found between the diagnosis of sarcopenia and the SM mass index, knee extensor strength, and hand grip test (9).

Changes in body structure and malnutrition are the most common comorbid conditions in patients with COPD and negatively affect the prognosis (3,4,7,8). Studies show that 30%–60% of COPD patients do not receive adequate nutrition (9,17,18), 20 to 40% have LMM (3,4), and 15 to 21.6% patients have sarcopenia (19,20). Normally, an adult consumes 36 to 72 calories a day to breathe. COPD patients with severe obstruction can consume 10 times more energy. It is not always possible to meet the increased calorie need with a diet (21). Sarcopenia and malnutrition negatively affect the prognosis of COPD, causing a decrease in exercise tolerance, an increase in the risk of hospitalization, and a decrease in the quality of life (4,19,20). Malnutrition and sarcopenia negatively affect the prognosis of COPD, causing a decrease in exercise tolerance, an increase in the risk of hospitalization, and a decrease in the quality of life (4,19,20).

In our study, sarcopenia was found in 37% of male patients with COPD over the age of 65 years, and the mean duration of COPD disease was 7 years. The prevalence of sarcopenia increased by 14.5% with age and GOLD stage, but no differences were shown with gender and quadriceps muscle weakness (14.9% vs. 13.8%, p=0.40) (22). While the rate of sarcopenia was found to be 21% in men over 65 years of age in a general population assessment from Japan, 11% in a systematic review, and 6% in another study conducted in our country, it was found to be high in our study because it was found in the group of patients with COPD in our country, which is a country with a low socio-economic status (8,17). It has been shown in previous studies that BMI and sarcopenia cannot be evaluated in patients with COPD (23).

Deniz et al. (20) showed that there is a significant relationship between diaphragm thickness and peak (Peak Expiratory Flow) and sarcopenia. Kaluźniak-Szymanowska et al. (21), similar to the study he conducted, found that pulmonary function tests were lower in the malnourished and sarcopenic group over 65 years of age, they were in the GOLD stage 3-4 group, and their mMRC scores were higher. However, we think that the lack of a statistically significant result is due to the insufficient number of our cases.

Study Limitations

Because the study consisted of patients participating in pulmonary rehabilitation, it was not representative of the entire COPD population and was designed retrospectively. We also evaluated the GLIM etiological

criterion of reduced food intake using subjective responses to the MNA-SF questionnaire. The lack of multivariate analysis is another limitation of our study. We can emphasize that women were not included in the study because we could not provide a statistically homogeneous distribution in our limited sample size, but no gender difference was observed in sarcopenia in copd patients in the literature. We can also discuss the fact that COPD causes sarcopenia on its own and is not compared with <65 years of age.

Conclusion

Although it was observed that the frequency of malnutrition and sarcopenia was higher than normal in the COPD patient group over 65 years of age, a decrease in pulmonary function tests and a decrease in effort capacity due to sarcopenia, a statistically significant result was reached due to the insufficient number of cases. We think that large series with control group and prospective studies are needed.

Ethics Committee Approval: The study was approved by the University of Health Sciences Turkey, Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital Clinical Research Ethics Committee (approval number: 2023 - 451, date: 28.12.2023).

Informed Consent: Verbal and written consent was obtained from the patients in accordance with the Declaration of Helsinki and our hospital practice.

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