Predictors of Bone Mass Density in Patients with Chronic Obstructive Pulmonary Disease

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Abstract

Background and Aim: The low bone mass as presented as osteopenia and osteoporosis represent example of the morbidities that occur in patients with chronic obstructive pulmonary disease (COPD). Predictors of bone mass density include osteopenia and osteoporosis. There is little data from Iraq on the relation between COPD and low bone mass. This study aimed to assess predictors of bone mass density in COPD patients attending Merjan Medical City.

 Patients and Methods: The study was performed on patients with COPD patients seen at the Merjan Medical City in the period between January 2018 and June 2019. The study included taking history with physical examination in addition to the needed investigation which included spirometry and dual-energy X-ray absorptiometry (DEXA) scan, osteopenia was defined if the T score was -<1 to <-2.5 and osteoporosis of <-2.5 as according to the WHO guidelines.

Results: The study involved 122 patients with COPD, average age was 61.52±10.01, males were 107 (88.52%) and females were 15 (11.48%), 22 patients (18.03%) had normal bone mass while the remaining 100 (81.97%) had with low bone mass, 64 (52.46%) were osteoporotic and 36 patients (29.51%) had osteopenia. There was also significant relation between T score and FEV1, (P value= 0.000), significant relation between T score and smoking (P value 0.000), in addition there was significant relation between pack year and severity of airways obstruction as assessed by pulmonary function test (P value 0.000).

Conclusions: Our study shows that patients with low bone mass that presented as osteopenia and osteoporosis form high percentage in patients with COPD and greatly related to disease severity and amount of smoking.

Keywords: Chronic obstructive pulmonary disease, osteopenia, osteoporosis.

Introduction

Chronic obstructive pulmonary disease (COPD) is considered as a pulmonary long-standing debilitating disease that has many systemic manifestations [1]. Predictors of bone mineral density include osteoporosis and osteopenia that can be diagnosed by using DEXA scan [2]. Osteopenia, osteoporosis and fragility fractures are examples of the serious systemic manifestations that occurs in COPD patients due to low bone mineral density, in osteoporosis the T-score is below −2.5 while in osteopenia the T-score is between −1.0 and −2.5) [3]. The risk factors for causing decrease in bone mass in COPD are age, gender (mostly females), low exercise levels, impaired nutritional status, tobacco smoking and corticosteroids use [4-6]. The dual-energy X-ray absorptiometry (DEXA) method is the gold standard for measuring bone mineral density (BMD) [7]. Many studies showed that osteoporosis and osteopenia commonly occur in patients with COPD and the prevalence in the range of 24-44% is reported(8,9,10). Osteoporosis usually were overlooked and remain undertreated which may be due to that it is a silent disease until it manifests clinically as pathologic fracture. Therefore, the primary focus of physicians in patients with COPD is to improve and maintain lung function without realizing that these patients suffer from low bone mass, which in turn increases the risk of fragility fractures and this could lead to an increase in pain and a worsening of respiratory function. there are few studies about the relation between

COPD and BMD in Iraq [11-13]. This study aimed to assess BMD in COPD patients who attended Merjan Medical City and were investigated with a DEXA scan to assess bone mass.

Patients and methods

This is a cross-sectional study that was done in Merjan Medical City in the period from November 2018 to July 2019, the study included 120 patients (107 males and 15 females) suffered from COPD.

Demographic data of the patients were taken which included ages of patients, gender, height and weight for calculating body mass index (BMI), duration of the COPD smoking status as assessed by pack years, DEXA scan to assess bone mineral density. Pulmonary function tests were measured by using the computerized spirometer (MIR company, Italy). The forced expiratory volume in first second (FEV1) is a reliable and valid test to assess lung function according to standards of the American Thoracic Society [14]. The level of COPD severity was determined by The FEV1% predicted depending on the global initiative of obstructive lung disease (GOLD) [15].

Data analysis

The Statistical Package for Social Sciences (SPSS) (version 22) was used to analyze the data of this work. Results were presented as means ± standard deviation. Cross tabulation was used to compare between variables. The level of statistical significance was P-values < 0.05 .

