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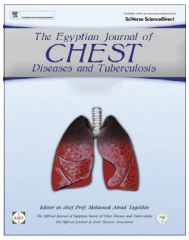

ORIGINAL ARTICLE

Study of Osteoporosis in chronic obstructive pulmonary disease

Ahmad Godah EL-Gazzar, Mohamed E. Abdalla *, Mohamed A. Almahdy

Department of Chest Diseases, Benha Faculty of Medicine, Egypt

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KEYWORDS

COPD;
Osteoporosis

Abstract *Background:* Chronic obstructive pulmonary disease (COPD) is a lung disease that is thought to result from chronic inflammation that may affect other organ systems. Evidence suggests that the prevalence of osteoporosis in patients with COPD is high and potentially important. Currently, the gold standard to assess osteoporosis non-invasively is dual energy X-ray absorptiometry (DEXA) scan.

Purpose: We wanted to investigate the prevalence of osteoporosis in a population of patients with COPD and to determine the severity of osteoporosis in correlation with degree of COPD.

Methods: This study was conducted on 50 patients with COPD and 10 healthy subjects as a control group. Study subjects were divided into four groups Group included 10 healthy volunteers as a control group. Group included 20 patients with moderate COPD. Group included 22 patients with severe COPD. Group IV included 8 patients with very severe COPD. All subjects were subjected to; detailed clinical history, thorough clinical examination, plain chest-X-ray postero-anterior view, ventilatory function tests (spirometry), and measurement of bone density by using DEXA.

Results: The results of this study revealed significant reduction of body mass index (BMI) in COPD group in comparison with the control group (p value <0.05). As regards osteoporosis, its prevalence in total COPD group was higher than control group and reached 26%, while osteopenia reached 54%. Comparison between the COPD degrees as regards bone mineral density (BMD) revealed that, prevalence of osteoporosis increases with the increase of the severity of COPD from moderate to severe then very severe (20%, 27.3%, and 37.5% respectively). Highly significant sta-

* Corresponding author. Tel.: +20 1272797744 (Egypt)/+966 507378430 (KSA).
E-mail address: mabdalla66@yahoo.com (M.E. Abdalla).
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tistical correlation was found between *T* score and FEV1% in COPD group revealing that osteoporosis severity increases with the increase of the severity of COPD.

Conclusions: Prevalence of osteoporosis was higher in COPD patients. Prevalence and severity of osteoporosis increased with the increase of COPD degree.

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Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by a progressive airflow limitation that is not fully reversible and associated with an abnormal inflammatory response of the lung to noxious particles and gasses [1]. A variety of systemic effects become obvious as the disease progress.

Osteoporosis has been recognized as one of the systemic effects of COPD and debate continues on the precise mechanisms involved and on the options for treatment [2]. Osteoporosis is a systemic skeletal disease characterized by a decreased bone mineral density (BMD) and/or deterioration of the micro architecture, resulting in increased bone fragility and hence an increased susceptibility to fractures [3].

The gold standard to diagnose osteoporosis is dual energy absorptiometry (DEXA) scan. With this technique the amount of mineral in the scanned area of bone is measured in grams and divided by the measured bone surface in square centimeters to acquire a definite bone mineral density (BMD). The BMD score of patients is expressed as *T* score. The definition of osteoporosis according to the WHO is based on this *T*-score [3].

It has been reported that BMD is lower in COPD patients than in healthy subjects [4]. One of the most obvious causes of osteoporosis in COPD patients is treatment with glucocorticoids, both as systemic therapy and as inhaled glucocorticoids [5,6]. Glucocorticoid use does not fully account for the low bone mineral density (BMD) and high prevalence of osteoporosis in COPD patients [7].

A number of factors have been suggested to account for these findings. COPD patients are often smokers, as well as they have impaired mobility due to decreased muscle mass and respiratory dysfunction. Further, the group of patients with the most severe COPD also has lower weight than the general population, and low BMI is further a risk factor of increased mortality. All these factors are known to pre-dispose to osteoporosis, and can explain the increased prevalence [8].

Aim of the work

The aim of this study was to determine the frequency of osteoporosis in COPD patients, and to determine the severity of osteoporosis in correlation with degree of COPD.

Patients and methods

This study was conducted on 50 patients of COPD and 10 healthy subjects as a control group; they were selected from Chest Department, Benha Faculty of Medicine from December 2009 to April 2010. The study protocol was approved by the local ethics committee. Informed consent was obtained from the patients. Age of COPD group ranged from 40 to 68 years, they were all males; while age of the control group ranged from 40 to 55 years, they were all males also. Study subjects were divided into four groups. Group included 10 healthy volunteers who had no symptoms or signs of any chest disease and normal ventilatory function tests as a control group. Group included 20 patients with moderate COPD. Group included 22 patients with severe COPD. Group IV included 8 patients with very severe COPD. Group , and IV included patients who had symptoms of chronic airflow obstruction and who fulfilled lung function criteria and classification as set out by the National Heart and Lung Institute/World Health Organization Global Initiative for Chronic Obstructive Lung Disease guidelines [9]. Exclusion criteria in-

Table 1 Characteristic of subjects.

