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Original Research Article

To Investigate the Potential Association between Vitamin D and Cellular Senescence as Evaluated by the Telomerase Enzyme in Pre-Hypertensive

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Abstract

Aim: The aim of the present study was to explore the link between Vitamin D and cellular senescence measured with the enzyme telomerase in pre-HTN.

Methods: The current investigation was carried out at the Department of Physiology. The inclusion criteria for the pre-hypertensive group (pre-HTN) (n = 50) consisted of persons of both genders, aged between 18 and 25 years, with systolic blood pressure (SBP) ranging from 120 to 139 mmHg and diastolic blood pressure (DBP) ranging from 80 to 89 mmHg. These participants were required to be in apparent good health. The control group consisted of 50 persons who were healthy and aged between 18 and 25 years. Their systolic blood pressure (SBP) ranged from 100 to 119 mmHg, while their diastolic blood pressure (DBP) ranged from 60 to 79 mmHg.

Results: A hundred healthy people were studied. The study included 100 pre-hypertensive individuals aged 22.58±1.56 and controls aged 18.92±1.28. Out of 100, 28 men, 22 females were pre-HTN and 26 males, 24 females were control. Height and waist-hip ratio did not vary significantly across groups. Compared to controls, pre-HTN group subjects had higher BMI ($P < 0.001$) and weight ($P < 0.001$). The pre-HTN group had substantially higher HR, SBP, DBP, MAP, and RPP compared to controls ($P < 0.001$). PP was somewhat higher in pre-HTN group and adversely linked with Vitamin D. Waist-hip ratio, SBP, DBP, MAP, and RPP are correlated with high telomerase levels, whereas BMI, HR, and PP are not.

Conclusion: Decreased levels of Vitamin D in individuals with pre-hypertension may lead to disruptions in the body's cardiovascular balance and accelerate the process of cellular ageing as assessed by telomerase.

Keywords: Hypertension, Vitamin D, cellular senescence

Introduction

Years of research have revealed the association of three conditions with the development of subclinical atherosclerosis and non-alcoholic fatty liver disease (NAFLD): obesity, vitamin D deficiency (VDD), and cellular senescence. Obesity is a serious worldwide chronic health problem for all ages. [1] Cellular senescence induces a cell-cycle arrest and a pro-inflammatory reaction, both of which promote aging and age-related diseases, and its exacerbation was seen with obesity in many studies. [2] VDD was reported to be induced by obesity among all age groups and in both genders. [1,3] Numerous genetic studies explored that excessive adiposity causes a reduction in circulating 25-hydroxyvitamin D (25(OH)D), the main reflector of vitamin D status. [1,3]

VDD in obese people usually has no direct consequence but may affect many organs at the subclinical level and predispose them to a state of improper metabolism. [4] On the other hand, the effects of vitamin D supplementation on obese individuals do not largely extend beyond ameliorating the detrimental consequences of various obesity-induced cardio metabolic disorders, and no evidence proves a protective effect of vitamin D against obesity. [1,3] Obesity promotes cardiovascular diseases through vascular remodeling, which induces subclinical

atherosclerosis that finally ends in fatal cardiac events. [5]

High blood pressure (hypertension) is a serious risk factor for cardiovascular diseases, such as coronary artery disease, myocardial infarction, or stroke, if untreated. [6] Study results revealed that vitamin D deficiency ameliorates the development of hypertension (HT). [6,7] Vitamin D deficiency (25-OH-D < 30 ng/mL) is an independent risk factor for high blood pressure and is involved in the promotion of cardiovascular mortality. [8] Obesity is thought to affect cardiovascular events. Indeed, the concept of "metabolically healthy" obesity has been studied, and it has been shown that coronary heart disease may be increased in this obesity phenotype. [9] Low 25(OH)D3 concentrations increase the risk of hypertension, peripheral vascular disease, diabetes mellitus, myocardial infarction, heart failure, and cardiac mortality. [10] Moreover, it is reported that low 25(OH)D levels are associated with endothelial dysfunction, inflammation, increased vascular stiffness, and high coronary artery calcium scores. [11] Moreover, it is reported that shortened telomere as an early sign and characteristic feature of cellular senescence is a prognostic biomarker for the early identification of subjects at high risk of developing CVD before symptoms appear. [12]

The aim of the present study was to explore the link between Vitamin D and cellular senescence measured with the enzyme telomerase in pre-HTN.

