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Assessment of muscle dysfunction in COPD patients: A case-control study

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Abstract

Introduction: peripheral muscle dysfunction satellite of chronic obstructive pulmonary disease (COPD) has emerged in recent years as a major factor which limits patients' ability to exercise.

Methods: This study is a case-control investigation of the associations between COPD and muscle dysfunction. Cases and control subjects were recruited to evaluate their body composition using bioelectrical impedance (BIA). Quadriceps strength and endurance tests were performed. Dyspnoea was estimated by the mMRC scale.
The patients were redirected from the department of pulmonary diseases of Batna, Algeria.
The healthy subjects were volunteers without any lung, heart or systemic diseases or handicap in physical effort.

Results: 175 patients with stable COPD (9 female and 166 male) aged between 40–86 years, mean FEV1 52 ± 21% and 175 age-and-sex-matched healthy subjects (FEV1: 91± 9%) were included in this study. The cigarette consumption was 35 (20) pack/years in COPD patients vs 15 (15) pack/years in healthy subjects. The classification of airflow limitation showed that 19.43% of patients were classified GOLD I, 30.29% (GOLD II), 33.71% (GOLD III), and 16.57% (GOLD IV). 22. 85% of COPD patients were classified in (category A) ,17.14% (category B) ,16.57% (category C) and 43.42% (category D). fat-free mass index (FFMI) was 19.3 (1.6) kg/m^2 in COPD patients vs 18 (4.7) kg/m^2 in controls.
Quadriceps strength was 109.27 (42.8) Nm in COPD patients vs 141.6 (15) Nm in healthy subjects. The quadriceps endurance was 3.75 (1.14) min in patients vs 16.6 (15) min in controls.

Conclusion: This study supports the idea that skeletal muscle mass, quadriceps strength and endurance, were adversely affected in patients with COPD.

Keywords: COPD; Case-control; Muscle dysfunction; Strength; Endurance.

1. Introduction

Muscle dysfunction in COPD is associated with a poor prognosis, and high health costs. The purpose of this study was to assess and compare BMI, fat-free mass index (FFMI), peripheral muscle strength and endurance, between patients with COPD and healthy subjects.

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2. Material and Methods

Stable COPD patients and healthy subjects were recruited to evaluate their muscle function (masse, strength, and endurance). Patients were redirected from the department of pulmonary diseases, Batna, Algeria. Healthy subjects were volunteers without any lung, heart or systemic diseases or handicap in physical effort.

Pulmonary function testing was performed with a spirometer (Sibelmed; Datospir 120). Body mass index (BMI), peripheral muscle mass and body composition were assessed by bioelectrical impedance analysis (BIA) (Tanita 418). Dyspnea was evaluated using the Modified Medical Research Council (mMRC) scale. Right quadriceps strength was measured using a computerized dynamometer, and it was repeated three times and the mean value in Newtons (N) was recorded. Quadriceps endurance was evaluated by the dynamic test by measuring the duration which patients can repeat stretch relaxation movements of the leg at a rate of 10 movements per minute and at a load equivalent to 30 or 40% of maximal strength. All assessments were performed in COPD patients and healthy subjects.

3. Results

Table 1 Characteristics of study population (COPD and healthy subjects

	Healthy subjects	**COPD**	**P**
Subject (n)	175	175	
Age (years)	68 (9)	67 (9)	
Sex (male/female)	166:9	166:9	
Smoking (pack/years)	15 (15)	35 (20)	0.0012
FEV1 (%)	91(9)	53 (21)	<0.0001
BMI (kg/m^2)	24.00 (3.23)	21,32 (4.10)	<0.0001
FFMI (kg/m^2)	19.3 (1.6)	18 (4.7)	<0.001
MMRC (0–4)	0±1	2±1	<0.001

Demographic characteristics (age and sex) of patients with COPD and healthy subjects were similar. The cigarette consumption was significantly higher in COPD patients compared with controls (p= 0.0012). FEV1 values of patients were significantly lower than those of healthy subjects (p = 0.0001), and dyspnea levels (p = 0.001) were significantly higher in COPD patients than in controls. There was also statistically significant difference in BMI and FFMI values (p < 0.0001 and p < 0.001 respectively) in COPD compared to healthy subjects. (table1).

