Original Article

Journal of Practical Biochemistry and Biophysics
Volume 1 Number 1, January - June 2016

The Impact of Serum Uric Acid and Vitamin D on Essential Hypertension

Ramchandra K. Padalkar*, Sangita M. Patil, Sonali S. Bhagat**, Rahul A. Ghone**, Dhananjay V. Andure****

Author Affiliation: *Professor and Head, **Assistant Professor, Department of Biochemistry, PDVVPF's Medical College, Ahmednagar, (MS), India.

Abstract

Background: Hypertension is the third leading killer disease in the world and is responsible for 1 in every 8 deaths. Uric acid has been associated with hypertension in many studies involving different population but results were controversial and no information was found on the association between vitamin D insufficiency and elevated uric acid. The aim of present study was to assess the serum uric acid and vitamin D level in essential hypertension and try to find out its correlation. *Material and Methods:* The present study was case-control study. Total 90 subjects were included and divided into two groups. Group I consisted 45 subjects of essential hypertension in the age group 25-75 years while Group II consisted of age and sex matched 45 normal healthy individuals who served as control with no history of essential hypertension. Serum levels of uric acid, vitamin D were estimated in all the subjects under study. Values were expressed as mean± standard deviation. SYSTAT version 12 software was used for statistical analysis.Comparisons of study groups to control groups were done by applying student t test. Pearson's correlation coefficient was used to find out the correlation between two variables. *Results:* Serum uric acid level was increased significantly ($p<0.001$) in essential hypertension as compared with controls. Correlation between uric acid and diastolic blood pressure and systolic blood pressure was positively correlated and significant. Correlation between Vitamin D and diastolic and systolic blood pressure was negatively correlated and non-significant. *Conclusion:* In the present study,It can be concluded that, the essential hypertension is associated with abnormalities in the level of serum uric acid and vitamin D. Serum uric acid and vitamin D can be used as biochemical markers to determine severity of hypertension and it may be beneficial for better management and for developing new treatment strategies.

Keywords: Essential Hypertension; Uric Acid; Vitamin D.

Introduction

Hypertension is an important worldwide public-health problem because of its high frequency and concomitant risk of cardiovascular and kidney disease [1]. It is common in majority of readily detectable, usually treatable and often leads to lethal complications if left untreated [2].

Reprint Request: Ramchandra K. Padalkar, Professor and HOD, Dept. of Biochemistry, PDVVPF's Medical College, Vilad Ghat, Ahmednagar, Maharashtra 414111
E-mail: dr.padalkar@rediffmail.com

A recent report on the global burden of hypertension indicates that nearly 1 billion adults had hypertension in 2000 and this is predicted to increase to 1.56 billion by 2025. Hypertension is a major health burden and leading cause of death in the world. Although it is common in economically developed countries [3].

In India, awareness of hypertension and its complications is very poor. Poor awareness of normal blood pressure values in hypertension can be important factor hindering blood pressure control [4].

The pathogenesis of essential hypertension is not

clearly understood. Different investigators have proposed the kidney, the peripheral resistance vessels and sympathetic nervous system as the seat of primary abnormality [5].

The endothelial dysfunction could facilitate the maintenance of elevated peripheral resistance which could favors the occurrence of complication such as atherosclerosis, myocardial infarction and heart failure [6].

Uric acid is byproduct of purine metabolism produced in blood from endogenous purine substances or from diet. Alcoholic , high purine foods consumption low water consumption and poorly exercising are contributing factor responsible for hyperuricaemia [7].

Uric acid might be a cause of hypertension or renal disease. Uric acid plays an important role in hypertension mediated by several mechanisms such as inflammation, vascular smooth muscle cell proliferation in renal microcirculation and endothelial dysfunction [8].

Incidence of Hypertension in the general population rises with the increase in latitude which in turn is associated with low UV irradiation levels. Dark pigmentation in the black population which effects an efficient UV light penetration has been associated with a higher blood pressure [9].

Many studies in India have demonstrated that the level of VitaminD in the population is low and there is high prevalence of chronic disease like hypertension, diabetes, cardiovascular disease. Therefore in present study we examined serum uric acid andvitamin D level in patients with essential hypertension and their role in etiopathogenesis of essential hypertension.

Material and Method

The present study was conducted at Department of Biochemistry, PDVVPF's Medical College Ahmednagar. The study was approved byInstitutional Ethics Committee. All participants providing informed consent and utmost care was taken during experimental procedure according to the declaration of Helsinki 1975.

Study Type

Case- Control study.

Study Design

Total 90 samples were enrolled in the present study.

Control Group

45 healthy age and sex matched individuals without any evidence of essential hypertensionas per Clinical examination by physicians in medicine OPD were taken as control subjects.

Patients Group

The study included total 45 patients between age group 25-75 years with essential hypertension.

