ORIGINAL RESEARCH PAPER

Volume-8 | Issue-7 | July - 2019 | PRINT ISSN No. 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ESTIMATION OF SERUM CALCIUM LEVEL IN ESSENTIAL HYPERTENSION AND ITS PROGNOSTIC SIGNIFICANCE

Cardiology

Ravi Vishnu Prasad* MD (Medicine), DM (Cardiology), Associate Professor, Department of Cardiology, IGIMS, Patna. *Corresponding Author

Kumar Abhishek Senior resident, Department of Cardiology, IGIMS, Patna.

P K Agarwal Professor, Department of medicine, Kathihar medical college, Kathihar.

ABSTRACT

Hypertension is an important worldwide public-health challenge because of its high frequency and concomitant risks of cardiovascular, cerebrovascular and kidney disease. This study was designed to compare total and ionized calcium levels between patients with newly detected essential hypertension and normotensive controls. The ionized serum calcium levels are significantly lowered in newly detected essential hypertensive patients when compared to normotensive controls. The total serum calcium levels are not significant and levels are found to be same in the hypertensive as well as the normotensive patients. The total and ionized serum calcium levels have a significant negative correlation with the level of systolic blood pressure and with the diastolic blood pressure in newly detected essential hypertensive patients. The total and ionized serum calcium levels showed no significant difference with age, sex, BMI, life style, smoking, alcohol, family history of hypertension in newly detected essential hypertensive patients.

KEYWORDS

Hypertension, serum calcium

INTRODUCTION

Hypertension is an important worldwide public-health challenge because of its high frequency and concomitant risks of cardiovascular, cerebrovascular and kidney disease. It has been identified as the leading risk factor for mortality, and is ranked third as a cause of disability-adjusted life-years.

As per the World Health Statistics 2012, nearly one billion adults (more than a quarter of the world's population) had hypertension in 2000, and this is predicted to increase to 1.56 billion by 2025. An elevated blood pressure is probably the most important public health problem worldwide. Peripheral resistance is one of the determinants of arterial pressure. It is widely accepted that the increase in peripheral resistance results from an increase in active tension in the vascular smooth muscle.

Although our understanding of the pathophysiology of essential hypertension has increased, the aetiology remains hypothetical. Essential hypertension is associated with disturbed calcium metabolism. The calcium ions play major role in intracellular second messenger in excitation contraction coupling in cardiac and smooth muscle cells and increased in peripheral vascular resistance is a uniform finding in all types of established hypertension.

This study was designed to compare total and ionized calcium levels between patients with newly detected essential hypertension and normotensive controls. Total and ionized calcium levels were compared for various subsets of patients with newly detected essential hypertension viz. age, sex, smoking, alcohol, life style, BMI. Also, correlation of total and ionized calcium levels was determined with systolic blood pressure and diastolic blood pressure in patients with essential hypertension.

AIM OF THE STUDY

1. To compare the total and ionized calcium levels between patients with newly detected essential hypertension and normotensive controls.
2. To compare the total and ionized calcium levels of various subsets of patients with newly detected essential hypertension viz. age, sex, smoking, alcohol, life style, BMI.
3. To determine the correlation of total and ionized calcium levels with systolic and diastolic blood pressure in patients with essential hypertension.

MATERIALS AND METHODS

This study was a prospective study, with randomly enrolling 120 patients who attended in outpatient department (OPD) of department of cardiology, Indira Gandhi Institute of Medical Sciences (IGIMS), Patna during the period between December 2017 to June 2018.Our study was approved by institute ethical committee.

Inclusion criteria: Newly detected essential hypertension patients with systolic blood pressure ≥140mm of Hg and diastolic blood pressure ≥90mm of Hg.

