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Assessment Of Bone Minerals Density Among Vitamin D Deficient Hypertensive Patients

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Abstract

Background: One of the main risk factors for cardiovascular illnesses and a widespread health issue, is hypertension which can result in improper calcium metabolism. Vitamin D may lessen the prevalence of hypertension as it has been suggested that rickets and osteomalacia are frequently brought on by vitamin D insufficiency.

Objective: the present study aims to assess bone minerals density in hypertensive patients with vitamin D deficiency.

Materials and Methods: this is a cross-sectional study conducted in April through June of 2019. Eighty-eight hypertension patients were included in the study, 46 men and 42 women, and they were divided into two groups depending on their vitamin D results: normal, >20 ng/ml, and case, 20 ng/ml. The data were analyzed by using SPSS version20. Serum vitamin D level was determined by using an ELISA competitive assay, serum ALP and Mg level was determined by using spectrophotometric methods, and serum Ca and Ph level was determined by using dye colorimetric methods.

Results: Females, overweight subjects and more than 5 years patients showed a decrease in vitamin D level, with *P*-values (0.000, 0.003 and 0.041) respectively. The mean serum level of ALP and Mg were significantly increased in overweight group (*P*-values 0.048 and 0.041). The mean serum levels of ALP, Ca, Ph and Mg showed insignificant differences in the study group classified based on gender *P*-values (0.844, 0.546, 0.173 and 0.716) respectively. Patients with long history of disease (> 5 years) have significant increase in Ca levels *p*-value (0.019).

Conclusion Patients with obesity have lower vitamin D levels, while having higher levels of ALP and Mg. Patients with long histories of disease (> 5 years) have higher levels of Ca. Females are more susceptible to vitamin D deficiency. There is no discernible difference in serum ALP, calcium, phosphate, or magnesium between hypertensive patients with normal or lower of levels vitamin D.

Key words: ALP, Bone, Calcium, Hypertension, Phosphate, Magnesium, Vitamin D.

INTRODUCTION

Hypertension (HTN) is metabolic disorders characterized by high blood pressure, systolic ≥ 140 mm Hg and diastolic ≥ 90 mm Hg, for a period of time; this case needs a medical interaction to decrease the BP by especial medication kwon as antihypertensive drugs (1-3). HTN is an important issue to all worlds due to its strong correlation with cardiovascular disease(4). There were 34 million men and 39 million women who had high blood pressure in 2005. HTN in the Sudan were spread recently; prevalence reached about 7.5% (5). Systemic HTN is dys-regulation of homeostatic processes of blood pressure by essential or unknown etiology (2). There is evidence linking problems in calcium metabolism to high blood pressure. In people with high blood pressure, ongoing calcium loss may accelerate bone mineral loss (6). Additionally, magnesium may play a crucial role in the physiological control of blood pressure, whereas changes in cellular magnesium metabolism may be a pathogenesis of elevated blood pressure (7). The 1,25(OH)2D active vitamin D metabolite's primary impact is to promote calcium absorption from the stomach. The effects of vitamin D insufficiency include secondary hyperparathyroidism, bone loss that causes osteoporosis and fractures, mineralization problems that may eventually result in osteomalacia, and muscle weakness that increases the risk of falls and fractures (8). Globally, vitamin D insufficiency is widespread. Rickets and osteomalacia are frequently brought on by it, but they can also be caused by other ailments. The metabolism of bones is significantly regulated by vitamin D. By regulating calcium's admission into the colon, exit through the kidney, and storage in bone, it regulates calcium, the primary mineral component of the skeleton. Vitamin D insufficiency is a significant contributor to bone loss because it affects how calcium and phosphate are absorbed in the gut. This results in subpar bone mineralization which can eventually develop osteomalacia. Additionally, it increases parathyroid hormone production (PTH), this results in accelerated bone turnover and bone loss. PTH production is increased in many older patients with poor renal function, which contributes to this rapid bone loss (9). The examination of hepatobiliary and bone problems is where elevations of ALP are of the most diagnostic value(3). When osteoblasts are involved in bone diseases, increases are seen. Increases are mostly caused by an increase in the enzyme's synthesis, which is brought on by cholestasis (3). The present study is interested in evaluating bone mineral density in individuals with HTN and had insufficient vitamin D.