Inclusion Criteria

a. Patients with essentialhypertension systolic blood pressure ≥140 and diastolic blood pressure ≥90 mm of Hg attending medicine Output patient department.
b. Controls are healthy individuals, age and sex matched without any major illness and not on any medication

Exclusion Criteria

Patients with secondary hypertension, complications of cardiovascular, renal disorders, and stroke, history of multiple transfusions, liver diseases, pregnancy, anemia and history of any other medical or surgical illness were excluded.

Method of Collection of Data

A pre-structured and pre-tested proforma was used to collect the data. Informed consent was taken from all cases and control subjects. Baseline data including age, sex, detailed medical history, clinical examinations and relevant investigations were included as part of methodology.

Collection of Blood Sample

About 5 ml of venous blood was drawn from subjects under aseptic precautions, using a sterile disposable syringe and collected in clot activator and fluoride EDTA vacuum evacuated tubes. After an hour, the samples were centrifuged at 3000 rpm for 10 minutes to separate serum and used for analysis of uric acid and Vitamin D.

Method

Determination of Serum Uric Acid

Uric acid is oxidized to allantoin by uricase with

production of hydrogen peroxide. The peroxide reacts with 4-amino antipyrine in presence of peroxidase to yield quinoneimine dye. The absorbance of this dye at 546 nm is proportional to uric acid concentration in the sample.

Estimation of Vitamin D by Chemiluminiscence Method

Sample antigen and purified 25-OH Vitamin D antigen competes to combine with 25-OH vitamin D monoclonal antibody to form antibody-antigen complex with starter reagent, the flash chemiluminiscent reaction is initiated. The light reaction is measured by a photomultiplier which is proportional to the concentration of vitamin D present in sample.

Statistical Analysis

Statistical software SYSTAT version-12 (by Cranes software, Bangalore) was used to analyze the data. The result were expressed in mean ± Standard Deviation (Mean± SD) Data was analysed by descriptive statistics as mean, SD, percentage etc. Comparisons of study group to control group by using the Students't' test. Pearson's correlation coefficient was used to find out the correlation between two variables. P – Values of <0.001 was considered as statistically significant.

Result

Table 1 showed that, the mean serum uric acid levels in essential hypertension was 6.98 ± 1.51 and in controls it was 4.72 ± 1.83. The mean serum uric acid in essential hypertension was significantly, higher when compared with healthy controls (p<0.001). As shown in Table 1 the mean serum Vitamin D levels in essential hypertension was 17.05 ± 7.13 and in controls it was 34.2 ± 5.18. The mean serum Vitamin D essential hypertension was significantly decreased in essential hypertension when compared with normal healthy controls (p<0.001).

Table 3 and 4 Showed thatcorrelations between the parameters. 'r ' values were for Uric acid Vitamin D verses hypertension. This illustrates that correlation between uric acid and diastolic and systolic blood pressure was positively correlated and significant. Correlation between Vitamin D and diastolic and systolic blood pressure was negatively correlated and non-significant.

Table 1: Baseline characteristic and biochemical changes in essential hypertension and control

Variable	Controls (n=45)	Essential hypertension (n=45)	P value
Age (In years)	27-72	25-74	-----
Sex (M / F)	30 / 18	29 / 27	------
Pulse rate	71.65±2.09	87.73±18.31	**<0.01**
Diastolic blood pressure	74.83±5.79	84.95±21.71	**<0.01**
Systolic blood pressure	112.25±8.54	132.48±27.25	**<0.01**
Uric acid (mg / dl)	4.72±1.83	6.98± 1.51	**<0.001**
Vitamin D	34.2±5.18	17.05±7.13	**<0.001**

Table 2: Pearson's correlation between the uric acid and hypertension

Parameters	Correlation Co- efficient	P-value
Systolic blood pressure	0.32	0.03 Significant
Diastolic blood pressure	0.32	0.03 Significant

Table 3: Pearson's correlation between the Vitamin D and hypertension

Parameters	Correlation Co- efficient	P-value
Systolic blood pressure	-0.2	0.16 Non-Significant
Diastolic blood pressure	-0.2	0.16 Non-Significant

Disccussion

Hypertension is an increasingly important medical and public health issue worldwide affecting approximately one billion individuals [10]. Because of risk factor for cardiovascular and renal morbidity and mortality, it is a leading contributor to global disease burden [11].

Uric acid has been implicated in hypertension through the probable role. It is thought to play in mediating hypertension via mechanisms like inflammation, vascular smooth muscle cell proliferation in renal microcirculation, endothelial dysfunction and activation of renin-angiotensin aldosterone system [8].