Exclusion criteria:

1. Adolescents and young adults < 30 yrs.
2. BMI < 18.5Kg/m2
3. Patients with secondary hypertension, malignant hypertension, Ischemic heart disease, Congestive cardiac failure, Chronic renal failure, Diabetes mellitus, Cerebrovascular accident, Peripheral vascular disease
4. Patients on antihypertensive agents or hypertension inducing drugs
5. Patients with acute illness or any medical or surgical complications

Applying these criteria, sixty essential hypertensives (Group A) as cases and sixty normotensives (Group B) as control were selected and included in the study after informed consent (Group A).

METHODOLOGY

- A detailed history taking and clinical examination was done in patients regarding hypertension. Relevant blood and urine investigations were done with estimation of serum calcium and ionized serum calcium. Fundus examination for hypertensive retinopathy and ultra-sonogram were done in all patients.
- **Statistical analysis:** Data was analyzed using Graph Pad InStat Software. 'p' value below 0.05 were considered significant. Tests used for statistical analysis were chi-square test, student- t test and Analysis of variance (ANOVA).

RESULTS

Majority of Hypertensive patients (Group A) were from age group of 41-50 years (33%) and mean age of both groups were more or less same. Male to female ratio was 1.22:1 and 1.06:1 in group A and group B respectively (Table 1).

Table 1: Age distribution, Mean age and Sex distribution between Group A and Group B

		Groups		Total (n=60)
		A (n=60)	B (n=60)	
Age Groups (Years)	< 40	03 (05%)	04 (07%)	07 (06%)
	41-50	20 (33%)	23 (38%)	43 (36%)
	51-60	19 (32%)	19 (32%)	38 (32%)
	61-70	13 (22%)	08 (13%)	21 (17%)
	>70	05 (08%)	06 (10%)	11 (9%)
Mean age	Mean age ± SD	55.6±9.8	55.37±10.6	
Sex	Male	33 (55%)	31(52%)	64(53%)
	Female	27(45%)	29(48%)	56(47%)

In Group A and B, 24 and 20; 18 and 22; 31 and 28; 38 and 19; 29 and 32

were smokers; alcoholics; had sedentary life style; had family history of hypertension; had BMI >25 respectively (Table 2).

Table 2: Distribution of Smokers, Alcoholics, Lifestyle, Family history of Hypertension and BMI between Groups A and B

		Group		Total
		A	B	
Smoking	No	36(60%)	40(67%)	76(63%)
	Yes	24(40%)	20(33%)	44(37%)
Alcohol	No	42(70%)	38(63%)	80(67%)
	Yes	18(30%)	22(37%)	40(33%)
Lifestyle	Sedentary	31(52%)	28(47%)	59(49%)
	Non-Sedentary	29(48%)	32(53%)	61(51%)
Family History of Hypertension	No	22(37%)	41(68%)	63(52%)
	Yes	38(63%)	19(32%)	57(48%)
BMI (Kg/m²)	BMI <25	31(52%)	28(47%)	59(49%)
	BMI >25	29(48%)	32(53%)	61(51%)

Both SBP and DBP in group A was more than group B (Table 3).

Table 3: Comparison of SBP and DBP in study groups

	Group	n	Mean
Systolic Blood Pressure	A	60	168.233
	B	60	112.63
Diastolic Blood Pressure	A	60	100.3
	B	60	72.4

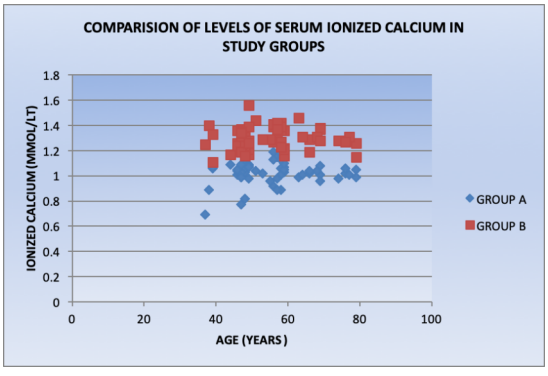
Both Total serum calcium and ionized calcium in group A was less than group B (Table 4).

