

Prevalence of Osteoporosis in Male Patients with Chronic Obstructive Pulmonary Disease

Bari MJ¹, Patwary MI², Hossain MD³, Hye AQMA⁴, Rahman SM⁵

Abstract

Osteoporosis is one of the systemic features of COPD. Aims and objective is to determine the prevalence of osteoporosis in male COPD. In a cross-sectional study, we conducted dual-energy X-ray absorptiometry bone mineral density scans of the femoral neck and lumbar spine and collected data on smoking, duration of COPD, inhaled and oral corticosteroid treatment and staging by pulmonary function tests. We included 60 male patients with COPD, the mean age was 62.4 ± 8.1 years, smoking was 36.8 ± 17.2 smoking-pack year, duration of COPD was 5.4 ± 3.3 years, GOLD stage-III (56.7%) stage-IV (38.3%) and stage-II (5.0%), use of oral steroid (11.7%) inhaled steroid (63.3%) and none (25.0%). Normal bone mineral density was in 6 (10.0%), osteopenia in 24 (40.0%) and osteoporosis in 30 (50%) patients in femoral neck; whereas normal bone mineral density was in 4 (6.7%), osteopenia in 17 (28.3%) and osteoporosis in 39 (65.0%) patients in lumbar spine. Osteoporosis is highly prevalent in male COPD patients in both femoral neck and lumbar spine.

1. Corresponding Author:
Dr. Mohammad Zabed Jillul Bari
Assistant Professor
Department of Medicine
Sylhet MAG Osmani Medical College, Sylhet.
e-mail: drzabedj75@gmail.com
Mobile: 01712055613
2. Dr. Md. Ismail Patwary
Professor
Department of Medicine
Sylhet Women's Medical College, Sylhet.
3. Dr. Md. Delwar Hossain
Assistant Professor
Department of Respiratory Medicine
Sylhet MAG Osmani Medical College, Sylhet.
4. Dr. Azizul Qadar Md. Abdul Hye
Associate Professor
Department of Pathology
Sylhet MAG Osmani Medical College, Sylhet.
5. Dr. Syed Mujibur Rahman
Assistant Professor
Department of Dermatology
Sylhet MAG Osmani Medical College, Sylhet.

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major cause of morbidity and mortality in adults and is the fourth leading cause of death in the world¹. It is characterized by chronic air flow limitation that is usually progressive². COPD is now considered as a multicomponent disorder associated with systemic inflammation and extra pulmonary manifestations³. Osteoporosis is a systemic skeletal disease characterized by a low bone mineral density (BMD) and microarchitectural changes in bones leading to an increased bone fragility and, in turn, resulting in an increased fracture risk⁴.

The prevalence of osteoporosis in COPD patients is 2-fold to 5-fold higher than in age-matched subjects without air-flow obstruction⁵⁻⁷. Osteopenia is present in 35-72% of patients with COPD, and 36-60% of patients with COPD have been reported to be osteoporotic^{8,9}. Moreover, COPD patients have a 60 to 70% higher risk of death following hip fracture than people without COPD¹⁰. It is therefore of high clinical importance to diagnose and treat osteoporosis in COPD according to international guidelines¹¹.

The gold standard for the diagnosis of osteoporosis is dual-energy absorptiometry (DXA)¹¹. Multiple sites can be used to measure BMD by DXA. The sites most frequently used are the hip, the lumbar spine, forearm and/or whole-body. Several studies investigated the best location for DXA-scanning to diagnose osteoporosis^{12,13}. Indeed, the International Society for Clinical Densitometry advocates to measure BMD of the lumbar spine and the hip and to diagnose osteoporosis based on the lowest T-score of the measured locations¹⁴.

Now COPD has been identified as a disease associated with osteoporosis and has been included in the fracture risk assessment in a few guidelines on osteoporosis and fracture prevention¹⁵. However, data is scarce in Bangladesh on the prevalence of osteoporosis in male patients with COPD, hence we aimed to assess the prevalence of osteopenia and osteoporosis in male patients with COPD.

Materials and Methods

This was a cross sectional study carried out in the Department of Medicine, Sylhet M.A.G. Osmani Medical College Hospital, Sylhet during the period from 1st July 2013 to 30th June 2015. Sixty male smokers at least 10 pack years, aged more than 40 years and diagnosed as cases of COPD fulfilling the inclusion and exclusion criteria were enrolled in this study. Patients with bronchial asthma, chronic heart failure, liver cirrhosis, thyroid dysfunction and rheumatologic disorders, malignancies, chronic renal disease; those using systemic steroid (at least for 3 month during the recent year); bisphosphonate, erythocalciferol, levothyroxin, lithium, calcium and vitamin D preparations were excluded.

