Original Research Article

Assessment of Prevalence of Osteoporosis Among Female Chronic Obstructive Pulmonary Disease Patients at A Rural Tertiary Care Centre of North India

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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 suggeststhat the prevalence of osteoporosisin patients with COPD is high and potentially important.The strength of the bone depends on bone mineral density (BMD) and bone quality. The BMD is measured by the dual-energy X-ray absorptiometry (DEXA) scan. This disease being severe but its prevalenceamongfemale COPD patients in North India is not well documented. **Objectives:** To find the prevalence of osteoporosis among female chronic obstructive pulmonary disease patients at a rural tertiary care centre of north India. **Materials & Method:** This is a cross sectional study conducted between January 2019 to June 2020 in Department of Respiratory Medicine, UPUMS, Saifai, Etawah. Female COPD patients those who fulfilled the inclusion criteria were included in the study and Classification of Osteopenia and Osteoporosis were done by World Health Organization Criteria.**Result:** A total of 210 female COPD patients were included. The mean age of the patients in this study was 63.38 ±10.54years with a range from 40 to 92 years.In this study 88% patients were exposed to biomass fuel smoke and 44.76% were exposed to smoking. Out of 210 female COPD patients 44.29% were of GOLD Stage2, 30.48% were of GOLD Stage 3, 17.62% were of GOLD Stage 1 and 7.61% were of GOLD Stage 4. Out of 210 patients 3.81% had T-Score in DEXA Scan of ≥(-1.0) i.e. Normal, 25.71 % had T-Score in range of (-1.0) to (-2.5) i.e. Osteopenia and 70.48% had T-Score in DEXA Scan <(-2.5) i.e. Osteoporosis.**Conclusion:** Out of 210 patients prevalence of Osteoporosisin female Copd patients was 70.48%. There was a significant correlation of severity of COPD (GOLD Stage) with Osteoporosis. There was no positive correlation between route and duration of steroid use with Osteoporosis and number of COPD exacerbations with Osteoporosis. There was no significant correlation between Body mass index (BMI) and Osteoporosis. Osteoporosis is common in female patients with COPD and its presence may have significant impact on the quality of life of such patients.

Keywords: Chronic obstructive pulmonary disease, Osteoporosis, DEXA Scan

Introduction

Chronic obstructive pulmonary disease (COPD)is a common preventable and treatable disease characterized by persistent respiratory symptoms and airflow limitation that is due toairway and or alveolar abnormalities usually caused by significant exposure to noxious particle or gases(GOLD 2020). [1] COPD is currently the fourth leading cause of death in the world but is projected to be the 3rd leading cause of death by 2020.More than 3 million people died of COPD in 2012 accounting for 6% of all deaths globally. [2]The prevalence of COPD in women varies by country; however most evidence indicates similar disease prevalence in menand women. [3-8].

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Co-morbidities are very common in COPD and they contribute to the overall severity of the disease, impairing quality of life and increasing mortality .The prevalence of the different co-morbidities in COPD varies according to several variables like gender, severity of the ventilatory impairment or predominant COPD phenotype. 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. [9] 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. [10-12] Osteoporosis tends to progress in COPD patients also. In a three-year follow-up study, Osteoporosis prevalence increased from 47% to 61% in stable COPD patients. [13] The prevalence of osteoporosis is higher in women than in men, and it could be expected that women with COPD therefore would be even more susceptible to develop osteoporosis than women with normal lung function. It is well-established that women are more prone to develop COPD even if they on an average basis do not smoke as

much as men. This is partially because they are less resistant to the harmful side effects of smoking than men, but also that women live longer, and live to an older age with their lung disease. [14] Therefore this study was plannedto assess prevalence of osteoporosis among female COPD at a rural tertiary care centre of north India.

