Original Article

Prevalence of osteoporosis and osteopenia in advanced chronic obstructive pulmonary disease patients

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ABSTRACT

Background: Reduction of bone mineral density (BMD) is a known and established phenomenon in chronic obstructive pulmonary disease (COPD). However, there have been no data regarding osteoporosis/osteopenia in COPD patients in India. **Aim:** To look for the degree and frequency of osteoporosis/osteopenia in our OPD patients being diagnosed as COPD. **Materials and Methods:** Thirty-seven randomly selected patients with COPD were assessed for BMD with commercially available ultrasound bone densitometer (HOLOGIC SAHARA) in a pulmonary OPD. Some cofactors for reduced BMD were also noted. **Results:** Out of the 37 COPD (all belonging to the GOLD III/IV category) patients studied, the BMD was found to be normal in 10 (27%) patients, while 27 (73%) patients were found to have osteopenia/osteoporosis [19 (51.35%) and 8 (21.62%) patients having osteopenia and osteoporosis, respectively]. **Conclusion:** Frequency of osteoporosis and osteopenia was found to be very high (73%) in our population of advanced COPD. The data suggest a need for further in-depth study regarding the issue.

KEY WORDS: Bone mineral density, chronic obstructive pulmonary disease, osteopenia, osteoporosis

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) predominantly affects elderly people with history of smoking or exposure to noxious gaseous substances for a prolonged period. This progressive and poorly reversible problem of air flow limitation has been found to be associated with a variety of systemic manifestations, and amongst these, reduced bone mineral density (BMD) has been recognized as one of the systemic effects of COPD irrespective of the stage of the disease,[1] being compounded by restricted mobilization, poor intake of food and use of corticosteroids concomitantly. Osteoporosis and osteopenia are common observations in COPD,[2] and the degree of the loss of BMD has been found to be proportionate to the severity of the disease.[3] This association is important from a clinical point of view as appropriate interventions may lessen the morbidity of the COPD patients.

In the present study, we have looked at the degree and frequency of osteoporosis and osteopenia in our OPD patients with COPD.

MATERIALS AND METHODS

COPD patients, diagnosed on spirometry as per the GOLD guidelines,[4] were selected randomly from the OPD of the Institute of Pulmocare and Research, Kolkata (India), and were included upon the availability of written informed consent for measurement of BMD. Patients with any significant comorbidity such as concomitant active respiratory tract infection, neoplastic disease, significant cardiac ailment or any systemic disease that can likely affect the BMD from immobilization or treatment were excluded. Similarly, patients with history of taking systemic steroid in the preceding 6 weeks were also excluded.

Access this article online

Quick Response Code:

Website: www.lungindia.com

DOI: 10.4103/0970-2113.83974

Information about smoking and treatment with corticosteroids, calcium supplementation, day-to-day activities, respiratory exercises done regularly or not along with history of hospitalization and exacerbation frequently (more than twice), cumulative dose of systemic steroid (prednisolone equivalent use in last 1 year) was obtained with the help of a questionnaire.

The study had approval from the institutional research ethics committee.

Measurement of BMD

The BMDs of the left heel bone (calcaneus) of the patients of the COPD education camps were measured with the help of a broadband ultrasound bone densitometer (HOLOGIC SAHARA, HOLOGIC Inc., USA) during the period from November 2007 to July 2009. The system incorporates two ultrasound transducers positioned opposite to each other, touching the lateral aspects of the heel that is being placed in between the transducers. The densitometer measures the speed of sound (SOS) and broadband ultrasonic attenuation (BUA) in dB/MHz of an ultrasound beam that passes through the calcaneus. It makes an estimation of BMD and the T-score from this data by the system software. The T-score quantifies the difference between the patient's BMD and the mean value for healthy young adults from the reference group. According to WHO, the normal value for T-score is within 1 SD of the mean value for young adults (−1 to +1).[5] Osteopenia is considered when T-score is between −1 and −2.5. Osteoporosis is considered to be present when the value for BMD is less than −2.5 SD below the mean for young adults.

RESULTS AND ANALYSIS

Thirty-seven patients with mean age 65.32 ± 9.58 years and a male female ratio of 35:2 were included. The BMD findings were (a) normal in 10 patients (27%) (the mean T-score being 0.51 ± 0.27), (b) osteopenia in 19 patients (51.35%) (the mean T-score being 1.78 ± 0.31), and (c) osteoporosis in 8 patients (21.62%) (the mean T-score being 2.84 ± 0.23). When the mean BMD scores of osteoporosis (0.26 ± 0.03) and osteopenia (0.38 ± 0.04) were compared, the difference was found to be highly significant ($P < 0.001$) statistically. The mean T-scores were 0.51 ± 0.27 for normal group, −1.78 ± 0.31 for osteopenia, −2.84 ± 0.23 for osteoporosis, and −2.10 ± 0.57 for osteopenia and osteoporosis combined.