Materials and Methods

The present study was conducted in Department of Physiology and Biochemistry, Employees' State Insurance Medical College and Hospital, Bihta Patna, Bihar, India for 12 months. Inclusion criteria for the pre- hypertensive group (pre-HTN) (n =50) were both genders between 18 and 25 years of age with SBP between 120 and 139 mmHg and DBP between 80 and 89 mmHg in apparently healthy individuals. The controls (n = 50) population were healthy individuals with 18-25 years of age with SBP between 100 and 119 mmHg and DBP between 60 and 79 mmHg.

Individuals suffering from diabetes, hypertension, endocrine disorders, kidney diseases, and hypertensive patients already receiving medication were not considered to take part in this research. The volunteers were asked to not participate in heavy exercises, not drink alcohol and coffee 1 day before the data collection. Baseline, anthropometric parameters were recorded before recording of the BP by sphygmomanometer as per standard protocol. [13] Then, 5 ml of blood was collected, allowed to clot, and subjected to centrifugation to separate the serum. Serum was stored at –80°C for processing of Vit-D and telomerase levels as per the instructions provided in the commercially available kits.

Statistical analysis was done to analyze the data. To study the between-group differences, independent t-test, to assess the correlation of vitamin D with telomerase and other parameters, Pearson's correlation coefficient analysis was applied.

Results

Table 1: Comparison of anthropometric characteristics between pre-HTN and controls

Parameters	Pre-HTN(*n*=50)	Controls(*n*=50)	*P*-value
Age	22.58±1.56	18.92±1.28	0.436
Gender (male/female)	28/22	26/24	1.316
Height(cm)	172.28±9.81	169.71±7.52	0.392
Weight(kg)	65.45±10.40	58.42±8.56	<0.001
BMI (k/m^2)	24.16±4.76	22.78±4.86	<0.001
Waist to hip ratio	0.93±0.10	0.88±0.08	0.474

The study population included 100 apparently healthy individuals. 100 were pre- hypertensive with the age of 22.58±1.56and the age of controls was 18.92±1.28. Out of 100, 28 males, 22 females were in pre- HTN group and 26 males, 24 females were in the control group. A significant difference was not found between-group differences in height and waist-hip ratio.

Table 2: Comparison of cardiovascular parameters between pre-HTN and controls

Parameters	Pre-HTN(*n*=50)	Controls(*n*=50)	*P*-value
HR(BPM)	87.43±5.75	82.48±5.25	<0.001
SBP(mmHg)	122.18±4.86	114.6±4.56	<0.001
DBP(mmHg)	82.68±4.06	76.34±3.96	<0.001
PP (mmHg)	41.73±5.90	39.01±5.55	0.175
MAP(mmHg)	94.56±2.82	87.73±3.72	<0.001
RPP	10950.80±704.76	9082.78±490.82	<0.001

However, pre- HTN group subject's BMI (P < 0.001) and weight (P < 0.001) was more compared to controls. In pre-HTN group, significantly higher HR (P < 0.001), SBP (P < 0.001), DBP (P < 0.001), MAP (P < 0.001), and RPP (P < 0.001) were seen when compared to controls. No significant difference was seen in PP but it was slightly high in pre-HTN group and negatively associated with Vitamin D.

Table 3: Comparison of Vitamin D and telomerase levels between pre-HTN and controls

Parameters	Pre-HTN(*n*=50)	Controls(*n*=50)	*P*-value
Vitamin D(ng/ml)	19.21±4.36	23.04±6.24	0.044
Telomerase(IU/ml)	35.85±18.82	7.03±5.95	<0.001

High telomerase levels have correlation with waist-hip ratio, SBP, DBP, MAP, and RPP but no significant correlation was seen with BMI, HR, and PP.

