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Original Research Article

Exploring prevalence and risk factors association of osteoporosis among chronic obstructive pulmonary disease patients: a cross-sectional study in western Rajasthan

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a prevalent respiratory condition with progressive respiratory symptoms and systemic complications, including osteoporosis. It is characterized by decreased bone mass represents significant health risks among COPD patients. However, associated risk factors were partially understood requires further exploration.
Methods: Study conducted at a tertiary care hospital in western Rajasthan, India, we aimed to assess the prevalence and risk factors association of osteoporosis among COPD patients. A cross-sectional study was conducted from January 2023 to December 2023, involving 102 COPD patients by Convenience sampling categorized according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. Bone mineral density (BMD) was measured using dual-energy X-ray absorptiometry (DEXA), and demographic and clinical data were collected.
Results: Our findings revealed high prevalence of osteoporosis (48%) among COPD patients, showed significant associations with advancing age, female sex, underweight status, and more severe COPD stages. Female gender, older age, underweight status, higher Modified Medical Research Council (mMRC) dyspnea scores, and advanced GOLD stages were identified as significant risk factors for osteoporosis.
Conclusions: These results underscore the importance of early screening and management of osteoporosis in COPD patients to mitigate its adverse effects on quality of life and morbidity. Implementing routine BMD measurements using DEXA in COPD management protocols can facilitate timely diagnosis and intervention, ultimately improving patient outcomes. Further research is warranted to elucidate the mechanistic links between COPD and osteoporosis and to explore targeted therapeutic strategies for mitigating bone loss and fracture risk in this vulnerable population.

Keywords: Bone mineral density, Chronic obstructive pulmonary disease, Osteoporosis

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is common and causes progressive and persistent respiratory symptoms. If we talk of the year 2019, COPD was considered as the third leading cause of death worldwide and was thought to be continue to rise.[1] COPD patients also have concomitant chronic diseases due to systemic involvement, including cardiovascular disease, skeletal muscle wasting, lung cancer, osteoporosis, metabolic

syndrome, and anxiety/depression.[2] Comorbidities often affect the progression, morbidity, and mortality of patients with COPD.

Osteoporosis is a silent COPD comorbidity that is closely related and often under-detected in the clinic; it leads to poor health status and mortality. Osteoporosis is characterized by a decrease in bone mass and microarchitectural deterioration of the bone tissue, leading to bone fragility and fracture.[3] However, the pathophysiology of COPD-associated osteoporosis is still not well understood and requires further research and study. This hypothesis was based on low bone mineral density (BMD), abnormal bone changes, impaired bone quality, and low bone turnover due to systemic inflammation.[4] Nowadays, there are much increasingly diverse data on the relationship between osteoporotic risk factors and COPD; including smoking, systemic inflammation, long-term corticosteroids used, decreased physical activity, smoking, and malnutrition.[5] The molecular pathways of osteoporosis in COPD patients comprise of the interaction between risk factors and molecular pathways such as inflammatory cytokines, irisin, myostatin, osteoclast differentiation, osteoblast activity, etc.[6] These purposed pathways describe the mechanisms of bone loss and muscle loss in COPD patients. Meanwhile, osteoporosis can lead to fractures that have an enormous impact; vertebral fractures may reduce pulmonary function, and rib fractures can cause hypoventilation and interfere with expectorant secretion.[7]

In the present study, we have analyzed our OPD patients with COPD and recorded degree and frequency of osteoporosis and osteopenia.

METHODS

The present study was conducted in the department of Pulmonary Medicine at tertiary care hospital in western Rajasthan, India on COPD patients during the period of January 2023–December 2023 involving 102 COPD patients by Convenience sampling.

This was a cross-sectional study. The study included outdoor patients of varying stage of Chronic Obstructive Pulmonary Disease. The COPD staging was done according to the GOLD criteria.[2]

Inclusion criteria

All the patients diagnosed as a case of COPD, based on GOLD guidelines were included in the study.[2] The diagnosis of COPD was done by pulmonary function testing and staging was done as per GOLD criteria.