The frequency and the results of the unpaired "*t*" test were charted as per the information on each variable presented in the questionnaire. The results have been shown in Table 1.

The statistical analysis shows that there is significant difference in mean dose of glucocorticosteroid (duration in months) and mean BMD score of COPD patients between normal and low BMD patients with osteopenia + osteoporosis.

Table 1: Difference between the COPD patients with normal and lower bone density as regards different historical, clinical, FEV_1 and BMD score

Parameters	Normal (10)	Osteoporosis + osteopenia (27)	*P* value
Age (years)	63.30 ± 9.53	66.07 ± 9.67	0.44
Pulse rate (/min)	102.7 ± 15.83	92.7 ± 14.1	0.07
SaO_2 (%)	95.3 ± 2.98	95.52 ± 5.40	0.90
Duration of symptoms (months)	121.20 ± 85.87	212.70 ± 193.52	0.16
Duration of diagnosis (months)	95.4 ± 67.20	149.88 ± 198.38	0.40
Hospitalization	50%	40.74%	0.89
Exacerbation in last 1 year (more than thrice)	50%	70.37%	0.44
Ca++ drug intake in last 1 year	20%	48.15%	0.24
Respiratory exercise done regularly	80%	70.37%	0.86
Dose of glucocorticosteroid (duration in months)	16.12 ± 12.97 (9)	37.22 ± 21.36 (17)	0.01*
Pre FEV_1 (L)	0.79 ± 0.49	0.81 ± 0.37	0.90
BMD score (g/cm^2)	0.54 ± 0.06	0.35 ± 0.06	<0.001*

*Statistically significant. COPD: Chronic obstructive pulmonary disease; BMD: Bone mineral density

If the mean BMD scores of osteoporosis (0.26 ± 0.03) and osteopenia (0.38 ± 0.04) are compared, the difference is found to be highly significant ($P < 0.001$) statistically.

DISCUSSION

Reduced BMD is either expressed as osteoporosis or osteopenia. Osteoporosis is a systemic skeletal disease characterized by micro-architectural reduction of bone tissue, leading to a low bone mass, increased bone fragility and thereby increased fracture risk.[6] Osteopenia refers to BMD that is lower than normal peak BMD, but not low enough to be classified as osteoporosis. Both these phenomena can develop from different etiologies such as prolonged immobilization, restricted movement, calcium and phosphate deficiency, use of systemic steroid, etc.

It has been found that osteoporosis and osteopenia are common observations in COPD[3] which is a disease of chronic airflow limitation with poor reversibility to bronchodilators. Reduction of BMD in COPD has been found in about 50% of patients in several studies.[2] While steroid (inhaled or systemic) therapy is being considered the most common risk factor, investigators, however, have argued that use of steroids alone cannot explain the high prevalence of osteoporosis/osteopenia in COPD patients.[2] The degree of lung function reduction and severity of COPD is also found to correlate with these phenomena. In a cross-sectional study, the prevalence of osteoporosis was 75% in patients with GOLD Stage IV disease and was strongly correlated with reduced FFV1.[7,8] In the large TORCH (Towards a Revolution in COPD Health) trial again, over half of the COPD patients recruited (out of the 6000

patients) had osteoporosis or osteopenia as determined by dual energy radiograph absorptiometry (DEXA).[8] Our finding of the prevalence of osteoporosis and osteopenia to be as high as 73% tallies the observations elsewhere.[3,9]

The data from our observation reveal that COPD patients having osteopenia and osteoporosis ($n = 27$) and COPD patients with a normal BMD ($n = 10$) have no difference as regards age, lung function (FEV_1), hospitalization rate, and frequency of respiratory exercise done regularly. However, they differ in duration of symptoms ($P = 0.03$), the duration of diagnosis of COPD ($P = 0.04$), and dose of systemic steroid ($P = 0.011$). Although the patients with reduced BMD had higher frequency of repeated exacerbations in last 1 year, it was not statistically significant ($P = 0.44$). It is an interesting observation that the patients with a normal BMD had reduced duration of symptoms and the time elapsed after the diagnosis, while the disease severity was equal in magnitude as per the FEV_1 value. This is possible if the COPD patients with normal BMD had faster decline of FEV_1 or the low BMD COPD patients had some coexistent problem affecting their BMD differentially. This can be explained clearly by higher intake ($P = 0.011$) of systemic steroid in the later group. It is likely that the group having low BMD was also affected by prolonged immobilization for a higher rate of exacerbation as noted. Unfortunately, we have not taken into account the duration of immobilization in the low BMD group. Interestingly, although the exacerbation rate was higher in the osteoporosis–osteopenia (combined) group, the hospitalization rate in the same group was lower than the other. It is not possible to explain this paradox with such a small number of recruits.