	Patients	Control
Age		
Mean ± SD	56.04 ± 7.14	49 ± 4.42
t Test	2.325	
p Value	0.663	NS
BMI		
Mean ± SD	23.86 ± 3.75	26.50 ± 5.40
t Test	3.625	
p Value	0.049	S

This table compare between COPD patients and control as regards age and BMI.

Table 2 Comparison between COPD groups and control group as regards number and percentage of normal, osteopenia and osteoporosis.

	Normal	Osteopenia	Osteoporosis	Total
Control				
n	8	2	0	10
%	80	20	0	
Moderate COPD				
n	7	9	4	20
%	35	45	20	100
Severe COPD				
n	3	13	6	22
%	13.6	59.1	27.3	100
Very severe COPD				
n	0	5	3	8
%	0	62.5	37.5	100
Total of COPD				
n	10	27	13	50
%	20	54	26	100

As regards BMD (represented by *T* score), osteopenia and osteoporosis frequency increases as degree of COPD passes from moderate to very severe.

Table 3 Comparison between *T* score of COPD patients and control group.

	T score of patients	*T* score of control
Mean ± SD	−1.908 ± 0.325	−0.11 ± 0.02
t Test	16.80	
p Value	0.001 * HS	

As shown there is highly significant difference in *T* score between two groups.

Table 4 Linear regression analysis using least square method between forced expiratory volume in the first second (% predicted) and *T* score.

Regression statistics of FEV1	
Multiple *R*	0.98
R square	0.66
Adjusted *R* square	0.97
Standard error of the estimate	47.33
Number of cases	13 Cases

There was direct relation between FEV1% and *T* score.

cludes, FEV_1/FVC of more than 70%, Patients who had a clinical diagnosis of asthma, history of childhood respiratory disorders, chest wall deformity, known immunodeficiency.

All subjects were subjected to the following studies; full clinical history, thorough clinical examination, plain chest X-ray (postero-anterior and lateral views), blood sample for complete blood picture, ESR, liver and kidney functions, electrocardiogram, Ventilatory function tests, spirometry was performed using "Spirosift spirometry 5000 FUKUDA DENSHI". Bone Density Measurement; for all patients and controls, bone mineral density of the lumbar spines was measured by dual energy X-ray absorptiometry (DEXA) with the use of Norland, XR 46 apparatus. The mean BMD value of the second, third and fourth lumbar vertebrae (lumbar spine BMD) were used in the present young adult sex-matched control population > -1 was considered normal, *T* score between -1 and -2.4 was considered osteopenia, and *T* score $\leqslant -2.5$ was considered osteoporosis [10].

Statistical analysis

Statistical presentation and analysis of the present study was conducted, using the mean, standard deviation (*t* test), and chi-square test by SPSS V.16.

Table 5 Spearman's rho rank correlations between *T* score and pulmonary function tests in COPD group.

Parameters	Correlation coefficient	*p* Value	Sig.
Slow vital capacity (%)	−0.07	> 0.05	NS
Forced vital capacity (%)	−0.562	< 0.05	S
Forced expiratory volume at first second (%)	−0.986	< 0.001	HS
FEV1/FVC ratio	−0.08	> 0.05	NS
Forced expiratory flow (25–75)	−0.756	< 0.001	HS
Peak expiratory flow rate (%)	−0.852	< 0.001	HS

Results

From Table 5 there was;

- Statistically highly significant correlation between *T* score and FEV1%, FEF (25–75)%, and PEFR%.
- Statistically significant correlation between *T* score and FVC%.
- Statistically non significant correlation between *T* score and SVC% and FEV1/FVC ratio.

Discussion

Osteoporosis continues to be a major problem in men with chronic illness. In men with CLD, osteoporosis may be particularly disabling because vertebral fractures reduce vital capacity, which further compromises ventilation [11]. Evidence suggests that the prevalence of osteoporosis in patients with COPD is high and potentially important [12,13].

In the present study, the COPD patients age ranged from 40 to 68 years (56.04 ± 7.14) and the age of the control group ranged from 40 to 55 (49 ± 4.42) with no significant difference between the two groups as shown in (Table 1). But, the results of body mass index showed significant reduction in COPD group in comparison with the control group as shown in (Table 1). These results were in agreement with Iqbal et al. (2004) who found significant lower values of BMI in patients with COPD than in normal personnel [14].