Materials and methods

This is a hospital basedcross-sectional study carried out at Respiratory medicine Out Patient Department and In patient Department of up Universityof medical sciences, saifai, etawah, conducted between January 2019 to June 2020.Female COPD patients of 40 years and above, who were hemodynamically stable and co-operative and patients who provided consent to participate in the study were included. Patients with recent myocardial infarction , respiratory failure, Pregnant female COPD patients, patients with multiorgan failure, with thyroid dysfunction, with cardiac, renal, hepatic failure were excluded.Data were collected by semi-structured, pre-designed questionnaire with sections on socio demographic profile, (age, working status, habitat, family income and socio-economic status, education, smoking and other addiction habits) clinical profile sheet,[diagnosis of patient, stages of copd, grading of dyspnoea, duration of illness, number of exacerbations , dual energy x-ray absorptiometry (DEXA) Scan, history of smoking (Cigarette /Bidi/Hukka), Bio Mass Fuel exposure history, Treatment history,Blood pressure measurement, Anthropometric measurements, pft values, abg values,value and serum calcium values]. COPD has been diagnosed according to criteria adopted and recommended by GOLD 2020.All patients evaluated are subjected to chest X-Ray PA view and spirometrytoconfirm the diagnosis and to exclude other pathology of the chest.

Measurement of Bone Mass Density

World Health Organization Criteria for Classification of Osteopenia and Osteoporosis

Category	T-Score
Normal	-1.0 or above
Low bone mass osteopenia*	Between -1.0 and -2.5
Osteoporosis	-2.5 or below

Bone density results are reported as grams of mineral per square cm of projected bone area and are converted to T- scores.The T-score represents the number of Standard Deviations from the normal young-adult mean values.We have used T-Scores for evaluation of Osteoporosis in this study.

Data Analysis: The data thus collected was entered into Microsoft office excel worksheet and result was analysed by using SPSS version 25 (IBM USA) software and appropriate statistical interpretation was done using proportions, mean, standard deviation and chi-square test.

Results

A total 210 female COPD patients were subjected for assessment of bone mineral density. We found following results:

The mean age of the patients in our study was 63.38 ±10.54years with a range from 40 to 92 years. Most common age group was 60-69 years, which includes 82 (39.05%) patients. In this study 88% patient were exposed to biomass fuel smoke and 44.76% were exposed to smoking. Out of 210 female COPD patients 44.29% were of GOLD Stage 2, 30.48% were of GOLD Stage 3, 17.62% were of GOLD Stage 1 and 7.61% were of GOLD Stage 4. (Table 1)

Table 1: Demographic and Clinical Characteristics of Patients

S.No.	Variable Name	Sub groups	N= 210 (%)
1.	Age (Years)	40-49	17 (08.10)
		50-59	52(24.75)
		60-69	82(39.05)
		70-79	38(18.10)
		80-89	19(09.05)
		≥90	2(0.95)
		Total	210(08.10)
2.	Behavioural Factors	Biomass fuel Smoke Exposure	185(88)
		Smoking	94 (47.76)
3.	COPD Gold Stage	GOLD 1	37 ((17.62)
		GOLD 2	93 (44.29)
		GOLD 3	64 (30.48)
		GOLD 4	16 (7.61)
4.	T Score (in Dexa Scan)	≥(-1.0)	8(3.81)
		(-1.0) to (-2.5)	54 (25.71)
		<(-2.5)	148 (70.48)

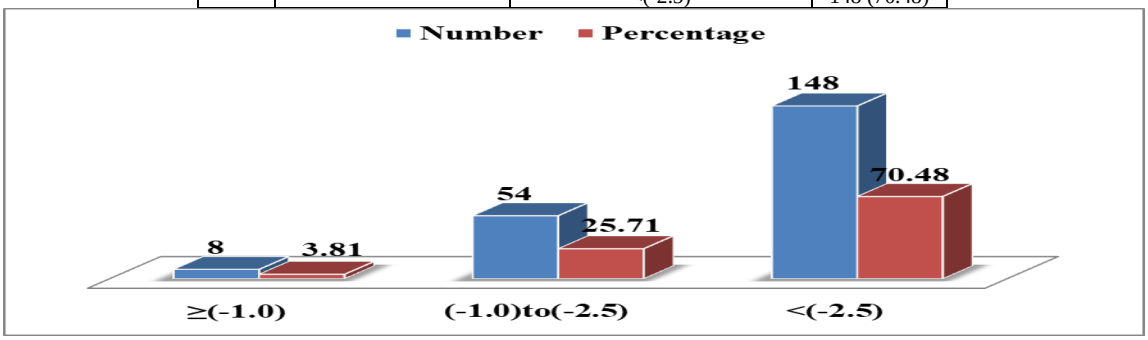

Fig 1: Group bar graph showing distribution of study participants according to T-Score in DEXA Scan measurement