Exclusion criteria

Bronchogenic carcinoma, untreated thyroid dysfunction, rheumatic diseases, diseases affecting bone or calcium homeostasis, primary or secondary hyperparathyroidism, Cushing's syndrome, established osteoporosis, and patients taking treatment with bone active agents.

Procedure

The study was approved by the ethical and research committee of institute. The selected patients were briefed about the study and written informed consent was obtained. The study was designed as a cross-sectional study and the enrolled patients were given a questionnaire concerning age, gender, previous bone fractures, present and previous medications, cigarette smoking in pack years, duration of respiratory disease, number of exacerbations and admission due to acute exacerbation of COPD in the past 1 year,

BMI of all the patients was calculated and they were classified as underweight, normal, overweight and obese with a BMI <18.5, 18.5–24.9, 25–29.9, ≥30, respectively.

Bone mineral density (BMD) of the patient was determined using whole body densitometer, DEXA Scan (GE Healthcare Lunar prodigy advance, scanner serial no. PA + 302343, software version - ENCORE 2008 version 12.2, Germany). A patient's BMD was given a T-score, which is derived by comparing it to an average score for a healthy 30-year-old of the same sex and race. The difference between the "normal young" score and the patient's score is referred to as a standard deviation.[8]

Statistical analysis

This is a cross-sectional study in which prevalence of osteoporosis in COPD was evaluated. Prevalence of osteoporosis in COPD was estimated by considering all the COPD patients attending the respiratory clinic. Severity of osteoporosis was correlated with stages of COPD by one-way analysis of variance (ANOVA) test.

RESULTS

Demographic characteristics

The study included a total of 102 participants, with a majority falling within the age groups of 50-69 years (approximately 75%). The mean age of the participants was 60.37 years, with a standard deviation of ±10.867. Regarding gender distribution, males constituted 72.5% of the sample.

Body mass index

In terms of body mass index (BMI) distribution, 46.1% of participants were categorized as underweight, followed by 39.2% classified as normal weight. A smaller percentage were identified as overweight (8.8%) or obese (5.9%). The mean BMI of the participants was 20.24, with a standard deviation of ±5.823.

Table 1: Demographic characteristics, body mass index, disease severity and functional status and osteoporosis status of participants.

Variables	N	Percentage
Age group (years)		
40-49	19	18.6
50-59	31	30.4
60-69	31	30.4
70-79	15	14.7
80-89	6	5.9
Mean age	60.37±10.867	
Sex		
Female	28	27.5
Male	74	72.5
Body mass index		
Underweight	47	46.1
Normal	40	39.2
Overweight	9	8.8
Obese	6	5.9
Mean BMI	20.24±5.823	
mMRC		
1	47	46.1
2	36	35.3
3	19	18.6
Gold stage		
A	26	25.5
B	36	35.3
E	40	39.2
Osteoporosis		
Yes	49	48
No	53	52

Disease severity and functional status

Based on the mMRC (Modified Medical Research Council) dyspnea scale, the majority of participants reported mild dyspnea (46.1%), followed by moderate (35.3%) and severe (18.6%) levels. Regarding GOLD (Global Initiative for Chronic Obstructive Lung Disease) stage classification, the distribution was as follows: Stage A (25.5%), Stage B (35.3%), and Stage E (39.2%).

Osteoporosis

Nearly half of the participants (48%) were diagnosed with osteoporosis, while the remaining 52% did not exhibit signs of the condition. Overall, these findings provide insight into the demographic profile, BMI distribution, disease severity, and prevalence of osteoporosis among the study population.

Risk factors of osteoporosis in chronic obstructive pulmonary disease (COPD) patients

Sex: Female gender was associated with a significantly increased risk of the condition, with an unadjusted odds ratio of 2.497 (95% CI: 1.015-6.144, p=0.046).

Age: Each one-year increase in age was associated with a 7.5% increased odds of the condition, with an unadjusted odds ratio of 1.075 (95% CI: 1.031-1.121, p=0.001).

Body mass index:

Underweight: Participants classified as underweight had a significantly higher risk of the condition compared to the reference population (normal BMI), with an unadjusted odds ratio of 3.061 (95% CI: 1.268-7.391, p=0.013).

Overweight: Being overweight did not show a significant association with the condition (OR: 0.593, 95% CI: 0.108-3.265, p=0.549).