Discussion

Hypertension is a common health problem, one of the leading costs to the health care system, and a significant cause of mortality and morbidity worldwide. [14] Hypertension is also one of the most common and influential risk factors of cardiovascular disease including myocardial infarction, cerebral stroke, congestive heart failure, peripheral vascular disorders and kidney disease. [15] It has been estimated that eliminating high blood pressure would reduce the occurrence of stroke by 35% and heart attacks by 18%. [16,17] To reduce the burden of hypertension, a multicomponent lifestyle intervention that includes weight loss, increased physical activity, restricted sodium and alcohol consumption, and adherence to a Dietary Approach to Stop Hypertension like diet with plenty of fruits, vegetables, and low-fat dairy items and little saturated fat is needed. [18] Moreover, improved vitamin D status has been proposed as an easily modifiable risk factor. [19]

Vitamin D deficiency has recently emerged as a public health problem, affecting almost 50% of the population worldwide. [20] In addition to the reduced exposition to sunlight [21], also genetic and environmental factors have been suggested as a cause of this pandemic, such as pollution, diet, sedentary life style and stress. [22] Moreover, vitamin D is no longer considered as only a pivotal mediator of calcium metabolism and skeletal health, but it also regulates several cell functions, including differentiation and metabolism. This aspect may explain the reason why hypovitaminosis D has been proved to be an independent risk factor for overall mortality in various cohort analyses [23], whereas vitamin D supplementation significantly reduced mortality. [24] Zhao et al [25] in an ongoing report detailed a positive relationship between Vit-D and hypertension and pre-HTN. Forman et al [26] reported a positive relationship between Vit-D and self-revealed occurrence hypertension among 38,388 men from the Health Professionals' follow-up study and 77,531 females from the Nurses' Health Study; a positive affiliation was likewise detailed between Vit-D and hypertension in a subsample of members. Further, a study concentrate from the second Nurses' health study detailed a positive relationship between serum Vit-D and hypertension among 1484 young females. In the NHANES, SBP was demonstrated to be conversely connected with Vit-D among 12,644 participants. [27]

The study population included 100 apparently healthy individuals. 100 were pre- hypertensive with the age of 22.58±1.56and the age of controls was 18.92±1.28. Out of 100, 28 males, 22 females were in pre- HTN group and 26 males, 24 females were in the control group. A significant difference was not found between-group differences in height and waist-hip ratio. However, pre- HTN group subject's BMI (P < 0.001) and weight (P < 0.001) was more compared to controls. In pre-HTN group, significantly higher HR (P < 0.001), SBP (P < 0.001), DBP (P < 0.001), MAP (P < 0.001), and RPP (P < 0.001) were seen when compared to controls. No significant difference was seen in PP but it was slightly high in pre-HTN group and negatively associated with Vitamin D.High telomerase levels have correlation with waist-hip ratio, SBP, DBP, MAP, and RPP but no significant correlation was seen with BMI, HR, and PP.Earlier reports have shown that higher Vitamin D is related to longer telomere length, which underscores the conceivably advantageous impacts of this hormone on cell senescence and age-related conditions. [28] High telomerase levels have correlation with waist-hip ratio, SBP, DBP, MAP, and RPP but no significant correlation was seen with BMI, HR, and PP.In this study, cellular senescence was assessed using telomerase. This enzyme attempts to inhibit the process of telomere shortening. [29] Since the cell telomere loss appears to result from cell division just to a fractional degree, different components, particularly oxidative stress, were attested to assume a job in the expanded rate for shortening of telomeres. [30] The exact mechanism by which lower Vit-D levels are associated with this cellular senesce is hypothesized dependent on the perceptions recommends that the degrees of the telomerase may really be related to oxidative stress, with higher oxidative stress prompting higher

telomerase levels. Cells of nearly complex organism may not have an ability to divide. This marvel was depicted by Hay flick in 1961. [31]

Conclusion

It can be concluded that reduced Vitamin D levels in pre-HTN may cause derangements of cardiovascular homeostatic mechanism, enhance the speed of cellular senescence measured by telomerase.

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