MATERIALS AND METHOD

Study population: A cross-sectional hospital study was undertaken in various Sudanese hospitals between April and June 2019 to gather information on patients who regularly underwent follow-up in the state of Khartoum. There were 88 HTN patients, ranging in age from 20 to 80year.

Inclusion and exclusion criteria: Vitamin D deficient Hypertensive Patients were included. Patients with chronic inflammatory diseases like rheumatoid arthritis (RA), osteoarthritis (OA), systemic lupus erythromatosus (SLE), autoimmune diseases, tuberculosis, diabetes, stroke, and any hepatic or renal diseases and malignancies were excluded from this study. Patients taking vitamin D supplements and those with other illnesses like diabetes mellitus are also excluded.

Blood sample and data collection: the data was collected by using a questionnaire; after overnight fasting, 5 ml of peripheral blood was withdrawn and the blood samples were centrifuged at 3000 rpm for 10 min and stored at −20°C. The anthropometric data including weight and height were measured. Body mass index (BMI) was defined as weight (kg) divided by height squared (m^2).

Ethical consideration: A written consent form, approved by the ethics committee of Sudan University of Sciences and Technology, was taken from all participants and were

informed by the aims of study. Sample and clinical information were used anonymously.

Statistical Analysis: The independent t-test was employed to compare differences between the means of continuous variables. *P*-values less than 0.05 were considered statistically significant. The data were analyzed by SPSS, Statistical Package of Social Science, (version 20).

RESULTS

In the current study, 88 individuals, 52.3% men and 47.7% women, with HTN were included; overweight patients are both more common, 80.4% and 66.7% respectively. The study has found that the percentage of male overweight patients has increased more than that of female. The mean serum levels of 25-hydroxyvitamin D (25- OH) were 30 ± 22.56 and 14.6 ± 10.34 nmol/l of both male and female hypertensive patients respectively. The prevalence of vitamin D deficiency was more common in female patients with HTN. For the levels of ALP, Ca, Ph, and Mg, there was no significant deferent between HTN patients with normal or deficiency vitamin D (Table: 1). Prevalence of vitamin D deficiency was more common in female patients with HTN. In general, the mean levels of ALP, Ca, Ph and Mg were approximately equal in male and female patients (Table: 2). The present study showed a significant decrease in the mean of vitamin D level of overweight group in comparison with that in the normal weight group, in contrast to a significant increase in the mean of ALP and Mg levels of overweight group in comparison with normal weight group (Table:3). This study has revealed that there was a significant decrease in vitamin D level in patients who have <5 years duration of HTN. Obviously, it has been observed that patients with long history of disease (> 5 years) have a significant increase in Ca levels, in contrast, they have slightly increase in ALP (Table: 4).

Table No.1: (Mean±SD) of parameters level in study group classified as normal and deficient vitamin D group.

Variable	Normal	Deficient	*p*.value
Alkaline phosphatase(mg/dl)	82.51±35.17	85.81±30.12	0.642
Calcium (mg/dl)	10.25±2.04	9.52±2.81	0.202
Phosphorus (mg/dl)	2.92±0.90	2.92±0.77	0.995
Magnesium (mg/dl)	3.00±0.42	3.03±0.40	0.786

Table No. 2: (Mean ±SD) of parameters level in study group classified as male and female.

Variable	Male	Female	*p*. value
Vitamin D (ng/ml)	30.32±22.56	14.66±10.34	0.000
Alkaline phosphatase (mg/dl)	85.22±36.67	83.86±26.26	0.844
Calcium (mg/dl)	9.64±2.29	9.97±2.84	0.546
Phosphorus (mg/dl)	2.81±0.874	3.05±0.743	0.173
Magnesium (mg/dl)	3.03±0.422	3.00±0.404	0.716

Table No.3:(Mean ±SD) of parameters level in study group classified as normal weight (BMI ≤ 26.5 kg/m^2)and over weight (BMI > 26.5 kg/m^2) .