Obese: There was no significant association observed between obesity and the condition (p=0.999).

Table 2: Risk factors of osteoporosis in chronic obstructive pulmonary disease patients.

Risk factors	Univariate analysis		P value
	Unadjusted odds ratio	95% CI	
Sex (female)	2.497	1.015-6.144	0.046
Age	1.075	1.031-1.121	0.001
BMI			
Normal	Reference population		
Underweight	3.061	1.268-7.391	0.013
Overweight	0.593	0.108-3.265	0.549
Obese	-	-	0.999
mMRC			
1	Reference population		
2	2.206	0.909-5.354	0.080
3	3.025	1.001-9.142	0.050
Gold stage			
A	Reference population		
B	3.360	1.036-10.893	0.043
E	9.800	2.991-32.111	0.000

p≤0.05 considered statistically significant

mMRC (Modified Medical Research Council) Score: - Participants with higher mMRC scores had elevated odds of the condition compared to those with a score of 1 (reference population). - Score 2: OR=2.206, 95% CI: 0.909-5.354, p=0.080. - Score 3: OR=3.025, 95% CI: 1.001-9.142, p=0.050.

GOLD (Global Initiative for Chronic Obstructive Lung Disease) Stage: - Participants categorized as Stage B had a significantly increased risk of the condition compared to Stage A (reference population), with an unadjusted odds ratio of 3.360 (95% CI: 1.036-10.893, p=0.043). - Participants in Stage E exhibited the highest risk, with an unadjusted odds ratio of 9.800 (95% CI: 2.991-32.111, p<0.0001) p≤0.05 was considered statistically significant.* These results highlight significant

associations between various demographic and clinical factors and the risk of the condition.

DISCUSSION

In this study, osteoporosis was found in 58.04% patients, In a similar study done by Graat-Verboom et al in 2009 in a review of 13 studies with a total of 775 COPD patients reported that the prevalence of osteoporosis in COPD patients varies between 9 and 69%.[9]

It is a known fact that female sex is at increased risk for development of osteoporosis, due to the effect of estrogen, as compared to male sex. In the current study, it was observed that prevalence of osteoporosis was high in female population in compare to male which was statistically significant (P<0.046). Similar result was also found in a meta-analysis done by Graat-Verboom et al.[9]

In the present study, majority of patients who had osteoporosis had stage E COPD (57.14%). Similar result found by study done by Jørgensen et al, it was observed that there was increased incidence of osteopenia and osteoporosis with advancing COPD stage.[10] Similar result also found in study by Graat-Verboom et al, they observed that as severity of COPD increased, the prevalence of osteoporosis also increased.[9] In another study by Vrieze et al, had similar findings of higher prevalence of osteoporosis in stage III and stage IV COPD disease as compared to stage I and stage II COPD.[11]

A correlation of BMI to the development of osteoporosis was also done in the study. It was observed that patients who were underweight have higher prevalence of osteoporosis as compared to overweight patients and this association was statistically significant (P<0.013). A study by Bisboking et al, observed that bone mass was directly correlated with BMI.[12] Both men and women with high BMIs have higher BMD. This is thought to be partially due to the effect of the greater weight-bearing load on the bones. In addition, estrogen levels tend to be higher in obese people due to the increased aromatization of testosterone to estrogen in adipose tissue. The resulting higher estradiol levels may help to explain the higher BMD in obese persons, since estradiol levels in both men and women correlates with BMD. Many patients with end-stage COPD lose weight as the disease progresses due to decreased intake and increased energy requirements.[13]

CONCLUSION

COPD is now increasingly being recognized as an inflammatory condition of the lung; and over the past decade, it has been recognized for its systemic inflammation and having extrapulmonary manifestations. In this study, the prevalence of osteoporosis is high in COPD patients with increasing severity of disease, advance age, female sex and underweight. Hence it is recommended that all patients with COPD should be screened for osteoporosis using BMD measurements made by DEXA, which is considered the GOLD standard method for the early diagnosis and proper therapy of this condition can be advised at the earliest. This will help in improving the quality of life in these patients and thus improving the morbidity of this condition.

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