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Original article

Correlation of vitamin d3 levels with bone mineral density in patients of low back ache

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Abstract

Introduction- Chronic Low back ache (CLBA) is a common complaint amongst the middle aged and elderly and is an important public health issue. Vitamin D3 is responsible for calcium metabolism and bone mineralization. Its deficiency has been linked with several disorders including musculoskeletal pain and fractures. Different studies have reported varying degree of association between vitamin D3 levels and Bone Mineral Density (BMD).

Aim- The present study was conducted to evaluate the correlation of BMD with serum vitamin D3 levels in symptomatic patients of chronic idiopathic low back ache.

Materials and Methods- This prospective observational study was done on 50 patients of idiopathic CLBA seen at Northern Railway Central Hospital between January to December 2018. All patients were evaluated for their pain by Visual Analogue Scale (VAS) score, their BMD by Dexa-scan and for their serum Vitamin D3 levels. Serum D3 was evaluated by immunoassay and the lowest T-score amongst all sites was chosen for evaluation and the data obtained was statistically evaluated.

Observation and Results- Vitamin D3 levels ranged from 11-35 with males having significantly higher levels than females. The T-scores ranged from -0.5 to -2.9 with males having significantly higher levels than females. Age more than 60 years was a risk factor lower T-scores and lower vitamin D3 levels but the latter was statistically insignificant. Correlation between vitamin D3 and T-score was 0.41

Conclusion - Our study also revealed a positive but not very strong co-relation of low Vitamin D levels with poorer bone health. Bone health and vitamin D were adversely affected by old age and female sex.

Key Words- Chronic low back ache, Visual Analogue Scale, Vitamin D3, Dexa scan, T-score

Introduction

Vitamin D is a fat-soluble secosteroids responsible for calcium, magnesium and phosphate metabolism, and multiple other biological effects, including bone mineralization. Vitamin D_3 is chemically cholecalciferol, which is synthesized in the skin from cholesterol through a sun mediated chemical reaction (mainly UVB radiation). It must be hydroxylated to convert it to the active form, calcitriol (also known as 1, 25-dihydroxycholecalciferol). [1-4] The Indian subcontinent is tropical and extends from 8.4 degrees N and 37.6 degrees N latitudes with adequate sunshine

all the year. And the population is presumed to be vitamin D sufficient. However, the socio-cultural aspect of the region is such that people are usually well covered and direct skin exposure to sunlight is sub-optimal, leading to Vitamin D deficiency. Deficiency of Vitamin D can cause several chronic diseases, including secondary hyperparathyroidism which has detrimentally impacts calcium and bone metabolism, more so in postmenopausal women and in the elderly,[5]

Low back pain is a pain localized to the area below the costal margins and above the inferior gluteal folds.[6] Low back ache (LBA) is one of the most frequently encountered complaints with a lifetime prevalence of around 80%. [7, 8] In 10-20% individuals LBA persists for longer than 3 months either as continuous or episodic pain to be labelled as chronic LBA. [9]

AGE-RELATED bone loss leads to increased risk of fractures and decreased Bone Mineral Density in the elderly (l0). Different studies have reported varying degree of association between vitamin D3 levels and BMD with some finding a significant correlation [10, 11] and the others not. [5, 12]

Aims and Objectives

The present study was conducted to evaluate the correlation of BMD with serum vitamin D3 levels in symptomatic patients of chronic idiopathic low back ache.

Materials and methods

This was a prospective observational study conducted at Northern Railway Central hospital between January to December 2018. The subject population consisted of all patients with idiopathic chronic low backache, which was defined as persistence of continuous or episodic low back pain persisting over 3 months or more without obvious traumatic, metabolic or inflammatory causes. Patients with obvious trauma, deformity or inflammatory conditions of the spine were excluded from the study. A total of 50 consecutive patients from both sexes and all age-groups who fulfilled the inclusion criterion were included in the study. All patients underwent a careful and detailed clinical evaluation with specific reference to pain scoring. The visual analogue scale was used to record pain and the highest score amongst all episodes of pain in the last 3 months was chosen for evaluation. Patients with a score of 4 or more were included in the study. All patients underwent X-ray of the spine AP and Lateral views and a Dexa scan to evaluate bone mineral density. Any other investigations like MRI, RA factor, CRP etc., were guided by the results obtained. All scans were reviewed by the same radiologist. The Dexa scan was performed on – GE lunar full fan beam whole body Dexa system. The T-scores were calculated at the hip and spine and the lowest score amongst them was taken for evaluation. T scores of upto -1 were taken as normal, between -1 to -2.5 were labelled as osteopaenia and below =2.5 were diagnosed as osteoporosis. The Vitamin D3 was assessed on Beckman Coulter Access 2 Automated immunoassay Machine, Appropriate statistical tests were applied to ascertain the correlation and significance of the parameters evaluated.

