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ASSOCIATION OF VITAMIN D AND PARATHYROID HORMONE WITH HYPERTENSION

Medicine

Jagdish Vishnoi* MD, Assistant Professor, Department of General Medicine, Pacific Medical college and Hospital Udaipur (Rajasthan), India, *Corresponding Author

K.R.Sharma MD, Assistant Professor, Department of General Medicine Pacific Medical college and Hospital Udaipur (Rajasthan), India

Priyanka Paul MD, Senior Resident, Department of General Medicine Pacific Medical college and Hospital Udaipur (Rajasthan), India

Y.K.Bolya MD, Senior Professor and Head, Department of General Medicine Pacific Medical college and Hospital Udaipur (Rajasthan), India

ABSTRACT

Introduction: Hypertension is one of the few most attentive ailments throughout the globe because of its varied prevalence throughout the population irrespective of the region, religion and food habits, social and economic status. Low 25-hydroxyvitamin D [25(OH)D] levels are commonly found in patients with both Type 1 and Type 2 diabetes mellitus. Observational studies suggest that low 25(OH)D levels are associated with a higher risk of hypertension. Parathyroid hormone(PHT) is also associated with increased risk of arterial hypertension. The present analysis was based on a cross-sectional study in the framework of comprehensive cardiovascular health examinations.

Materials & Methods: Statistical analysis was done using IBM SPSS Statistics 20 package. p-value of <0.05 is considered as statistically significant and p-value of <0.005 is considered as statistically highly significant. The results were averaged as (mean ± standard deviation) for each parameter subgroups separately for Hypertensives & Normotensives. Statistical analysis was done using IBM SPSS Statistics 20 package.

Results: The values of Mean Systolic & Diastolic Blood Pressures of Hypertensives is found to be 153.76 mmHg and 86.32mmHg; and in Normotensives they are 137.27mmHg and 79.18mmHg. Mean Vitamin D in Hypertensives is 52.31ng/mL; and 31.43ng/mL in Normotensives. Similarly, the values of PTH in Hypertensives is 71.86ng/mL and 34.56ng/mL in Normotensives.

Discussion: In the present study, it is found that there is significant increase in Blood pressure in the individuals with decreased vitamin D levels. The levels of PTH were also found to be significantly less in the individuals with increased blood pressure. Dietary intake of sodium and increased activity of the RAS are known to be linked with increased blood pressure; salt restriction and inhibition of RAS activity is found to be linked with reduced blood pressure. Changes in systemic calcium metabolism are thought to play an important role in the regulation of blood pressure. One hypothesis for this link implicates parathyroid hormone (PTH). Serum calcium level is tightly regulated by PTH in a classic negative feedback system.

KEYWORDS

Vitamin D, PTH, Hypertension.

INTRODUCTION

Hypertension is one of the few most attentive ailments throughout the globe because of its varied prevalence throughout the population irrespective of the region, religion, and food habits, social and economic status. This feature makes the world to be even more attentive in prevention, management and treatment of the Hypertension. Now a days because of increased awareness, the importance of prevention and early detection of Hypertension is increased so that the damage in an individual is minimized as early as possible. Vitamin D is known to regulate calcium and phosphate metabolism [1]. However, accumulating evidence suggests that vitamin D level is inversely related to blood pressure and risk of hypertension in observational studies in the Western populations [2,3,4,5,6,7].

Low 25-hydroxyvitamin D [25(OH)D] levels are commonly found in patients with both Type 1 and Type 2 diabetes mellitus [8–11]. In patients with established diabetes mellitus and in the general population, low 25(OH)D levels are associated with higher fasting glucose and higher levels of glycated haemoglobin [12,13]. Such associations are not only found in cross-sectional studies; low 25(OH)D levels are associated with a higher probability of future diagnosis of diabetes mellitus or metabolic syndrome in prospective population studies [14–16]. There are several mechanisms whereby vitamin D might alter glucose metabolism. Vitamin D is known to have anti-inflammatory and immunomodulatory effects [17]. This could influence the autoimmue pathology of Type 1 diabetes, and could ameliorate low-grade chronic inflammation that has been implicated in insulin resistance in Type 2 diabetes [18]. Vitamin D may also stimulate insulin release by pancreatic b-cells [19,20]. Elevated parathyroid hormone levels, consequent on low vitamin D levels, have also been implicated in impaired insulin release from pancreatic b-cells [21].