Vitamin D plays a key role in regulation of blood pressure and in the pathogenesis of hypertension

through its effects on calcium homeostasis, vascular smooth muscle, endothelial cells and activity of renin- angiotensin system [12]. Vitamin D deficiency is widely prevalent across all ages, races, geographical regions and socioeconomic strata. It plays an important role in skeletal development and calcium homeostastis [5].

In present study, the mean serum uric acid was significantly higher in essential hypertension when compared with normal healthy controls ($p<0.001$). Correlation between uric acid and diastolic and systolic blood pressure was positively significant. Our results are strongly supported to previous results. Charies et al have demonstrated that, hyperuricemia influenced the development of hypertension via its role in vascular endothelial cell dysfunction and activation of renin-angiotensin system [13]. Infollow-up Study, ≥40 years allowed to assess the durability of the prospective association of uric acid level with hypertension [14].

In current study, the mean serum Vitamin D was significantly decreased in essential hypertension when compared with normal healthy controls ($p<0.001$). Correlation between Vitamin D and diastolic and systolic blood pressure was negatively correlated and non-significant. Our results were similar to previous reports. Scragg et. al in their cross – sectional study showed that, significant inverse correlation with both systolic ($p<0.01$) and diastolic ($p<0.05$) blood pressure [15]. This association was stronger in patients who were more than 50 years. In one more cross- sectional study, Martin et.al reported that increased prevalence of hypertension in the lower quartile of 25 (OH) Vitamin D [16]. Thomas J. Wang et al have demonstrated that, potential interaction occurred between Vitamin D deficiency and hypertension. Left ventricular hypertension and vascular remodeling are major complication developed in hypertension. Thus Vitamin D deficiency directly promotes the development of hypertension [17].

Conclusion

Thus it can be concluded from the present study that, the essential hypertension is associated with abnormalities in the level of serum uric acid and Vitamin D. Because of association of Vitamin D deficiency and increased risk of hypertension its supplementation may play key role in controlling high blood pressure and to prevent further complication. The study also concluded that, serum uric acid and vitamin D can be used as biochemical markers to determine severity of hypertension and it may beneficial for better management and for developing new treatment strategies.

References

1. Kearney PM, Whelton M, Reynolds K, et.al. Global burden of hypertension analysis of worldwise data. Lancet. 2005; 365: 213-217.
2. Naomi DL Fisher, Gordon H. Williams. Hypertensive vascular diseases. Harrison's principles of internal medicine. 16th edvol 1: 1463
3. B. Wizner, B Gryglewska, J Gasowski et al. Normal blood pressure values as perceived by normotensive and hypertensive subjects. J Hum Hypertens. 2003; 17: 87-91.
4. Colin J, Dollery MB. Risk predictors, Risk indicators and benefit factors in hypertension. Am. J. Med. 1987; 82: 2-8.
5. T Reynolds. Serum uric acid, the endothelial and hypertension: an association revisited. J Hum Hypertension. 2007; 2: 591-593.
6. J Plange- Rhule, R Phillips, JWA Chempoung et al. Hypertension and renal failure in Kumasi Ghana. J Hum Hypertens. 1999; 13: 37-40.
7. Harris ED, Budd RC, Firestein GS, Genorese MC, Sergent JS et al. Kalley's textbook of Rheumatology. 2005; 7thedn USA; Elsevier Saunders.
8. Zhang W,Sun K, Yang Y, Zhang H. et.al. Plasma uric acid and hypertension in a chinese community, propective study and meta-analysis. Clin Chem. 2009; 55: 2026-2034.
9. Sandeep Chopra, Davis Cherian, JubbinJ Jacob. The thyroid hormone, parathyroid hormone and vitamin D associated hypertension. Indian Journal of Endocrinology and Metabolism. 2011; 15(8): 354-360.
10. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA et al. Seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure. Hypertension. 2003; 42: 1206-1252.
11. Add J, Smeeth L, Leon DA. Hypertension in sub-Saharan Africa: a systematic review. Hypertension. 2007; 50: 1012-1018.
12. Lu wang. Vitamin and Hypertension. N A J Med. Sci. 2009; 2(4):115-149.
13. Charles BA, Shriner D. et al. A Genome- wide association study of serum uric acid in African Americans. BMC Medical Genome. 2011; 4: 17.
14. Perlsteinet. al. Uric acid and the development of hypertension. The Normative aging study hypertension. 2006; 48: 1031-1036.

15. Martin LA. Vitamin D and Metabolic syndrome. Nutri. Rev. 2006; 64(11): 479-786.
16. Scragg R, Sowers M, Bell C. Serum 25-hydroxyvitamin D, ethnicity and blood pressure in the third national health and nutrition examination survey. American Journal of Hypertension. 2007; 20(7): 713-719.
17. Thomas J. Wang et. al. Vitamin D deficiency and risk of cardiovascular disease. Am. J. Med. Sci. 2009; 338(1): 40-44.