

Research Article

To Study the Prevalence of Osteopenia and Osteoporosis in Patients with COPD and to Correlate Severity of COPD with Prevalence of Osteopenia and Osteoporosis

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A B S T R A C T

Chronic Obstructive Pulmonary Disease (COPD) is a chronic respiratory airway disease characterized by both pulmonary and systemic inflammatory response and associated extra-pulmonary complications. Female gender, age and smoking are common pathogenic risk factors for both COPD and osteoporosis. Many other factors like low daily physical activity, chronic malnutrition, hypogonadism, vitamin D deficiency and chronic steroid therapy are risk factors for osteoporosis.

Objectives: The study was done to evaluate the prevalence of osteopenia and osteoporosis in patients of COPD and to correlate the severity of COPD with osteopenia/ osteoporosis.

Material & Method: The study was conducted at a tertiary care hospital in Delhi after ethical clearance from institutional review board. Total of 76 patients of both genders were taken. COPD diagnosis and staging was done as per Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. Bone mineral density (BMD) was evaluated by DEXA scan in all patients. All data was entered in preformed data sheets. Statistical analysis for association of COPD with osteoporosis was done by chi-square test.

Result: Mostly patients were having either osteopenia or osteoporosis, only 6% patients were having normal BMD. COPD stage III-IV were having significant bone mass loss. Those having long smoking history were more osteoporotic as compared to others.

Conclusion: There is a very high prevalence of osteopenia and osteoporosis in COPD patients especially those with prolonged smoking history, GOLD stage III-IV. 35.5% of COPD patients had osteopenia and 57.9 % had osteoporosis.

Keywords: COPD, Dual-Energy X-ray Absorptiometry (DEXA), Osteoporosis, Global Initiative for Chronic Obstructive Lung Disease (GOLD)

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a disease of increasing public health importance around the world. According to Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD is a common preventable and treatable disease which is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the lung to noxious particles or gases.¹ Recurrent exacerbations and other associated comorbidities contribute to the overall severity in individual patient. COPD remains a major public health problem and is projected to be rank fifth, in year 2024, in burden of disease worldwide. In India, it is estimated that there are around 1.49 crore chronic cases of COPD in the age group of 30 years and above. In literature, it is stated that in most Western world, while the peak incidence of osteoporosis occurs at about 70-80 years of age, in India it may afflict 10-20 years younger age group as compared to the western world. In normal Indian population, 29.9% of women and 24.3% of men between the age group of 20 and 79 years have low bone mass, while about 50% women and 36% of men over 50 years of age have low bone mass as compared to the western population. Its prevalence is 5.0% amongst Indian males and approximately 3.2% among the Indian females over 35 years of age.² Patients with moderate to severe COPD often have multi-organ disease like skeletal muscle wasting, lung cancer (small cell, non-small cell), pulmonary artery hypertension, ischemic heart disease, vascular endothelial dysfunction with peripheral vascular disease, obstructive sleep apnoea, depression and osteoporosis.³

Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength, predisposing a person to an increased risk of fracture. The fracture risk depends on bone strength, which is determined by bone mineral density (BMD) and bone quality.⁴ However, due to the absence of clinical tools for precise evaluation of bone quality, a diagnosis of osteoporosis has been reliant on BMD measured by Dual Energy X-ray Absorptiometry (DEXA): osteoporosis is diagnosed when BMD is 2.5 standard deviations or more below the young adult mean (T-score is equal to or less than -2.5) according to the World Health Organization criteria.⁴ Evidence suggests that the prevalence of osteoporosis in patients with COPD is high and potentially important with disease progression. As the disease progresses, osteoporosis becomes a more prevalent finding in the patients of COPD.^{5,6}