Observational studies suggest that low 25(OH)D levels are associated with a higher risk of hypertension. However, findings from randomized trials of vitamin D supplementation to lower blood pressure are inconsistent, possibly stemming from variability in study population, sample size, vitamin D dose, and duration. If vitamin D supplementation lowers blood pressure, its widespread use could have major public health benefits. PHPT is associated with increased risk of arterial hypertension. Recent investigations have reported high blood pressure in 40 to 65% of patients with PHPT [22–26]. However, elevated PTH levels have also been reported in a subgroup of patients with primary (essential) hypertension [27].

In our regular Out Patient Services, we have found correlation between the same. This made us to explore correlation of increased blood pressure with altered levels of vitamins and hormones.

MATERIAL & METHODS

The present analysis was based on a cross-sectional study in the framework of comprehensive cardiovascular health examinations for all employees of a factory in Bohra Industries Limited, Umarda, Zamar Kotra Road, Udaipur. We invited all employees to take part in this study from August 2016 to June 2017. A total of about 554 people have given their consent for participating the present study. Out of these, about 243 were eligible individuals. Among these, 200 participants were randomly included in the present analysis after considering the inclusion and exclusion criteria. Known primary hypertensives and newly diagnosed hypertensives were included in the present study. Presence of complications related to hypertension and other factors which are known to aggravate the blood pressure are excluded from the study. The Ethics Committee of the Pacific Medical College & Hospital, Udaipur, Rajasthan has approved the study protocol. All subjects gave written informed consent.

One physician measured each participant's blood pressure three times consecutively using Sphygmomanometer (Diamond 2015), after the subjects had rested for at least 5 minutes in the sitting position. The three blood pressure readings were averaged for analysis. The same observer also administered a questionnaire to collect information on medical history, smoking habits, alcohol consumption and the use of medications.

A trained technician performed anthropometric measurements, including body height, body weight, and waist and hip circumference. Hypertension was defined as a sitting blood pressure of at least 140 mmHg systolic or 90 mmHg diastolic, or as the use of antihypertensive drugs. Body mass index was defined as a ratio of the body weight in kilograms to the square of the height in meters. Venous blood samples were drawn after overnight fasting for the measurement of serum glucose, creatinine and total cholesterol. Serum was also stored at -30°C for measurement of 25(OH)D and PTH. Serum 25(OH)D was determined by radioimmunoassay (Diasorin 25-hydroxyvitamin D 125I RIA Kit, Stillwater, Minnesota, USA) in the Clinical Laboratory of the Affiliated Hospital of Pacific Medical College. The intra- and interassay coefficients of variance were 6.0% and 5.6%. Serum PTH assay was performed in the same laboratory by the chemiluminescence method (DPC 2000, Siemens, Germany). The intra- and interassay coefficients of variance were 3.9% and 6.0%. Statistical analysis was done using IBM SPSS Statistics 20 package. p-value of <0.05 is considered as statistically significant and p-value of <0.005 is considered as statistically highly significant. Conclusions were drawn based on outcome of this statistical treatment.

The data was arranged in suitable tables for analysis under different headings. The results were averaged as (mean ± standard deviation) for each parameter subgroups separately for Hypertensives & Normotensives. Statistical analysis was done using IBM SPSS Statistics 20 package. p-value of <0.05 is considered as statistically significant and p-value of <0.005 is considered as statistically highly significant. Conclusions were drawn based on outcome of this statistical treatment.

RESULTS

On analysis of Blood Pressures, Vitamin D & Parathyroid Hormone in Hypertensives with Normotensives, the following results are observed.

Table 1: Mean ± SD of parameters in Hypertensive & Normotensive groups.