Observation and results

Out of the 50 cases enrolled in the study 35 were females. This female preponderance amongst patients of idiopathic low backache was statistically significant. The average age was 55.65 with a standard deviation (SD) of 10.09 and a range from 29 to 71 years. However, males in the study had significantly higher age than females (Table 1). The T-scores ranged from -0.5 to -2.9 with males having significantly higher levels than females. (Table 1). Vitamin D3

levels ranged from 11-35 with males having significantly higher levels than females. (Table 1). Patients with lower levels of vitamin D3 had poorer bone health (lower T-scores). However, this relationship was not very strong and he co-efficient of correlation was only 0.41. Patients with age more than 60 had significantly lower T-scores but though they had lower vitamin D3 levels, the difference was not statistically significant. (Table 2)

	Male	Female	Total	P-value
Number	15	35	50	
Av Age	63.8	52.31	55.65	p<0.01
SD (age)	5.35	9.6	10.09	
Range (age)	53 to 71	29 to 71	29 to 71	
T-score mean	-1.47	-1.7	-1.63	p<0.01
SD (T)	0.61	0.63	0.62	
Range (T)	-0.5 to -2.6	-0.5 to -2.9	-0.5 to -2.9	
D3 Level mean	32.67	22.73	23.94	p<0.01
SD (D3)	1.8	3.27	4.31	
Range (D3)	21 to 35	11 to 34	11 to 35	

Table-1 Relation of Serum Vitamin D3 levels and Bone health with Sex

	Age < 60 years	Age > 60 years	Total	P-value
D3 Level mean	25.06	23.63	23.94	p>0.05
SD (D3)	4.69	5.26	4.31	
Range (D3)	18 to 34	11 to 35	11 to 35	
T-score mean	-1.47	-1.9	-1.63	p<0.01
SD (T)	0.52	0.69	0.62	
Range (T)	-0.5 to -2.6	-0.5 to -2.6	-0.5 to -2.9	

Table-2 Relation of Serum Vitamin D3 levels and Bone health with Age

Discussion

Symptoms of Vitamin D deficiency depend on the grade and duration of deficiency. Most patients are asymptomatic.[13] Deficiency causes rickets in children and osteomalacia in adults. Patients may develop a decrease in bone mineral density, musculoskeletal pain and weakness and fractures, depending on the degree of deficiency. [14, 15] The commonest and most sensitive index used to assess vitamin D status in a person is serum 25(OH) D.[16]

The normal level of serum Vitamin D is >30 ng/mL, if it is 20–30 ng/mL, there is Vitamin D deficiency; if it is <20 ng/mL, there is lack of Vitamin D; and if it is <10 ng/mL, there is a serious lack of Vitamin D. [17]

Osteoporosis affects more than 75 million people in Europe, Japan and the USA, and causes more than 2.3 million fractures annually in Europe and the USA alone. It also causes people to become bedridden with secondary complications that may be life threatening. Its prevention is therefore essential for maintaining health and quality of life and decreasing economic losses in a community. Bone health is evaluated by Dexa-scan which measures bone mineral density. It reports results as T-score and Z-score. The T-score is the relevant measure when screening for osteoporosis. It is a comparison of a patient's BMD to that of a healthy 30-year-old. WHO recommends using data for a 30-year-old white female for everyone. Normal is a T-score of −1.0 or higher, Osteopenia is defined as a score between −1.0 and −2.5 and Osteoporosis is defined as −2.5 or lower. The Z-score is the comparison to the age-matched normal and is usually used in cases of severe osteoporosis. This is the number of standard deviations a patient's BMD differs from the average BMD of their age, sex, and ethnicity. [18]

Vitamin D deficiency leads to secondary hyperparathyroidism and low serum 25(OH)D and elevated serum intact parathyroid hormone (iPTH) concentrations are associated with low BMD. [19]. Other studies have also found that secondary hyperparathyroidism due to vitamin D deficiency is likely to be a major (and preventable) factor in age-related bone loss.[10] A study by Kremer et al also demonstrated that Vitamin D has a positive effect on bone density and bone quality. [20] Arya et al also opined that serum 25(OH)D level correlated with BMD. [11]

However, such co-relation between BMD and Vitamin D 3 is not universally observed and in their study done by Outila et al; linear regression analysis showed no significant associations between serum 25(OH)D concentration and forearm BMD. Similar lack of association was also noted by researchers.[12]

Our study also revealed a positive but not very strong co-relation of low Vitamin D levels with poorer bone health. Bone health and vitamin D were adversely affected by old age and female sex.