Table 4: Distribution of Total Serum Calcium and Ionized Calcium in Group A and Group B

Total Serum Calcium	Group	n	Mean
	A	60	8.9363
	B	60	9.0765
Ionized Calcium	A	60	1.0303
	B	60	1.296

There was no significant variation in level of ionized calcium is observed with age (Figure 1).

Figure 1: Correlation of the ionized calcium with various age group



DISCUSSION

Hypertension is one of the most prevalent cardiovascular disorders posing a major public health challenge to the population in socio-economic and epidemiological transition. Approximately 54% of all strokes and 47% of all ischemic heart disease were attributed to high blood pressure[1].

Calcium plays an important role in the pathophysiology of essential hypertension [2]. Various epidemiological studies stated that the calcium status with essential hypertension of human and genetic animal models of hypertension which is characterized by low serum total and ionized calcium concentration, increased intracellular calcium, increased urinary calcium excretion, and increased parathyroid hormone (PTH) concentration [3]. Present study was based on estimating serum calcium level in patients with essential hypertension and establishing relationship between serum calcium level and severity of hypertension.

In our study, the mean total serum calcium and ionized calcium levels in group A were 8.9363± 0.4964 mg/dl and 1.0303± 0.0957 mmol/l while the mean total serum calcium and ionized calcium levels in group B (controls) were 9.0765± 0.6143mg/dl and 1.296± 0.0873 mmol/l respectively. Statistical analysis revealed that the total calcium levels were not significantly in essential hypertensives (p value =0.9736) but it was significant when compared to ionized calcium levels (p value <0.001).

Our study also compared total and ionized serum calcium levels with various subsets of essential hypertensive population like age, sex, smoking, alcohol, family history of hypertension, lifestyle and BMI. After statistical analysis, our study revealed that there was no significant difference between the calcium levels in the above-mentioned parameters (p > 0.05).

Pawade, R Y et.al showed the correlation study of age with levels that was not significantly with age of level of serum ionized in cases as well in controls [4]. Our study revealed that there was no significant difference between the calcium levels with age.According to Folsom AR et al., serum total calcium was similar in both the sexes and no significant difference noted [5]. Our study revealed that there was no significant difference between the calcium levels in the both sexes. According to Lorena Hysi et al, there was no difference in serum calcium between non- smokers, ex-smoker and current smokers. According to C Brot. et al., there was no difference in serum ionized calcium between smokers and non-smokers in their study [6].

In Tromso study by J. Sundsfjord et.al. which showed that after correcting for other variables in a multiple regression model, a positive association of serum calcium with body mass index (BMI) in both sexes that persisted [7]. Physical activity(lifestyle) had no significant association with serum calcium. In females alcohol consumption was negatively, and smoking was positively associated with serum calcium. Our study revealed that there was no significant difference between the calcium levels in the above mentioned parameters.

The hypertensive cases showed lower levels of total serum calcium as compared to normotensive controls but the mean difference level of total serum calcium in hypertensive and normotensive was statistically non-significant (p value=0.973 i.e. >0.05). David A. McCarron, et al supported our present study [8].

Yogesh R Pawade et al. in their study stated that the mean level of total serum calcium was not statistically different between hypertensive and normotensive groups [4]. In a recent study by Hazari M A et al mentioned that there was no significant difference in serum calcium levels between normotensive and hypertensive groups. Kaushik Kar et al in their study showed that the mean serum total calcium level were decreased in hypertension patients than control but the decrease was not significant [9]. Our study showed that the level of ionized calcium in hypertensive group was significantly low in comparison with the normotensive group (p value<0.001).

Wright GL, Rankin GO., in their study on concentrations of ionic and total calcium in plasma of four models of hypertension noted a lower serum ionized and total serum calcium concentrations in spontaneously hypertensive rats (SHR) [10]. David A. McCarron et.al in their study stated that hypertensive had significantly lower levels of ionized serum calcium as compared to the normotensives. Our study well concided with the studies which was carried out by above author [8]. Yogesh R Pawade, et al. also, mentioned that hypertensive subjects had significantly lower mean serum ionized calcium as compared to the normotensive controls [4]. K. Kar et al. suggested that serum ionized calcium significantly decreased in hypertensives when compared to control subjects. whereas serum total calcium did not follow the same trend [9]. Some investigators like McCarron DA.et al., also noted that, compared with normotensive subjects, essential hypertensive subjects had lower serum ionized calcium concentrations even when total calcium levels were similar [8].