Results

The study involved 120 COPD patients, the mean age was 61.52±10.01

as shown in table (1)

Table (1): Demographic data

Parameter	Minimum	Maximum	Mean	Std. Deviation
Age	24.00	82.00	61.5246	10.01917
BMI	14.00	34.00	22.4672	5.04544
FEV1	21.00	68.00	45.2623	14.28159
Pack year	15.00	100.00	54.3934	25.77928

Distribution of smoking status was illustrated in table 2, the percentage of active smokers was 54% while that of ex-smokers was 46%

Table (2): Distribution of smoking status

State	Frequency (%)
Active smoking	66 (54)
Ex-smoking	56 (46)
Total	122 (100.0)

The study showed that the percentage of osteoporosis was 52.46% while osteopenia was 29.52 % as illustrated in figure (1)
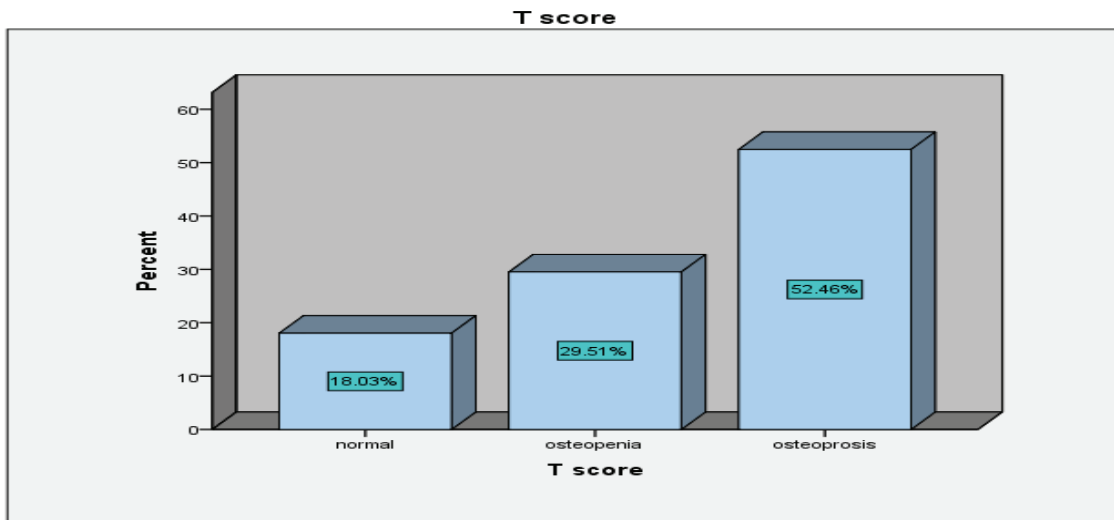
Figure (1): distribution of low bone mass in COPD patients

Figure (2) shows the relation between bone mineral density and BMI, osteoporosis was high in patients with BMI <19 while in normal subjects most of them was in 19-24 BMI, and the relation was significant (p value =0.000)
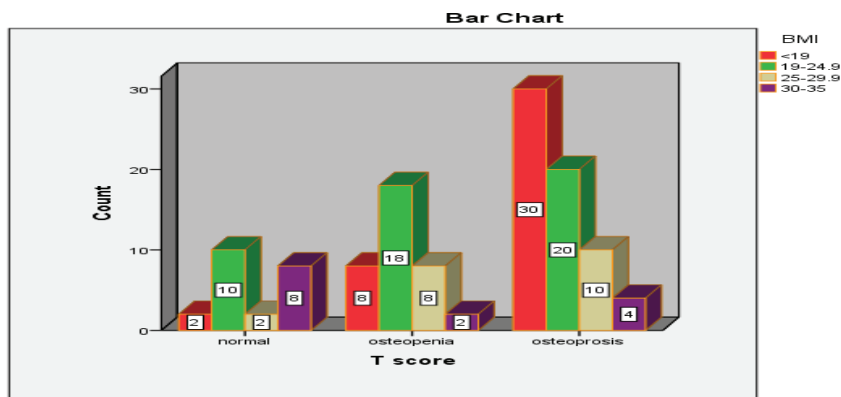

Fig (2) Relation between T score and BMI

The study also showed significant relation between T score and FEV1 , (P value= 0.000) as illustrated in figure (3)
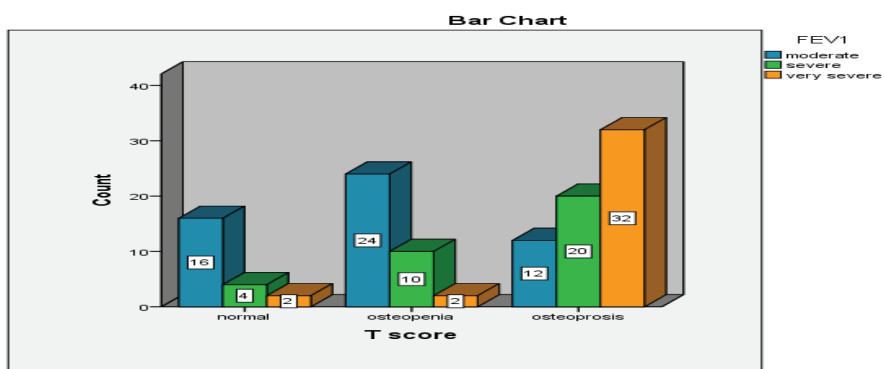