Several studies have shown an extremely high prevalence of osteoporosis and low BMD in patients with COPD, even in milder stages of the disease.⁷ Over half of the patients with COPD recruited for the large TORCH (Towards a Revolution in COPD Health) trial (6,000 patients) had osteoporosis

or osteopenia as determined by DEXA.⁸ In one study, the prevalence of osteoporosis was 75% in patients with GOLD stage IV disease and was strongly correlated with reduced Fat Free Mass (FFM).^{9,10} Osteoporosis is often disabling in these patients and may be equally disabling as COPD itself. However, osteoporosis often remains undiagnosed in these patients and may impair respiratory function even further, if the patient experiences vertebral compressions and loss of height.^{5,11}

Osteoporosis-associated fractures may further deteriorate pulmonary function and impair activities of daily life of COPD patients. Thus, the two diseases will form a vicious cycle, causing significant burden on these patients.

Material and Method

The study was a hospital-based cross-sectional study and had been conducted by recruiting total of 76 patients including both genders, attending Out Patient Department (OPD) of Medicine and Chest clinic along with some indoor patients who were admitted in Medicine wards, at Dr RML Hospital, Delhi for a period of one year. All the patients aged ≤ 70 years, who were diagnosed with COPD, according to GOLD criteria were included in the study.

The diagnosis of COPD was made on clinical history/examination and Pulmonary Function Testing (PFT). The patients who fulfilled the exclusion criteria based on history and examination were excluded from the study. Exclusion criteria in our study were Cushing's disease, rheumatic diseases, diseases affecting bones like CKD, CLD, hyperparathyroidism, bronchogenic carcinoma, thyroid dysfunction and patients receiving bone forming drug. Informed consent was obtained from all the participants. All the data were recorded on a pre-designed proforma. After doing the routine investigations, all patients were subjected to Pulmonary Function Tests (PFT) by Spirometry as per standard protocol. After staging all the patients into various stages of COPD as per GOLD criteria, all patients were investigated by DEXA scan for BMD at lumbar and hip spine for finding out the osteopenia or osteoporosis in these patients. World Health Organization (WHO) criterion was taken for defining the osteoporosis and was applied to all patients with T-score of > -2.5 standard deviation (SD) was diagnosed to have osteoporosis, -1 SD to -2.5 SD were diagnosed to have osteopenia and < -1 SD as normal.⁵ In our study, BMD had been measured by 05 Prodigy Pro-Bone Densitometry System, Wipro GE Healthcare machine.

Statistical analysis for association of COPD with osteoporosis was done by chi-square test.

Result and Observation

The present study was undertaken to study the prevalence of osteopenia and osteoporosis in patients of COPD and to correlate severity of COPD with prevalence of osteopenia

and osteoporosis. In our study, we had observed that, out of the total 76 patients, majority of the patients of COPD had osteopenia/ osteoporosis. Only 6.6% (n=5) patients had normal BMD, 35.5% (n=25) had osteopenia, while 57.9% (n=46) had osteoporosis. Among males 32% (n=16) had osteopenia, while 62% (n=31) had osteoporosis and 6% (n=3) had normal BMD. Among females 42.3% (n=11) had osteopenia, while 50% (n=13) have osteoporosis and 7.7% (n=2) have normal BMD. Incidence of osteoporosis in menopausal women was 52.4% (n=15) and observed higher, as compared to pre-menopausal, 40% (n=11) women. The difference in mean age of normal BMD group (54.8± 10.52) and osteoporosis (57.17± 7.90) was statistically significant p<0.05. Demographic profile of the patients and their BMD status is represented in Table 1 and BMD status in different stages of COPD is shown in Table 2.

Among smokers (n=59), only 6.8% (n=4) had normal BMD, whereas 35.6% (n=21) had osteopenia and 57.6% (n=34) had osteoporosis. Among non-smokers (n=17), only 5.9% (n=1) had normal BMD, whereas 35.3% (n=6) had osteopenia and 58.8% (n=10) had osteoporosis. Patients who had smoking history of >10 yrs had statistically higher prevalence of osteoporosis compared to those who had smoked for ≤ 10 yrs (88.2% vs 11.8%, p<0.0001). Osteoporotic patients

(n=34) with history of smoking had statistically higher mean pack years as compared to normal BMD smokers (29.47 ±10.66 Vs 5.0± 2.94).