Out of 210 patients 3.81% had T-Score in DEXA Scan of ≥(-1.0) i.e. Normal, 25.71 % had T-Score in range of (-1.0) to (-2.5) i.e. Osteopenia and 70.48% had T-Score in DEXA Scan <(-2.5) i.e. Osteoporosis. (Table 1, Fig 1)

Table 2:Association of T score

S. No.	Variable	T score			Chi-Square (P value)
1.	**Gold Stage** Gold 1	**-1.0 or above**	**-1.0 to -2.5**	**<-2.5**	16.006 df=6 P value =0.014*
		5(13.5%)	11(29.7%)	21(56.8%)	
	Gold 2	2(2.2%)	27(29.0%)	64(68.8%)	
	Gold 3	0(0.0%)	13(20.3%)	51(79.7%)	
	Gold 4	1(6.3%)	3(18.8%)	12(75.0%)	
	Total	**8**	**54**	**148**	
2.	BMI				11.872 df=6 p value =0.065
	Underweight	0(0.0%)	9(20.5%)	35(79.5%)	
	Healthy Weight	2(1.9%)	31(29.8%)	71(68.3%)	
	Overweight	5(8.8%)	13(22.8%)	39(68.4%)	
	Obese	1(20.0%)	1(20.0%)	3(60.0%)	
3.	Route Of Steroid Use				0.537 df=4 P value =0.970
	Not used	2(5.4%)	10(27.0%)	25(3.7%)	
	Oral	2(3.0%)	16(24.2%)	48(26.2%)	
	Inhaled	4(3.7%)	28(26.2%)	75(70.1%)	
4.	**Duration of Corticosteroid Use**				=0.541 df=4 P-value =0.969
	Not used	2(5.4%)	10(27.0%)	25(67.6%)	
	<1year	4(3.8%)	27(26.0%)	73(70.2%)	
	>1year	2(2.9%)	17(24.6%)	50(72.5%)	

In this study body mass index was compared with T score and found underweight was seen most commonly in T-score < (-2.5) and not seen in ≥ (-1.0) whereas healthy weight is seen most commonly in < (-2.5) group and least common in ≥(-1.0) group and overweight is most common in <(-2.5) group but least common in ≥(-1.0) group. Obese is most common in < (-2.5) group but least common in ≥(-1.0) group. There is no significant association between T-Score and BMI. (P-value=0.065). (Table 2)In this study COPD GOLD stage and T score were compared and found that COPD GOLD Stage1 was seen most commonly in T-score < (-2.5) and least common in ≥(-1.0), also GOLD 2 is seen most commonly in <(-2.5)group and least common in ≥(-1.0) group and GOLD 3 is most common in <(-2.5)group but not seen in ≥(-1.0) group. GOLD 4 is most common in <(-2.5)group but least common in ≥(-1.0) group. There was a significant association between T-score and various GOLD stages (p<0.05).(Table 2)T score compared with route of steroids use we found that T-score ≥(-1.0) most common in Inhaled corticosteroid users and least common in nonuser group and oral steroid users, whereas T-score between (-1.0)to(-2.5) was most commonly seen in Inhaled corticosteroid users and least common in nonuser group and T-score (<-2.5) was most commonly seen in Inhaled corticosteroid users and least common in nonuser group. There is no significant association between T-Score and type of corticosteroid use. (P value=0.970).(Table 2) &(Chart 2)