Fig (3) Relation between T score and severity of pulmonary function

There was significant relation between T score and smoking (P value= 0.000), as shown in figure (4)
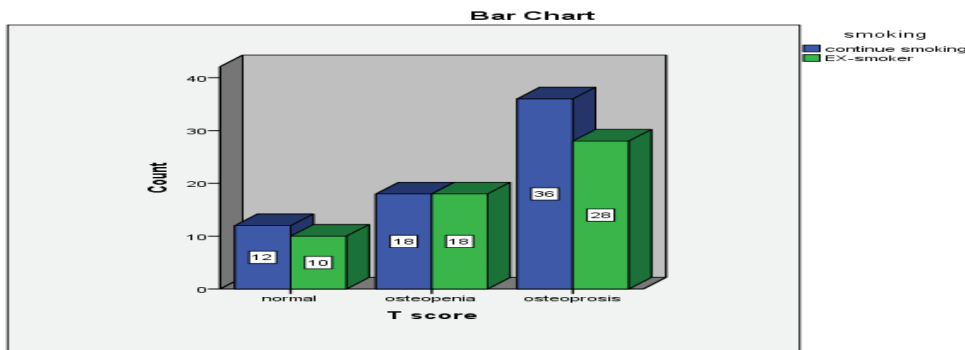
Fig (4) Relation between T score and smoking status

Discussion

The study showed that the percentage of osteoporosis was 52.46% while osteopenia was 29.52 % this means that the about 82% of our patients had low bone mass and this was slightly similar to a study performed in Saudi Arabia where the percentage of low bone mass was 90% (16). The study also showed that patients who were suffering from osteoporosis were older, had longer COPD duration and lower FEV1. In a study performed by Graat-Verboom *et al.* (2009) [17] in a review of 13 studies that involved 775 COPD patients, they reported that the prevalence of osteoporosis in COPD varies between 9 and 69% and that of osteopenia between 27% and 67%.

The study revealed significant relation between low bone mass and severity of airways obstruction and there was 26% of patients who had very severe COPD (GOLD stage IV) had osteoporosis and 9.8% in patients who had moderate COPD (GOLD stage II) and this agreed with a study by Alsayad *et al.* from south region of Saudi Arabia that found that the percentage of osteoporosis was 21.4% [16], while in a study by Tschopp *et al.* (2002) [18] found 69% of patients with GOLD Stage II had osteoporosis whereas Bolton *et al.* (2008) [19] found that 20% of patients with GOLD stage II had osteoporosis.

The study also showed significant relation between pack year and T score and the effect was dose-dependent that means increased risk of osteoporosis with increased amount of smoking. There are multiple causes behind this effect. Smoking has adverse effects on enzymes and hormones involved in bone regulation like parathyroid hormone [20] and alkaline phosphatase, it is also a risk factor for ischemic osteonecrosis which is associated with nicotine's peripheral vasoconstrictor effects [21,22].

The study also revealed significant relation between T-score and body mass index (BMI). Low body mass index (BMI) is regarded as a risk factor for osteoporosis in healthy people and many studies on COPD found that majority of the patients had low BMI [23,24]. The possible causes for low BMD in patients with COPD are decrease in the physical activity, decreased bone formation due to low mechanical loading and factors which influence proteolysis [25,26].

Conclusion

We conclude from this study that the low bone mass is common in COPD patients which have a relation with the disease severity and smoking. Bone mass index should be investigated in every patient with COPD by DEXA scan in order to be treated accordingly.

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the College of Medicine and all experiments were carried out in accordance with approved guidelines.

References

1.   Tarek F, Jayakumary M. Association between Body Mass Index and Bone Mineral Density in Patients Referred for Dual-Energy X-Ray Absorptiometry Scan in Ajman, UAE J Osteoporos. 2011; 2011: 876309

2.   Biskobing DM. COPD and osteoporosis. Chest. 2002; 121: 609–620.

3.   Jørgensen NR, Schwartz P. Osteoporosis in chronic

obstructive pulmonary disease patients. Curr Opin Pulm Med. 2008; 14: 122–127.

4. Ferguson GT, Calverley PM, Anderson JA, Jenkins CR, Jones PW, Willits LR, et al. Prevalence and progression of osteoporosis in patients with COPD: Results from the towards a revolution in COPD Health study. Chest. 2009;136:1456–65.