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Systolic B.P.	HSBP	153.76	100	13.84	1.38
	NSBP	137.27	100	15.83	1.58
Diastolic B.P.	HDBP	86.32	100	8.51	.85
	NDBP	79.18	100	7.69	.77
Vitamin D	H25(OH)D ng/mL	52.31	100	20.45	2.04
	N25OHD	31.43	100	9.87	.98
PTH	HPTH pg/mL	71.86	100	16.24	1.62
	NPTH	34.56	100	13.25	1.32

The values of Mean Systolic & Diastolic Blood Pressures of Hypertensives is found to be 153.76 mmHg and 86.32mmHg; and in Normotensives they are 137.27mmHg and 79.18mmHg. Mean Vitamin D in Hypertensives is 52.31ng/mL; and 31.43ng/mL in Normotensives. Similarly, the values of PTH in Hypertensives is 71.86ng/mL and 34.56ng/mL in Normotensives.

Table 3: Paired Differences of parameters in Hypertensives & Normotensive groups.

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
HSBP - NSBP	16.49	21.4238	2.1423	12.2390	20.7409	7.697	99	.000
HDBP - NDBP	7.14	12.0420	1.2042	4.7505	9.5294	5.929	99	.000
H25(OH)D ng/mL - N25OHD	20.88	23.4414	2.3441	16.2287	25.5312	8.907	99	.000
HPTH pg/mL – NPTH	37.30	20.5286	2.0528	33.2266	41.3733	18.170	99	.000

DISCUSSION

In the present study, it is found that there is significant increase in Blood pressure in the individuals with decreased vitamin D levels. The levels of PTH were also found to be significantly less in the individuals with increased blood pressure.

The prevalence of vitamin D insufficiency, defined by a 25-hydroxyvitamin D (25[OH]D) level <30 ng/mL. Exposure to sunlight is one of the largest prospective to study the effect of vitamin D supplementation on control of blood pressure. The study showed significant effect of vitamin D supplementation resulting in lowering of high blood pressure in individuals with vitamin D deficiency and untreated prehypertension or stage 1 hypertension.

Different biological mechanisms which relate vitamin D and increased blood pressure have been under consideration for more than 25 years. Dietary intake of sodium and increased activity of the RAS are known to be linked with increased blood pressure; salt restriction and inhibition of RAS activity is found to be linked with reduced blood pressure. This mechanistic link between vitamin D and the RAS has been translated to cross-sectional studies in humans. A quarter century ago, increasing 1,25(OH)2D concentrations were associated with lower plasma renin activity in human hypertension. Taken together, vitamin D may influence blood pressure by functioning as an endogenous inhibitor of the RAS, interacting with salt and the RAS to modulate vascular smooth muscle tone, and indirectly affecting the vascular endothelium. Definitive studies to test these hypotheses in humans and determine whether these mechanisms are interrelated or independent have to be encouraged. Because future investigations aim to better define the mechanistic link between vitamin D and hypertension, a crucial aspect of study designs will require focus on differentiating the causal role of vitamin D from that of calcium, parathyroid hormone, sodium, and the RAS.

Numerous studies in humans and experimental models have shown that alterations in calcium homeostasis are associated with an increased risk of cardiovascular complication. In particular, changes in systemic calcium metabolism are thought to play an important role in the regulation of blood pressure. One hypothesis for this link implicates parathyroid hormone (PTH). Serum calcium level is tightly regulated by PTH in a classic negative feedback system. A small decrease in serum calcium stimulates an abrupt increase in PTH secretion, which leads to calcium mobilization from bone, increased renal tubular calcium reabsorption and increased renal hydroxylation of 25-hydroxyvitamin D to the biologically more active 1,25-dihydroxyvitamin D (which enhances calcium absorption from the intestine). Factors that tend to reduce the serum calcium levels (i.e. vitamin D deficiency) induce secondary hyperparathyroidism. In primary hyperparathyroidism, there is an autonomous increase in PTH secretion resulting in hypercalcaemia. Several studies have reported a positive correlation between serum PTH levels and hypertension [28].

CONCLUSION

In the present study, it is found that there is significant increase in Blood pressure in the individuals with decreased vitamin D levels. The levels of PTH were also found to be significantly less in the individuals with increased blood pressure. These cumulative findings of an inverse relation between vitamin D and RAS activity, suggesting that vitamin D may act as an endogenous inhibitor of the RAS. Definitive mechanistic and outcome studies to evaluate the effect of vitamin D supplementation on the RAS and blood pressure have yet to be completed. These type of correlation have to be further done extensively to understand Vitamin D and its actions in large population with varied factors.

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