Variable	Normal weight	Over weight	*p*. value
Vitamin D (ng/ml)	29.12±24.41	17.11±10.63	0.003
Alkaline phosphatase(mg/dl)	75.89±17.18	87.65±35.35	0.041
Calcium (mg/dl)	9.45±2.48	10.112.61	0.233
Phosphorus (mg/dl)	2.83±0.709	3.00±0.907	0.318
Magnesium (mg/dl)	2.93±0.439	3.10±0.370	0.048

Table 4 :(Mean±SD) of parameters level in study group classified by duration of disease as 5 years and less and more than 5 years.

Variable	Less than 5 year	More than 5 year	*p*. value
Vitamin D (ng/ml)	25.61±22.08	18.00±12.27	0.041
Alkaline phosphatase(mg/dl)	82.97±2..58	87.38±36.05	0.559
Calcium (mg/dl)	9.31±2.23	10.64±2.90	0.019
Phosphorus (mg/dl)	2.98±0.878	2.81±0.702	0.346
Magnesium (mg/dl)	3.00±0.367	3.05±0.483	0.590

DISCUSSION

Due to its great frequency and link to a higher risk of cardiovascular disease, high blood pressure (BP) is a significant health issue everywhere in the globe. The results of independent t-test showed that there were insignificant differences in bone minerals ALP, Ca, Ph and Mg between case and control groups with P- values (0.642, 0.202, 0.995 and 0.786) respectively. The findings here were near to some previous study (10 -12). The current results provided experimental evidence that there was a significant increase in vitamin D in male with *P*-value (0.000); thus, females were more susceptible to vitamin D deficiency than males, the possible justification for this result is that males spend more time outdoors and women wear sun protective clothing and avoid sun exposure which may affect vitamin D synthesis. This agreed with previous studies performed in Saudi Arabia, Jordan, and Malaysia(13,14), and in conflict with others study which stated that there was a low vitamin D status despite abundant sun exposure(15). In the current study, gender independent t-test showed no significant differences between mean of serum bone minerals level ALP, Ca, Ph and Mg with P-values (0.844, 0.546, 0.173 and0.716); they disagree with a prior report that indicated a considerable correlation between calcium and phosphate levels in people who did not get enough vitamin D (16). The present study results showed significant decrease in mean vitamin D level of overweight group in comparison with normal weight group with (*P*-value0.003); this agreed with (17) they reported that obesity-associated with vitamin D insufficiency related to decreased bioavailability of vitamin D_3 from cutaneous because of its deposition in body fat compartments. The current study showed a significant increase in mean of ALP and Mg level of overweight group in comparison with normal weight group with (*P*-valve 0.041 and 0.048). The findings here confirm the role of obesity in cholestasis which increase ALP marker (18) who found that higher serum magnesium level was significantly associated with lower body weight and BMI (P value = 0.01), where there were no significant differences in the remaining bone minerals Ca and Ph with p.value (0.233 and0.318) this result disagreed with (19) who suggest that hypertensive vitamin D deficient individuals have a significant variation in calcium and phosphate levels. Besides, the current study revealed that there was a significant decrease in vitamin D level in patients having < 5 years duration of HTN with *P*-value (0.041).

The majority of observational data suggest that lower levels of vitamin D may be associated with a higher BP and a higher risk of developing HTN, although conflicting studies exist. Experimental studies in animals, as well as some observational and experimental data in humans, suggest that vitamin D and its metabolites are integrally related to BP and the RAS. Nevertheless, randomized, controlled trials have thus far failed to confirm that vitamin D supplementation lowers BP (20). In a series of cohort and interventional studies a relationship was seen between serum vitamin D and BP levels, while in some other no correlation was observed. The existence of

polymorphism in vitamin D receptor gene can be a reason for these contradictory results. Among interventional studies, there are studies supporting the idea that vitamin D supplementation reduces BP. In contrast, there are studies claiming that vitamin D is not correlated with BP. It seems that difference in dose and duration of vitamin D supplementation are the reason for this contradiction (21).

Conclusion: Female are more vulnerable to vitamin D deficiency than males, overweight patients have a decrease in the level of vitamin D, and an increase in ALP and Mg level. Patients with long history of disease (> 5 years) have an increase in Ca level, in contrast to vitamin D level which decreases. There no difference in serum ALP, calcium, phosphate and Mg of hypertensive vitamin D deficient compared with those hypertensive patients with normal vitamin D level.

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