Table 2 Classification of COPD patients

	Results
Air flow limitation Classification	GOLDI: 19.43%
	GOLDII: 30.29%
	GOLDIII: 33.71%
	GOLD IV: 16.57%
Symptoms/risk of exacerbation Classification	A: 22. 85%
	B: 17.14%
	C: 16. 57%
	D: 43.42%

The classification of airflow limitation according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria [1] showed that COPD stages was GOLDI:19,43%, GOLDII:30,29%, GOLDIII:33,71%, and GOLDIV: 16,57%.

Classification of symptoms/risk of exacerbation was found that 22.85% of COPD patients were classified in (category A) ,17.14% (category B) ,16.57% (category C) and 43.42% (category D) (Table 2)

Table 3 Muscle assessment in COPD patients and healthy subjects

	Healthy Subjects	**COPD**	**P**
Muscle mass (right leg) (Kg)	7.75(1.17)	7.01(1.25)	0.0001
Muscle mass (right arm) (Kg)	2.56(0.56)	2.33(0.65)	0.0001
Quadriceps strength (Nm)	141.6 (15)	109.27 (42.8)	0.019
Quadriceps endurance (min)	16.6 (15)	3.75(1.14)	0.0001

A significative difference was found in peripheral muscle mass (P< 0.0001), quadriceps strength (P< 0.019), and quadriceps endurance (P< 0.0001) between COPD patients and controls.

4. Discussion

The interest in the assessment of muscle dysfunction (strength and endurance) in COPD patients is mainly due to its considerable clinical impact on exercise tolerance [2,3], quality of life [4], and survival [5,6]. Excellent synthetic works concerning muscle dysfunction in COPD patients have been published in literature [7,8,9]. The main goal of our study is to confirm muscle dysfunction in COPD patient compared to healthy controls. Our results showed a significant decrease (P <0.0001) of the of peripheral muscle mass, estimated by impedancemetry in COPD compared to healthy subjects. Furthermore, peripheral muscular atrophy is associated with COPD in approximately 30% of cases, even in those who have a normal overall weight [10,11]. However, impedancemetry currently appears to be the method of choice for measuring body composition in COPD given its ease, speed and reproducibility, but its results must be interpreted with caution in cases of right heart failure with salt and water retention (10). This frequency increases with functional severity [12]. As for the significant differences in BMI and FFMI as well as segmental muscle mass found in our patients compared to controls were noted also in the Malaguti et al study [13]. On the other hand, as noted in the current study Kutukcu et al [14] were also noted a significant difference in dyspnea severity evaluated by mMRC scale in COPD patients compared to healthy subjects.

A decrease in quadriceps strength of 23% (P =0.019) was found in COPD patients compared with controls was objective in our study. Bernard and al [15] showed a reduction of 27% in quadriceps strength it was much higher than that of scapular girdle muscles in COPD compared to healthy controls. Similar findings have been demonstrated in other literature studies [16,17,18].

As for the dynamic endurance of our patients is reduced by 77% (p=0,0001) compared to controls, several other comparative studies have shown a decrease of dynamic endurance from 32% to 77% this wide range is related to the diversity of measurement methods used [19,20,21].

5. Conclusion

Muscle dysfunction in COPD is characterised by atrophy, and weakness. These muscle changes influence exercise tolerance and daily life activities. Currently, muscle strengthening and exercise retraining as part of a pulmonary rehabilitation program constitute the cornerstone for improving muscle dysfunction and consequently the quality of life of COPD patients.

Compliance with ethical standards

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Disclosure of conflict of interest

All the authors declare that they have no conflict of interest with this article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Vestbo J, Hurd SS, Agusti AG, et al: Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease, GOLD executive summary. Am J Respir Crit Care Med 2013, 187:347–365.

[2] Gosselink R, Troosters T, Decramer M. Peripheral muscle weakness contributes to exercise limitation in COPD. Am J Respir Crit Care Med 1996; 153 :976–980.

[3] Williams TJ, Patterson GA, McClean PA, Zamel N, Maurer JR: Maximal exercise testing in single and double lung transplant recipients. Am Rev Respir Dis 1992; 145:101-5.

[4] Mostert R, Goris A, Weling-Scheepers C, et al. Tissue depletion and health related quality of life in patients with chronic obstructive pulmonary disease. Respir Med, 2000; 94 :859–67.

[5] Swallow EB, Reyes D, Hopkinson NS, et al. Quadriceps strength predicts mortality in patients with moderate to severe chronic obstructive pulmonary disease. Thorax, 2007b; 62:115–20.