Several studies showed that concentration of total serum calcium and blood pressure are positively associated. But not all the studies were agreed, few studies noted that lower level of ionized calcium in the subjects in case of essential hypertension even when similar level of total calcium found. This observation is supported by our studies, low level of ionized calcium but not the total serum calcium suggests an abnormality in the protein binding of extracellular calcium.

Some authors stated that intake of calcium in diet is not associated with levels of blood pressure. but for the, lower level of calcium in diet may have a role in the pathogenesis and development of elevated blood pressure. These views were confirmed by studies when calcium supplements were advised to patients those who were diagnosed cases of hypertension and found lower level of blood pressure in that patients.

LIMITATIONS OF THE STUDY:

1. The sample size was small.
2. The follow up was not done.
3. Cytosolic calcium, urinary calcium, serum parathormone levels, serum renin levels, and serum Vit D3 levels were not measured due to financial constraints which may be helpful in better corelations.

CONCLUSION

The ionized serum calcium levels are significantly lowered in newly detected essential hypertensive patients when compared to normotensive controls. The total serum calcium levels are not significant and levels are found to be same in the hypertensive as well as the normotensive patients. The total and ionized serum calcium levels have a significant negative correlation with the level of systolic blood pressure and with the diastolic blood pressure in newly detected essential hypertensive patients. The total and ionized serum calcium levels showed no significant difference with age, sex, BMI, life style, smoking, alcohol, family history of hypertension in newly detected essential hypertensive patients.

REFERENCES

1. Adnan Awada , MD et al ; Hypertension and cerebrovascular diseases . The periodical third issue, July 2003.
2. Allender P S, Cutler J A , Follmann D et al . dietary calcium and blood pressure: a meta-analysis of randomized clinical trials. Ann intern med 1996; 124:825-831.
3. Blaustein MP.,Na/Ca Exchange and control of contractility in cardiac muscle and vascular smooth muscle.J cardiovascular Pharmacology; 1988,12(suppl 5);S56 – S68
4. Yogesh R Pawade, Suresh S Ghangale, Indrayani C Apte, Abhay N Nagdeote and Jayesh P Warade ; Serum Calcium: Can It Be A Diagnostic And Prognostic Marker In Essential Hypertension? ; Journal of clinical and diagnostic research . 2011Feb , vol5(1) : 58-62.
5. Folsom AR, Smith CL, Prineas RJ, Grimm RH Jr. Serum calcium fractions in essential hypertensive and matched normotensive subjects. Hypertension 1986;8:11-5.
6. C Brot, N Rye Jorgensen and O Helmer Sorensen; The influence of smoking on vitamin D status and calcium metabolism; EJCN December 1999, Volume 53, Number 12, Pages 920-926.
7. J. Sundsfjord., R. Jorde, and K.H. Bonaa; Determinants of serum calcium in men and women.The Tromso study, European Journal of Epidemiology; Volume 17, Number 12 / December, 2001.
8. McCarron, D.A. Role of Adequate Dietary Calcium Intake in the Prevention and Management of Salt-Sensitive Hypertension. American Journal of Clinical Nutrition, 1997 Feb, 65(2 suppl): 712S-716S.
9. Kaushik Kar , Satwika Sinha , Anindya Dasgupta, Sukanta Sen ; Significance of Ionized calcium in hypertension ; International Journal of Pharma Research and Health Sciences ; Volume 2 (4), 2014, Page-273-280
10. Wright GL, Rankin GO. Concentrations of ionic and total calcium in plasma of four models of hypertension. Am J Physiol. 1982 Sep;243(3):H365-70.