Patients who had history of inhaled corticosteroid (ICS) use for >2yrs had statistically higher prevalence of osteoporosis compared to those who had history of ICS use for ≤ 2 yrs (100% vs 48.3%, p<0.0001).

Mean duration of COPD was significantly lower in normal BMD group (1.86± 1.07 yrs) as compared to osteoporosis group (8.43± 1.66 yrs) p<0.05. Osteopenia and osteoporosis were affected significantly by the duration of COPD. The prevalence of osteoporosis increased with severity of COPD (28.6% in GOLD stage I, 38.2% GOLD stage II, 78.3% GOLD stage III and 91.7% GOLD stage IV (Figure 1).

Osteoporosis was found in majority of patients with COPD stage III and IV disease. Osteopenia and osteoporosis was more frequently noticed at lumbar spine than hip region (Figure 2). The patients having osteoporosis at hip area also had osteoporosis at lumbar area but the vice versa is not true. It was also observed significantly that those who smoked more than 10 years and frequently took steroids in oral or inhaled form had significant osteoporosis as shown in below study.

Table 1. BMD Status and Demographic Profile of Patients

Variable	Normal (n=5)		Osteopenia (n=27)		Osteoporosis (n=44)	
	Mean	SD	Mean	SD	Mean	SD
Mean age (yrs)	54.8	10.52	52.03	6.73	57.17	7.90
Female gender (n=26)	2 (7.7%)		11 (42.3%)		13 (50%)	
Male gender (n=50)	3 (6%)		16 (32%)		31 (62%)	
Mean duration of COPD (yrs)	1.86±1.07		2.20±1.04		8.43±1.66	
On ICS (n=66)	5 (7.6%)		25 (37.9%)		36 (54.5%)	
Not on ICS (n=10)	0		2(20%)		8 (80%)	
History of ICS used >24 months (n=8)	0		0		8 (100%)	
Tobacco Smoking (n=59)	4 (6.8%)		21 (35.6%)		34 (57.6%)	
>10yrs of smoking (n=31)	0		1 (3.2%)		30 (96.8%)	
Mean pack yrs of smoking	5.0±2.94		9.0±3.10		29.47±10.66	
Menopause (n=21)	2 (9.5%)		8 (38.1%)		11 (52.4%)	

Table 2. Association between COPD Stages and Bone Mineral Density

BMD	COPD STAGES							
	I (n=7)		II (n=34)		III (n=23)		IV (n=12)	
	No. [M/F]	%	No. [M/F]	%	No. [M/F]	%	No. [M/F]	%
Normal (n=5)	2 [1/1]	28.6	3 [2/1]	8.9	0	0.0	0	0.0
Osteopenia (n=27)	3 [2/1]	42.9	18 [12/6]	52.9	5 [2/3]	21.7	1 [0/1]	8.3
Osteoporosis (n=44)	2 [1/1]	28.6	13 [9/4]	38.2	18 [12/6]	78.3	11 [9/2]	91.7