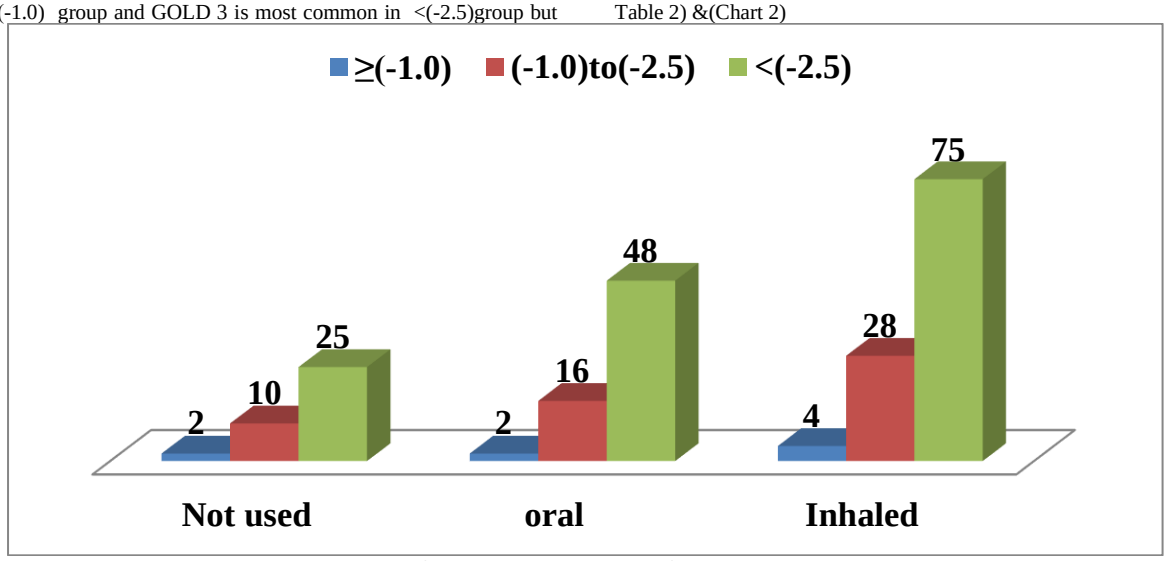

Fig 2: Group bar graph showing distribution of cases with various route of corticosteroid used in various T-Scores in DEXA Scan.

T Score was compared with duration of corticosteroids and found that T-score ≥(-1.0) most common in <1year corticosteroid users and least common in non-user and >1year corticosteroid users, whereas T-score between (-1.0)to(-2.5) was most commonly seen in<1year corticosteroid users and least common in nonuser group and T-score (<-2.5) was most commonly seen in <1year corticosteroid users and least common in nonuser group. There is no significant association between T-Score and year of corticosteroid use. (P value= 0.969) . (Table 2)

Table 3: Correlation of Osteoporosis with exposureof Smoking

Variable		Osteoporosis		
		Absent	Present	
Smoking	Present	21(22.1%)	74(77.9%)	Chi-square =4.588 Df=1 P-value=0.032*
	Absent	41(35.7%)	74(64.3%)	
	Total	62	148	

*Statistically significant

In our study osteporosis compared with smoking and biomass fuel smoke exposure and found thatthere was a significant association between Osteoporosis with smoking (p-value =0.032)(Table. 3)

Table 4:Correlation of number of COPD exacerbation per year with Osteoporosis

Number of COPD exacerbations per year	Osteoporosis		Total	Chi-square =0.972 df=2 P-value =0.615
	Absent	Present		
No exacerbation	5(31.3%)	11(68.8%)	16	
<3 exacerbations	20(25.6%)	58(74.4%)	78	
≥3 exacerbations	37(32.2%)	78(67.8%)	116	
Total	62	147	210	

In this study osteoporosis and number of exacerbation were compared and found that in patients with and without Osteoporosis maximum had ≥3 exacerbations/year i.e. 78(53.06%) and 37(59. 68%) patients respectively and in both with and without Osteoporosis groups least patients were in no exacerbation group i.e. 11(7.48%) and5(8.06%) patients respectively. There was no significant correlation between number of COPD exacerbations with Osteoporosis (p-value=0.615).(Table 4)

Discussion

The maximum number of female COPD patients (172/210) in this study were in the age group of 60-69 years with mean age 63.38 ±10.543years, which is similar to previous study done by Hong lei yin et al. (2017)[15] (66.66±8.72years), Harish Negi et al. (2014) [16] (62.69 ± 0.84years).

In present study mean age of patients with Osteoporosis was 64.58±10.43years and without the disease was 60.50±10.33years, this is similar to the study result of Verboom LG et al. (2009) [17] i.e. 66.07±9.62years and nearly similar to the study result of Gazzar AG et al. (2013) [18] i.e.56.04±7.14years.