All the patients were in GOLD III/IV stage (mean $FEV_1 = 0.80 \pm 0.40$ L) and we have not noted the BMD of the early COPD patients. Hence, the actual prevalence of osteoporosis/osteopenia in overall COPD population cannot be conferred from our observation. Incidentally, again, the history of calcium intake in the preceding 1 year was more with the patients of osteoporosis or osteopenia though none had history of taking bisphosphonate. It is not possible to comment on the reasons of such higher level calcium supplementation in this group. Besides intake, the calcium homeostasis depends on several other factors. Mere calcium supplementation may not be enough to measure actual calcium utilization for restoring the BMD. Factors like vitamin D deficiency need to be taken into account and this area needs attention in future studies.

The BMD in our patients was measured by a broadband ultrasound bone densitometer. Although the method has comparable accuracy, it is not considered the gold standard as DEXA scan. Moreover, a single heel ultrasound measurement may not correctly indicate the BMD in general since this can be affected by local pathological conditions. Although there was no such obvious factor encountered during the study, observing a strict protocol in this regard would have been better.

Since most of our volunteers were males, we could not gather any information about the BMD of female COPD patients in our community. With a small number of subjects, it is not possible to make any comparison between the osteopenia and osteoporosis groups. We have not looked for the presence and the effects of the systemic inflammation by measuring any of its markers, though we could have some idea about the level of sarcopenia from reduced BMI.[10] Historical assessment of frequency of exacerbation in last one year, though imperfect, is important since it reflects the status of the patient as per the severity and the level of care. Since there is no difference between the two groups as far as severity of COPD (FEV_1 as 0.79 ± 0.49 vs. 0.81 ± 0.37 L in normal and reduced BMD group, respectively) is concerned, the higher prevalence of hospitalization in normal BMD group needs further investigation.

Association of osteoporosis and osteopenia in COPD is important from a clinical point of view as appropriate intervention may lessen the morbidity of the COPD patients and such high prevalence of the conditions cannot be ignored in our population. The data suggest a need for further detailed prospective research in this area.

REFERENCES

1. Ionescu AA, Schoon E. Osteoporosis in chronic obstructive pulmonary disease. Eur Respir J 2003;22:Suppl 46:64s-75.
2. Jorgensen NR, Schwartz P. Osteoporosis in chronic obstructive pulmonary disease patients. Curr Opin Pulm Med 2008;14:122-7.
3. Mc Evoy CE, Ensrud KE, Bender E, Genant HK, Griffith JM, Niewoehner DE. Association between corticosteroid use and vertebral fractures in older men with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 1998;157:704-9.
4. Calverly PM. The GOLD classification has advanced understanding of COPD. Am J Respir Crit Care Med 2004;170:211-2.
5. World Health Organization. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: Report of a WHO study group,1994; Geneva.
6. Anonymous. Consensus development conference: Diagnosis, prophylaxis and treatment of osteoporosis. Am J Med 1993;94:646-50.
7. Jorgensen NR, Schwartz P. Osteoporosis in chronic obstructive pulmonary disease patients. Curr Opin Pulm Med 2008;14:122-7.
8. The TORCH Study Group. The TORCH (Towards a Revolution in COPD Health) survival study protocol. Eur Respir J 2004;24:206-10.
9. Vrieze A, Greef MH, Wijkstra PJ, Wempe JB. Low bone mineral density in COPD patients related to worse lung function, low weight and decreased fat-free mass. Osteoporos Int 2007;18:1197-202.
10. Mc Donald VM, Wood LG, Smart J, Higgins I, Gibson PG. An investigation of sarcopenic obesity in COPD. Am J Respir Crit Care Med 2009;179:A4039.

How to cite this article: Bhattacharyya P, Paul R, Ghosh M, Dey R, Dey R, Barooah N, Islam S, Acharya D, Nag S, Bardhan S. Prevalence of osteoporosis and osteopenia in advanced chronic obstructive pulmonary disease patients. Lung India 2011;28:184-6. **Source of Support:** Nil, **Conflict of Interest:** None declared.