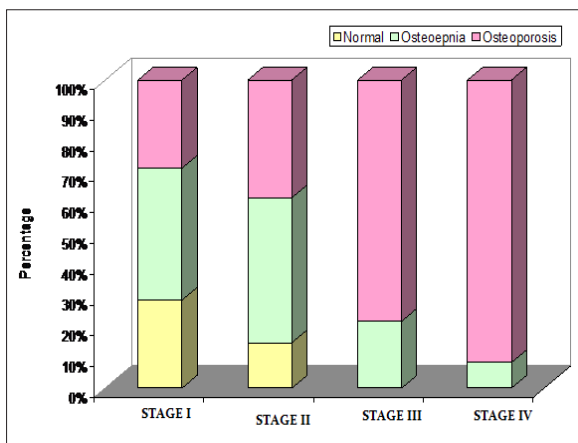


Figure 1. Relation of COPD Staging and BMD Results

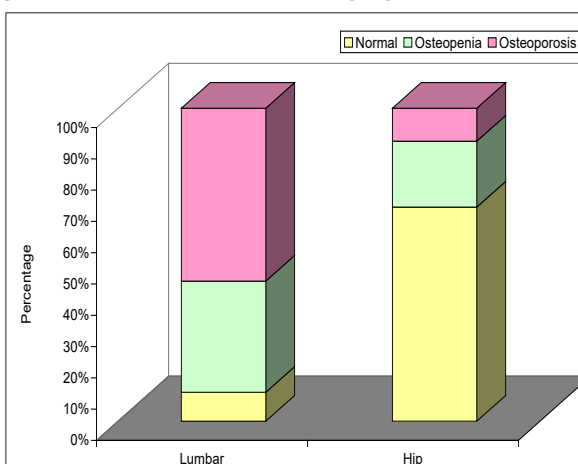


Figure 2. Distribution of Osteoporosis According to Site

Discussion

COPD is a chronic inflammatory airway and parenchymal disease, associated with various systemic comorbidities including osteoporosis. Osteoporosis and its related fractures are much common and have significant impacts on quality of life. DEXA along with other biochemical bone turnover markers are also useful for noninvasively evaluate bone metabolism.¹² Increase in bone markers, example, high bone turnover, has been shown to be not only a predictor of future BMD decline but also a BMD-independent risk factor of fracture in primary osteoporosis. It has been observed that COPD-associated osteoporosis is extremely under diagnosed as well as under-treated. Study done by Daga et al., also showed that osteoporosis is more prevalent among COPD patients than healthy subjects.¹³ Thus, it is also important to recognize other risk factors and strategies to manage osteoporosis in COPD patients to avoid osteoporotic fractures that deteriorate quality of life and future prognosis of the disease. The present study also supports the increased prevalence of osteoporosis in COPD patients. Also, various risk factors like chronic inhaled steroids, prolonged oral steroid therapy, poor nutrition and

recurrent exacerbation of COPD are also associated with reduced BMD in patients with COPD.

There are only a limited number of studies investigating bone turnover in COPD patients. Some of the recent studies¹⁴ have suggested that both decreased bone mineral density (BMD) and impaired bone quality contribute to bone fragility, causing fractures in COPD patients. Slemenda et al.¹⁵ reported that lumbar spine BMD was 12% lower in smokers who have smoked 20 pack years compared to non-smokers. It has been observed that prolonged smoking history has been shown to be an independent risk factor for osteoporosis both in men and women as shown in our study also. Patients with COPD who are often being treated with inhaled, oral, parenteral glucocorticoids, during exacerbations and such glucocorticoid therapy along with various other risk factors clearly increase the risk for the development and progression of osteoporosis in COPD patients. These finding also had been reported in study done Daga et al., which showed prevalence of osteoporosis in COPD in the range of 9-69%.¹⁶ Osteoporosis related fractures are associated with several adverse health outcomes in COPD, including an increase hospitalization along with loss of Disability-Adjusted Life-Years (DALYs) and increased mortality rates.¹⁷ Similar finding have been observed in our study also.

It has also been observed that after complete cessation of smoking, there is increase in BMD along with improvement in quality of life if complete abstinence is being maintained for smoking. Hence, a routine workup to screen all COPD patients for osteopenia/ osteoporosis should be done by DEXA. Early diagnosis and timely treatment of osteoporosis will prevent morbidity and significant loss of DALYs because of bone fractures. Also, all COPD patients should be counselled and followed on regular basis for complete cessation of smoking. It would further prevent other extra-pulmonary comorbidities and complications in COPD patients.

Conclusion

Our study showed that there is a high prevalence of osteopenia and osteoporosis in COPD patients especially those with prolonged smoking history, GOLD stage III-IV. Also it has been observed that lumbar spine is much more affected than hip region in COPD patients in our study.

Conflict of Interest: None

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