Most of the patients who had T-Score <-2.5 were in GOLD Stage 2 i.e. 43.24% ,where as in the study conducted by Gazzar AG et al. (2013) [18] showed that moderate, severe and very severe COPD was 20%,27.3% and 37.5% respectively in osteoporotic patients .

In our study 116 (55.24%) patients were nonsmoker that is similar to the study of Ramadan MB et al. (2012) [19], they found 41.7% nonsmoker COPD cases in their study. We have found positive correlation between biomass fuel and smoking exposure with severity of COPD whereas in study conducted by Halbert RJ et al.(2006) [20] they did not found any correlation between these two.

In our study out of 210 patients, 3.81% had T-Score in DEXA Scan of ≥ (-1.0) i.e. Normal, 25.71 % had T-Score in DEXA Scan in range of (-1.0) to (-2.5) i.e. Osteopenia and 70.48% had T-Score in DEXA Scan <(-2.5) i.e. Osteoporosis. 96.19% i.e. 202 patients among 210 patients had deranged T-Score in DEXA Scan. This result is higher than the study result of Bhattacharya P et al. (2011.) [21] Mean T-Score in DEXA Scan was (-3.58±1.578).In study conducted by Bhattacharya P et al. (2011). They have shown mean T-Score of -2.10±0.57 in combined osteoporosis and osteopenia patients. In our study we found a significant correlation between smoking with Osteoporosis but no significant correlation between biomass fuel exposure with Osteoporosis, whereas study result of Daga MK et al. (2009) [18] showing a positive correlation between the two with osteoporosis. Although in our study the patients with and without Osteoporosis both the groups have ≥3 COPD exacerbations per year and ourresult was not significant (p-value= 0.615) and this is similar with study conducted by Bhattacharya P et al. (2011).Among all osteoporotic patients mostly inhaled corticosteroid user were present i.e. 50.67% which is similar to the study of Pauwels RA et al. (1999) [19], Newnham DM et al.(2001) [20]. They both have found the effect of inhaled corticosteroid on Bone Mineral Density of patients. In our study most of the patients have used corticosteroids for <1 year duration i.e. 49.32%.Corticosteroids reduce the absorption of calcium in the gut, increase the renal excretion of calcium, and stimulate the bone resorption (probably through the effect of parathormone) [24]. In addition, corticosteroids reduce the bone formation by directly inhibiting the osteoblastic line, as well as secondary to the hypogonadism associated with the excess of corticosteroids. In the present study we found no significant correlation between steroid use and Osteoporosis whereas Mathioudakis AG et al.(2013) [24] had shown that long-term use of low-dose Inhaled Corticosteroids protects the COPD patients from developing osteoporosis.

Conclusion

There was no significant correlation between age groups and Osteoporosis.There was a positive correlation between smoking exposureand Osteoporosis but there was no significant correlation between biomass fuel smoke exposure with Osteoporosis. There was a significant correlation of severity of COPD (GOLD Stage) with Osteoporosis.Out of 210 patients prevalence of Osteoporosisin female Copd patients was 70.48%.There was no positive correlation between route and duration of steroid use with Osteoporosisand number of COPD exacerbations with Osteoporosis. There was no significant correlation between BMI and Osteoporosis.Osteoporosis is common in female patients with COPD and its presence may have significant impact on the quality of life of such patients.

Limitations of present study

1. This is a hospital based study so the result cannot be generalized to the population.
2. The absence of a control group limits a definite assessment of the role of COPD in the pathogenesis of Osteoporosis.
3. The study has a cross-sectional design, so no causal relationships with clinical outcomes could be established.
4. The sample size is small .The study with larger sample size with a longer duration will be required to get the better outcome

References

1. Global initiative for Chronic Obstructive lung disease – Global strategy for diagnosis, management and Prevention of Chronic Obstructive Pulmonary Disease.Available from:http//www.gold copd.org/uploads/users/files/GOLD_Report_2020.
2. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2003.PLoS Med. 2006; 3(11): 442.