5. Dimai HP, Domej W, Leb G, Lau KH. Bone loss in patients with untreated chronic obstructive pulmonary disease is mediated by an increase in bone resorption associated with hypercapnia. J Bone Miner Res. 2001;16:2132–41.

6. Prakash S, Meshram S, Ramtekkar U. Athletes, yogis and individuals with sedentary lifestyles; do their lung functions differ? Indian J Physiol Pharmacol. 2007;51:76–80.

7. Mineo TC, Ambrogi V, Mineo D, Fabbri A, Fabbrini E, Massoud R. Bone mineral densityimprovement after lung volume reduction surgery for severe emphysema. Chest. 2005;127:1960–1966.

8. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A. ATS/ERS Task Force. Standardisation of spirometry. Eur Respir J. 2005;26:319–38.

9. Singh D, Agusti A, Anzueto A, Barnes PJ, Bourbeau J, Celli BR, Criner GJ, Frith P, Halpin DMG, Han M, López Varela MV, Martinez F.Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Lung Disease: the GOLD science committee report 2019. Eur Respir J. 2019 May 18;53(5).

10. Katsura H, Kida K. A comparison of bone mineral density in elderly female patients with COPD and bronchial asthma. Chest. 2002; 122: 1949–1955.

11. Incalzi RA, Caradonna P, Ranieri P, Basso S, Fuso L, Pagano F, et al. Correlates of osteoporosis in chronic obstructive pulmonary disease. Respir Med. 2000;94:1079–1084.

12. van der Voort DJ, Geusens PP, Dinant GJ. Risk factors for osteoporosis related to their outcome: Fractures. Osteoporos Int. 2001; 12: 630–8.

13. WHO Scientific group on the prevention and management of osteoporosis. Prevention and management of osteoporosis: Report of a WHO scientific group.2012; 7.

14. Balasubramanian VP, Varkey B. Chronic obstructive pulmonary disease: Effects beyond the lungs. Curr. Opin. Pulm. Med. 2006;12:106–12.

15. Yawn BP, Kaplan A. Co-morbidities in people with COPD: A result of multiple diseases, or multiple manifestations of smoking and reactive inflammation? Prim Care Respir J. 2008;17:199–205.

16. Sin DD, Man JP, Man SF. The risk of osteoporosis in Caucasian men and women with obstructive airways disease. Am J Med. 2003;114:10–4.

17. Alsayed S. Bone mineral density changes in male patients with chronic obstructive pulmonary disease: Clinical and biochemical variables in correlation with glucocorticoids use. World Allergy Organ J. 2007;1:S253

18. Graat L, Wouters EF, Smeenk FW, van den Borne BE, Lunde R, Spruit MA. Current status of research on osteoporosis in COPD: A systematic review. Eur Respir J. 2009;34:209–18

19. Tschopp O, Boehler A, Speich R, Weder W, Seifert B, Russi EW. Osteoporosis before lung transplantation: Association with low body mass index, but not with underlying disease. Am J. Transplant. 2002;2:167–72.

20. Bolton CE, Ionescu AA, Shiels KM, Pettit RJ, Edwards PH, Stone MD. Associated loss of fat-free mass and bone mineral density in chronic obstructive pulmonary disease. Am. J. Respir. Crit. Care Med. 2004; 170:1286–1293.

21. Landin K, Wilhelmsen K, Lappas G, Rosen T, Linstedt G, Lundberg P-A, Wilske J, Bengtsson B-A. Serum intact parathyroid hormone in a random population sample of men and women: relationship to anthropometry, life-style factors, blood pressure, and vitamin D. Calcif Tissue Int. 1995; 56:104–108.

22. Gordon T. Factors associated with serum alkaline phosphatase level. Arch Pathol Lab Med. 1993; 117:187–190.

23. Forrest CR, Pang CY, Lindsay WK. Dose and time effects of nicotine treatment on the capillary blood flow and viability of random pattern skin flaps in the rat. Br J Plast Surg. 1987;40:295–299.

24. Compston JE, Flahive J, Hosmer DW, Watts NB, Siris ES, Silverman S, et al. GLOW Investigators. Relationship of weight, height, and body mass index with fracture risk at different sites in postmenopausal women: The global longitudinal study of osteoporosis in women (GLOW) J Bone Miner Res. 2014;29:487–93.

25. Vrieze A, de 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.

26. Sikon AL, Thacker HL, Carey J, Deal C, Licata AA. Secondary osteoporosis: Are we recognizing it? J Womens Health (Larchmt) 2006;15:1174–83.

27. Asomaning K, Bertone-Johnson ER, Nasca PC, Hooven F, Pekow PS. The association between body mass index and osteoporosis in patients referred for a bone mineral density examination. J Womens Health (Larchmt) 2006;15:1028–1034.