Conclusion

There was a positive correlation between vitamin D3 levels and bone mineral density, meaning thereby that patients with low BMD also had lower vitamin D3 levels. However this correlation was not very strong. Females had lower BMD and vitamin D3 than males. Patients over 60 years of age had significantly lower T-scores than those younger than 60 years. The same was true for vitamin D3 levels also, but the difference was not statistically significant.

Bibliography:

1. Champe PC, Harvey A FD. Translation Editor: Ulukaya E. Lippincott's Illustrated eviews Series. 3rd ed. Nobel Medicine Bookstores. 2007.
2. Richard BF, Demay Marie B, Krane Stephen M, Kronenberget Henry M. Bone and Mineral Metabolism in Health and Disease. Harrison's Princ.Intern. Med. 2005; 16:2238-86.
3. Holick MF . "Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease". Am J Clin Nutr. 2004 Dec;80(6 Suppl):1678S-88S.
4. Holick MF, Schnoes HK, DeLuca HF, Suda T, Cousins RJ (July 1971). "Isolation and identification of 1,25-dihydroxycholecalciferol. A metabolite of vitamin D active in intestine". Biochemistry. **10** (14): 2799–804

5. Outila TA, Ka¨rkka¨inen MUM, Lamberg-Allardt CJE. Vitamin D status affects serum parathyroid hormone concentrations during winter in female adolescents: associations with forearm bone mineral density.AmJ Clin Nutr 2001;74:206 –10.
6. Dionne CE, Dunn KM, Croft PR, Nachemson AL, Buchbinder R, Walker BF, et al. A consensus approach toward the standardization of back pain definitions for use in prevalence studies. Spine 2008; 33:95-103.
7. Walker BF, Muller R, Grant WD: Low back pain in Australian adults. Prevalence and associated disability. J Manip Physiol Therap 2004, 27:238-244.
8. Jeffries LJ, Milanese SF, Grimmer-Somers KA: Epidemiology of adolescent spinal pain. A systematic overview of the research literature. Spine 2007, 32:2630-2637.
9. Hayden JA, Dunn KM, van der Windt DA, Shaw WS: What is the prognosis of back pain? Best Pract Res Clin Rheum 2010, 24:167-179. 7. Briggs AM, Straker LM, Wark JD: Bone health and back pain: What do we know and where should we go? Osteoporos Int 2009, 20:209-219.
10. Perry HMIII, Horowitz M, Morley JE, et al. Aging and bone metabolism in African American and Caucasian women. J Clin Endocrinol Metab 1996;81:1108 –17.
11. Arya V[1], Bhambri R, Godbole MM, Mithal A; Vitamin D status and its relationship with bone mineral density in healthy Asian Indians. Osteoporos Int. 2004 Jan;15(1):56-61.
12. Marwaha RK, Tandon N, Reddy DRHK, Aggarwal R, Singh R, Sawhney RC , Saluja B, Ganie MA, and Singh S; Vitamin D and bone mineral density status of healthy schoolchildren in northern India. Am J Clin Nutr 2005;82:477–82.
13. Valcour A, Blocki F, Hawkins DM, Rao SD. Effects of age and serum 25-OH-vitamin D on serum parathyroid hormone levels. J Clin Endocrinol Metab 2012;97:3989-95.
14. Garg MK, Tandon N, Marwaha RK, Menon AS, Mahalle N. The relationship between serum 25-hydroxy Vitamin D, parathormone and bone mineral density in İndian population. Clin Endocrinol (Oxf) 2014;80:41-6.
15. Cauley JA, Parimi N, Ensrud KE, Bauer DC, Cawthon PM, Cummings SR, et al. Serum 25-hydroxyvitamin D and the risk of hip and nonspine fractures in older men. J Bone Miner Res 2010;25:545-53.
16. Hollis BW. Assessment of vitamin D nutritional and hormonal status: what to measure and how to do it. Calcif Tissue Int 1996;58:4 –5.
17. Gokcek E, Kaydu A. Assessment of relationship between Vitamin D deficiency and pain severity in patients with low back pain: A retrospective, observational study. Anesth Essays Res 2018;12:680-4.
18. WHO Scientific Group on the Prevention and Management of Osteoporosis (2000 : Geneva, Switzerland) (2003). "Prevention and management of osteoporosis : report of a WHO scientific group (WHO technical report series; 921)"
19. Rosen CJ, Morrison A, Zhou H, et al. Elderly women in northern New England exhibit seasonal changes in bone mineral density and calciotropic hormones. Bone Miner 1994;25:83–92.
20. Kremer R, Campbell PP, Reinhardt T, Gilsanz V. Vitamin D status and its relationship to body fat, final height, and peak bone mass in young women. J Clin Endocrinol Metab 2009; 94: 67-73

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