Informed written consent was obtained from the patients or attendants after full explanation of the details of the disease process and purpose of the study.

Height and weight was determined barefoot and in lightweight indoor clothing and the body mass index (BMI) calculated.

Diagnosis of COPD based on clinical history and confirmed by pulmonary function testing. All subjects performed spirometry (Forced expiratory volume in 1 second [FEV₁], Forced Vital Capacity [FVC], and FEV₁/FVC ratio) using RMS Helios 702 spirometer (Recorders and Medicare systems private limited, MEDSPIROR, India) in the Department of Medicine Sylhet MAG Osmani Medical College Hospital, Sylhet. Staging of COPD was done as per GOLD Criteria, stage-I: FEV₁/FVC < 0.70, FEV₁ 80% predicted, stage-II: FEV₁/FVC < 0.70, FEV₁ 50-79% predicted, stage-III: FEV₁/FVC < 0.70, FEV₁ 30-49% predicted and stage-IV: FEV₁/FVC < 0.70, FEV₁ < 30% predicted or FEV₁ < 50% predicted if respiratory failure present¹⁶.

Bone mineral density of the patient was determined using whole body densitometer, DEXA Scan (Dual Energy X-Ray Absorptiometry) (GE Healthcare Lunar prodigy advance, scanner serial no. PA + 302343, software version ± ENCORE 2008 version 12.2, Germany). BMD, bone mineral content (BMC), and area were measured at the lumbar spine (vertebrae L2-L4) and at the femoral neck. All parameters were expressed in standard globally accepted terms: BMD (g/cm²), BMC (g), and area (cm²). A patient's BMD was given a T-score, which was derived by comparing it to an average score for a healthy 30-year-old male. The difference between the "normal young" score and the patient's score were referred to as a standard deviation (SD). T-score values below -2.5 SD was definable for osteoporosis; between -1.0 and -2.5 SD was definable for osteopenia and -1 SD are definable for normal bone density¹⁷.

All the collected data were compiled and analyzed using the SPSS (Statistical package for social science) 21 for windows.

Results

The age of the patients of COPD ranged from 43 to 80 years with the mean age of 62.4 ± 8.1 years. The most of the COPD patients (75.3%) were aged between 51 to 70 years (Table-I).

The mean smoking-pack year was 36.8 ± 17.2 (range, 10-90) pack-years (Table-I).

The mean duration of COPD was 5.4 ± 3.3 years (range, 1-15 years); the duration of COPD was 1 to 5 years in 38 (63.3%), 6 to 10 years in 18 (30.0%) and 11 to 15 years in 4 (6.7%) patients.

GOLD stage-III was the most frequent severity of COPD constituted 56.7% cases, followed by stage-IV (38.3%) and stage-II (5.0%) (Table-I).

Use of oral steroid in 7 (11.7%) patients, inhaled steroid was in 38 (63.3%) and 15 (25.0%) patients did not use any types of steroid (Table-I).

Table-I: Baseline characteristics of patients.

Variables	Frequency	Percent
Age		
41-50 years	6	10.0
51-60 years	18	30.0
61-70 years	32	53.3
71-80 years	4	6.7
Mean ± SD	62.4 ± 8.1	
Smoking (pack-years)		
<20	10	16.7
31-40	34	56.7
41-60	11	18.3
≥61	5	8.3
Mean ± SD	36.8 ± 17.2	
Severity of COPD		
Stage-II	3	5.0
Stage-III	34	56.7
Stage-IV	23	38.3

T-score in femoral neck was -2.31 ± 0.96 (range -3.80 to -1.1) and BMD in femoral neck was 0.77 ± 0.17 gm/cm² (range, 0.58 to 1.03) (Table-II).

When BMD were categorized according to T-score in femoral neck, normal bone mineral density was in 6 (10.0%), osteopenia in 24 (40.0%) and osteoporosis in 30 (50%) patients (Table-II).

T-score in lumbar spine was -2.92 ± 1.33 and BMD in lumbar spine was 0.87 ± 0.16 gm/cm² (Table-II).

When BMD were categorized according to T-score in lumbar spine, normal bone mineral density was in 4 (6.7%), osteopenia in 17 (28.3%) and osteoporosis in 39 (65.0%) patients (Table-II).

Table-II: Distribution of the patients by BMD (n=60).

DXA	Femoral neck	Lumbar spine
T-score	-2.31 ± 0.96	-2.92 ± 1.33
BMD (gm/cm ²)	0.77 ± 0.17	0.87 ± 0.16
Normal	6 (10.0%)	4 (6.7%)
Osteopenia	24 (40.0%)	17 (28.3%)
Osteoporosis	30 (50%)	39 (65.0%)

Discussion

Osteoporosis continues to be a major problem in men with chronic illness. In men with COPD, osteoporosis may be particularly disabling because vertebral fractures reduce vital capacity, which further compromises ventilation¹⁸. Evidence suggests that the prevalence of osteoporosis in patients with COPD is high and potentially important^{19,20}.