[6] Marquis K, Debigaré R, Lacasse Y, LeBlanc P, Jobin J, Carrier G, Maltais F: Midthigh Muscle Cross-Sectional Area Is a Better Predictor of Mortality than Body Mass Index in Patients with Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med 2002; Vol 166. pp 809–813.

[7] Gosker HR, Wouters EF, Van Der Vusse GJ, Schols AM: Skeletal muscle dysfunction in chronic obstructive pulmonary disease and chronic heart failure: underlying mechanisms and therapy perspectives. Am J Clin Nutr 2000; 71:1033-47.

[8] Debigaré R, Côté CH, Maltais F: Peripheral muscle wasting in chronic obstructive pulmonary disease; clinical relevance and mechanisms. Am J Respir Crit Care Med 2001;164: 1712-7.

[9] Gea J, Casadevall C, Pascual S, Orozco-Levi M, Barreiro E, Respiratory diseases, and muscle dysfunction. Expert Rev Respir Med 2012; 6:75–90.

[10] Schols AMWJ, Soeters PB, Dingemans MC, Mostert R, Frantzen PJ, Wouters EFM: Prevalence and characteristics of nutritional depletion in patients with stable COPD eligible for pulmonary rehabilitation. Am Rev Respir Dis 1993;147: 1151-6.

[11] Vestbo J, Prescott E, Almdal T, et al Body mass, fat-freebody mass, and prognosis in patients with chronic obstructive pulmonary disease from a random population sample findings from the Copenagen City Heart Study. Am J Respir Crit Care Med 2006; 173:79–83.

[12] Engelen MP, Schols AM, Does JD, Wouters EF. Skeletal muscle weakness is associated with wasting of extremity fat-free mass but not with airflow obstruction in patients with chronic obstructive pulmonary disease. Am J Clin Nutr 2000 ;71 :733–738.

[13] Malaguti C, Nery L E., Dal Corso S, Napolis L, De Fuccio M B, Castro M, Neder J. A Scaling skeletal muscle function to mass in patients with moderate-to severe COPD Eur J Appl Physiol 2006; 98 :482–488.

[14] Calik-Kutukcu E, Savci S, Saglam M, Vardar-Yagli N, Inal-Ince1 D, Arikan H, Aribas3 Z, Ozer1 O, Bosnak-Guclu M, Coplu L. A comparison of muscle strength and endurance, exercise capacity, fatigue perception and quality of life in patients with chronic obstructive pulmonary disease and healthy subjects: a cross-sectional study BMC Pulmonary Medicine 2014, 14:6 http://www.biomedcentral.com/14712466/14/6

[15] Bernard S, Leblanc P, Whittom F, Carrier G, Jobin J, Belleau R, Maltais F. Peripheral Muscle Weakness in Patients with Chronic Obstructive Pulmonary Disease. AM J Respir Crit Care Med 1998; 158: 629–634.

[16] Seymour JM, Spruit MA, Hopkinson NS, Natanek SA, Man WD, Jackson A, Gosker HR, Schols AM, Moxham J, Polkey MI, et al. The prevalence of quadriceps weakness in COPD and the relationship with disease severity. Eur Respir J 2010; 36:81–88.

[17] Hopkinson NS, Tennant RC, Dayer MJ, Swallow EB, Hansel TT, Moxham J, Polkey MI. A prospective study of decline in fat free mass and skeletal muscle strength in chronic obstructive pulmonary disease. Respir Res 2007; 8:25.

[18] Clark CJ, Cochrane LM, Mackay E, Paton B. Skeletal muscle strength and endurance in patients with mild COPD and the effects of weight training. Eur Respir J 2000; 15:92–97.

[19] Koechlin C, Couillard A, Cristol JP, Chanez P, Hayot M, Le Gallais D, Prefaut C. Does systemic inflammation trigger local exercise-induced oxidative stress in COPD? Eur Respir J 2004; 23(4):538-544.

[20] Serres I, Gautier V, Varray A, Prefaut C. Impaired skeletal muscle endurance related to physical inactivity and altered lung function in COPD patients. Chest 1998;113(4):900-905.

[21] Coronell C, Orozco-Levi M, Mendez R, et al. Relevance of assessing quadriceps endurance in patients with COPD. Eur Respir J 2004; 24 :129-136.