3. Bischoff EW, Schermer TR, Bor H, Brown P, Van-Weel C, van den Bosch WJ. Trends in COPD prevalence and exacerbation rates in Dutch primary care. Br. J. Gen. Pract. 2009; 59:927–33.
4. Waatevik M, Skorge, TD, Omenaas E, Bakke PS, Gulsvik A, Johannessen A. Increased prevalence of chronic obstructive pulmonary disease in a general population. Respir. Med. 2013; 107:1037-45.
5. Rycroft CE, Heyes A, Lanza L, Becker K. Epidemiology of chronic obstructive pulmonary disease: a literature review. Int. J. Chron. Obstruct. Pulmon. Dis. 2012; 7:457-94.
6. World Health Organization (WHO). Chronic obstructive pulmonary disease (COPD). Fact sheet 315. Updated March 2015. Last accessed 24 October 2015. Available at: http://www.who.int/ mediacentre/factsheets/ fs 315/en/.
7. World Health Organization (WHO). Chronic obstructive pulmonary disease (COPD).Updated2015. Available at: http://www.who.int/respiratory/copd/en/.
8. Afonso AS, Verhamme KM, Sturkenboom MC, Brusselle GG. COPD in the general population: prevalence, incidence and survival. Respir. Med. 2011; 105:1872-84.
9. Anonymous.Consensus development conference: diagnosis, prophylaxis and treatment of osteoporosis. Am J Med. 1993; 94(60):646-50.
10. Biskobing DM.COPD and osteoporosis. Chest. 2002; 121:609-20.
11. McEvoy CE, Ensrud KE, Bender E. Association between corticosteroid use and vertebral fractures in older men with chronic obstructive pulmonary disease. Am J RespirCrit Care Med. 1998; 157:704–09.
12. Praet JP, Peretz A, Rozenberg S, Famaey JP, Bourdoux P. Risk of osteoporosis in men with chronic bronchitis. Osteoporosis Int. 1992; 2:257-61.
13. Verboom LG, Smeenk FW, Borne BEV. Progression of osteoporosis in patients with COPD: a 3 year follow-up study. Respir Med. 2012; 106(6):861-70.
14. Prescott E, Bjerg AM, Andersen PK, Lange P, Vestbo J.Gender difference in smoking effects on lung function and risk of hospitalization for COPD: results from a Danish longitudinal population study. Eur Respir J.1997;10:822–7.
15. Yin HL, Yin SQ, Lin QY, Xu Y, Xu HW, Liu T. Prevalence of comorbidities in chronic obstructive pulmonary disease patients A meta-analysis. Medicine.2017;96:19.
16. Negi H, Sarkar M, AmitRD, Pandey K, Das P. Presence of depression & its risk factors in patients with chronic obstructive pulmonary disease. Indian J Med Res. 2014; 139:402-8.
17. Verboom LG, Wouters EF, Smeenk FW, Borne BE, Lunde R, Spruit MA. Current status of research on osteoporosis in COPD: a systemic review. Eur Respir J. 2009; 34:209-218.
18. Daga MK,Gupta BK, Mawari G,Hira HS. Assessment of Osteoporosis and Osteopenia and its Co-relation with Disease Severity in Patients of Chronic Obstructive Pulmonary Disease with Respect to Associated Risk Factors: A Case Control Study in India. Pulm Respir Med.2018;8:2
19. Pauwels RA, Lofdahl CG, Laitinen LA. Long-term treatment with inhaled budesonide in persons with mild chronic obstructive pulmonary disease who continue smoking. N Engl J Med. 1999; 340:1948-53.
20. Newnham DM. Asthma medications and their potential adverse effects in the elderly. Drug Safety. 2001; 24:1065-80.
21. Canalis E. Mechanisms of glucocorticoid action in bone: implications to glucocorticoid-induced osteoporosis. J Clin Endocrinol Metab. 1996; 81:2441-3447.
22. Urena P, Iida-Klein A, Kong X-F. Regulation of parathyroid hormone (PTH)/PTH-related peptide receptor messenger ribonucleic acid by glucocorticoids and PTH in ROS17/2.8 and OK cells. Endocrinology. 1994; 134:451-56.
23. Lane NE, Lukert B. The science and therapy of glucocorticoid-induced bone loss. EndocrinolMetabClin North Am. 1998; 27:465-83.
24. Mathioudakis AG, Amanetopoulou SG, Gialmanidis IP. Impact of long-term treatment with low-dose inhaled corticosteroids on the bone mineral density of chronic obstructive pulmonary disease patients: aggravating or beneficial? Respirology. 2013; 18(1):147–53.

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