In this study the age of the patients of COPD ranged from 43 to 80 years with the mean age of 62.4 ± 8.1 years. This result was almost similar to the study of Jorgensen et al¹⁸ that the mean age of the male COPD patients was 62.8 ± 5.6 years. This result also correlated with other studies^{5,20}.

This study revealed that the mean smoking-pack year was 36.8 ± 17.2 (range, 10-90) pack-years. This result was consistent with the study of Graat-Verboom et al⁵ that the mean smoking-pack year of the COPD patients was 39.7 ± 0.8 .

In the present study the mean duration of COPD was 5.4 ± 3.3 years (range, 1-15 years); the duration of COPD was 1 to 5 years in 38 (63.3%), 6 to 10 years in 18 (30.0%) and 11 to 15 years in 4 (6.7%) patients. Nuti et al²¹ reported that COPD duration was ≤ 1 year in 13.1%, 1-5 years in 31.2% and above 5 years in 55.8% of patients.

In this study GOLD stage-III was the most frequent severity of COPD constituted 56.7% cases, followed by stage-IV (38.31%) and stage-II (5.0%). Graat-Verboom et al⁵ found that GOLD stage-I and II in 22%, GOLD stage-III in 34% and GOLD stage-IV in 44% patients with COPD.

This study showed that use of oral steroid in 7 (11.7%) patients, inhaled steroid was in 38 (63.3%) and 15 (25.0%) patients did not use any types of steroid. Nuti et al²¹ reported that oral corticosteroid in 4.5%, inhaled corticosteroid in 54.1% and both oral and inhaled corticosteroid in 10.6% cases of COPD.

In this study T-score in femoral neck was -2.31 ± 0.96 (range -3.80 to -1.1). Jorgensen et al¹⁷ found that the T-score in femoral neck was -1.51 ± 1.08 in male COPD patients. This study also revealed that T-score in lumbar spine was -2.92 ± 1.33 . Jorgensen et al¹⁷ found that the T-score in lumbar spine was -1.25 ± 2.08 in male COPD patients.

In the present study BMD in femoral neck was 0.77 ± 0.17 gm/cm² (range, 0.58 to 1.03). This result was almost similar to the study of Duckers et al²² that BMD in femoral neck was 0.74 ± 0.11 gm/cm² in men with chronic obstructive pulmonary disease. Jorgensen et al¹⁷ found that BMD in femoral neck was 0.888 ± 0.138 gm/cm² in men with chronic obstructive pulmonary disease. This study also showed BMD in lumbar spine was 0.87 ± 0.16 gm/cm². Duckers et al²² found that BMD in lumbar spine was 1.03 ± 0.20 gm/cm² in men with chronic obstructive pulmonary disease. Jorgensen et al¹⁷ found that BMD in lumbar spine was 1.089 ± 0.152 gm/cm² in men with chronic obstructive pulmonary disease. Jorgensen et al¹⁷ found that BMD in lumbar spine was 1.089 ± 0.152 gm/cm² in men with chronic obstructive pulmonary disease.

In this study bone mineral density was normal in 6 (10.0%), osteopenia in 24 (40.0%) and osteoporosis in 30 (50%) patients as regards BMD in femoral neck; while normal bone mineral density was in 4 (6.7%), osteopenia in 17 (28.3%) and osteoporosis in 39 (65.0%) patients as regards BMD in lumbar spine. Also it was demonstrated that 90% of patients with COPD varying from moderate to very severe had abnormal BMD in femoral neck and about 93% of patients with COPD varying from moderate to very severe had abnormal BMD in lumbar spine. These results were in agreement with the results of the cross sectional study carried by Jorgensen et al¹⁷ on 62 COPD patients who found that 78% of patients had low BMD either osteopenic or osteoporotic. Also, these results were in agreement with results of the study carried by Dubois et al²³ 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. Naghshin et al²⁴ reported the frequency of osteopenia was 36% and osteoporosis was 26% COPD patients according to spinal densitometry; while using femoral neck densitometry results the frequency of osteopenia was 24% and osteoporosis was 52% COPD patients.

Conclusion

A low BMD and osteoporosis is highly prevalent in male in COPD patients both in femoral neck and in lumbar spine. This study suggests a disease related causative component. The mechanism of BMD loss in COPD remains unclear but our results suggest increased bone turnover. These findings highlight the potential value of studying BMD and reinforce the need for earlier identification and targeting of risk factors for osteoporosis as part of the management of COPD. However further study is warranted.

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