In this study, from 50 patients with different degrees of COPD; 10 patients (20%) were normal as regards BMD, 27 patients (54%) were osteopenic as regards BMD and 13 patients (26%) were osteoporotic as regards BMD. While from 10 normal personnel; 8 (80%) were normal as regards BMD and 2 (20%) were osteopenic as regards BMD.

Also it was demonstrated that 80% of patients with COPD varying from moderate to very severe had abnormal BMD either osteopenia (*T* score −1 to −2.4) which were 54%, or osteoporosis (*T* score $\leqslant -2.5$) which were 26% as shown in (Table 2 and Fig. 1).

These results were in agreement with the results of the cross sectional study carried by Jorgensen et al. (2007)on 62 COPD patients who found that 78% of patients had low BMD either osteopenic or osteoporotic [15].

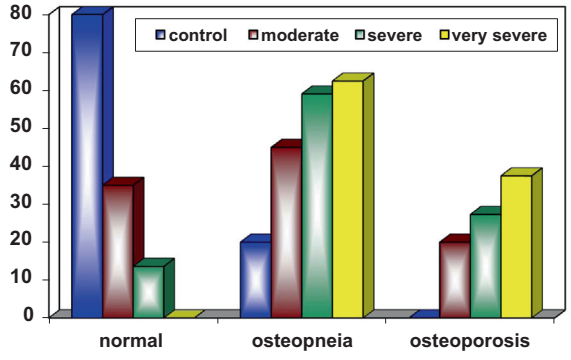

Figure 1 Comparison between COPD subgroups and control group as regards number and percentage of normal, osteopenia and osteoporosis.

Also, these results were in agreement with results of the study carried by Dubois et al. (2004) which carried on 86 patients with COPD and revealed that; 28% of patients were normal as regards BMD, 50% of patients were osteopenic as regards BMD, and 22% of patients were osteoporotic as regards BMD [16].

From the results of our study, it was demonstrated that prevalence of osteopenia and osteoporosis increased with the increasing in COPD degree from moderate to severe and then very severe as shown in (Table 2 and Fig. 1). These results can be explained as increase in COPD degree is associated with increase of risk factors that lead to occurrence of osteoporosis such as increased inflammatory load of COPD, using more corticosteroid treatment, decrease in pulmonary functions, and decrease in BMI.

These results were in agreement with the results of the study carried by Sin et al. (2003), which revealed that risk of osteopenia increases by 30% in moderate COPD and by 70% in severe COPD more than normal personnel, and the risk of osteoporosis increases by 2.1 fold in moderate COPD and by 2.8 fold in severe COPD more than normal personnel [17].

In our work there was statistically high significance between the mean of *T* score of COPD group and the mean of *T* score of control group that means BMD in COPD group was lower than BMD in control group as shown in (Table 3).

These results were in agreement with the results of the study carried by Lung Health Study Research Group (2000) which carried on 412 COPD patients during duration of 3 years and revealed that BMD was much lower in COPD patients than of normal personnel of same sex and age [6]. These results also were in agreement with the results of the study carried by McEvoy et al. (2003) on 312 COPD patients and revealed low BMD in COPD group more than in control group of the same sex and age [18].

Table 4 shows that there is direct relation between FEV1% and BMD in COPD patients who were osteoporotic.

These results were in agreement with Iqbal et al. (2004) who found that, in COPD group who had osteoporosis BMD decreases in linear patren with the decrease of FEV1% [14]. Also, these results were in agreement with the results of the cross sectional study carried by Jorgensen et al. (2007) on 62 COPD patients who found that, BMD had direct relation with FEV1% in COPD patients who had osteoporosis [15]. In contrast, Vesto et al. (2002) found that BMD in COPD patients had no relation with the degree of COPD, in other words there was no relation between *T* score and FEV1% [19].

In the present study, by using spearman's rho rank correlation between *T* score and different spirometric parameters in COPD group, there was; Statistically highly significant correlation between *T* score and FEV1%, FEF (25–75)%, and PEFR%, statistically significant correlation between *T* score and FVC%, and statistically non significant correlation between *T* score and SVC% and FEV1/FVC ratio, as shown in (Table 5).

Incalzi et al. (2004) found that there were significant correlation between *T* score and all spirometric parameters except FEV1% which had highly significant correlation and SVC% which had no significant correlation [20].

Conclusion

In conclusion, the present study showed that, osteoporosis is highly prevalent in patients with moderate to very severe COPD. Prevalence and severity of osteoporosis increased with the increase of COPD degree.

Recommendations

On the basis of the finding in this study it is recommended that all patients with COPD should be screened for osteoporosis in order to initiate treatment for the disorder before they develop fractures. Further studies are needed to determine the frequency and severity of osteoporosis in mild COPD patients.

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