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Original Research Article

Study of serum calcium and serum magnesium levels in newly diagnosed hypertensives

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ABSTRACT

Background: In normal vascular tissue physiology, calcium plays a crucial role. Calcium and magnesium metabolism have been implicated in the pathogenesis of primary hypertension. The present study aimed to assess serum calcium and serum magnesium levels and to study the association of the serum magnesium and serum calcium levels with hypertension in newly diagnosed hypertensive patients of Bikaner, Rajasthan.
Methods: This cross- sectional study was carried out on 60 subjects aged between 18 years to 60 years in the department of physiology and in association with department of medicine and department of cardiology, S. P. Medical College and associated group of hospitals, Bikaner. Data was compiled and entered into Microsoft software statistical package for the social sciences (SPSS) version 22.0. Data was summarised as frequencies, mean and standard deviations. For continuous data the means were compared between cases and controls using unpaired or independent t test; and for nominal data, chi-square or Fisher's exact tests were applied to compare frequency distribution between cases and controls to see the statistical significance.
Results: The present study shows statistically insignificant change in serum calcium and serum magnesium levels in newly detected hypertensive patients when compared to normotensive controls.
Conclusions: In view of statistically insignificant change in serum calcium and magnesium levels in newly detected hypertensive patients in our study, further studies with a large sample size and more uniform population are required to find if any significant association exists between these cations and hypertension.

Keywords: Serum calcium level, Serum magnesium level, Hypertension

INTRODUCTION

Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure. According to World Health Organization (WHO) hypertension is one of the most important risk factors for morbidity and mortality worldwide.[1] Most common type of hypertension is essential hypertension affecting 95% of hypertensive patients.[2] The essential hypertension has probably multifactorial etiology. The autonomic nervous system have very vital role in blood pressure and heart rate regulation and hence it may be an important factor in the development of hypertesion.[3] Arterial hypertension can also be determined by genetic predisposition and environmental factors such as stress, obesity and salt consumption.[4,5] Many epidemiologic studies indicate the importance of diet in determining blood pressure.[6] many national and international organizations recommend for adequate amount of nutrient intake to prevent hypertension.[7,8] Calcium and Magnesium metabolism have been implicated in the pathogenesis of primary hypertension.[9] In normal vascular tissue physiology, calcium plays a crucial role. The extracellular

and intracellular calcium level may influence the pathogenesis of essential hypertension.

Some studies showed no significant difference in serum calcium in hypertensive group compared with normotensive group.[10,11] While other studies reported a significant decrease in serum calcium in patients with essential HTN compared with normotensive subjects.[12,13] Several studies reported that calcium intake had an association with oxidative stress and suggested that calcium supplementation might increase the lipid oxidation.[14,15] As the pathogenesis of hypertension is often associated with oxidative stress, the relationships among calcium intake, blood pressure, and oxidative stress is yet to be investigated. Lower concentrations of magnesium are known to be associated with oxidative stress, pro-inflammatory state, endothelial dysfunction, platelet aggregation, insulin resistance, and hyperglycaemia. In view of direct and indirect actions of magnesium on cardiac and vascular smooth muscle, it was suggested that magnesium deficiency might be relevant to disorders of blood pressure homeostasis, such as hypertension.[16] Studies have indicated that low dietary or circulating magnesium may be related to the development of hypertension because of its calcium antagonist and endothelial effects.[17] It has also been shown that hypertensive patients often have reduced serum and intracellular levels of magnesium compared with normotensives.[18] Epidemiologic, observational, and clinical trial data indicate that a diet high in magnesium may lower BP, but the results are inconsistent.[19,20] There is long-standing interest in the promising yet unproven role of magnesium in the regulation of BP for the prevention of hypertension, although evidence from human studies has been both inconsistent and controversial and the therapeutic value of magnesium in the prevention and treatment of essential hypertension remains unclear.[21] Previous studies of the effect of calcium and magnesium on blood pressure have provided conflicting data. Hence, it is necessary to study the serum level of calcium and magnesium in hypertensive people to know their relationship with blood pressure for the future dietary intervention and supplementation. With this background the present study is taken up to assess serum calcium and serum magnesium levels in newly diagnosed hypertensive patients of Bikaner, Rajasthan.

METHODS

This cross-sectional study was carried out in the department of physiology and in association with department of medicine and department of cardiology, PBM hospital associated with S. P. Medical College Bikaner.

Sample size

This study was conducted on 60 subjects (sample size was calculated by MEDCALC 16.4 version software). In this study, 30 newly diagnosed hypertensive subjects without any other comorbidities and 30 healthy subjects as controls in the age group of 18 to 60 years were selected randomly from the patients visiting medicine outpatient department.

Inclusion criteria

Inclusion criteria for cases: patients with newly detected hypertension, but must not be on antihypertensive treatment, patients aged between 18-60 years are included, body mass index should be within normal range, patients who had given consent for the study, and patients must not have any comorbidities or any endocrinal or renal disease.

Inclusion criteria for controls: same age group as cases, same socioeconomic status, body mass index should be within normal range, cases must not have any comorbidities, and patients who had given consent for the study.

Exclusion criteria

Exclusion criteria include: known hypertensive patients on antihypertensive drugs, patients having thyroid and parathyroid disorders, pregnant women, any other known medical co-morbidities like chronic renal disease, diabetes, COPD, liver disease and heart diseases, with any history of smoking, alcohol or substance abuse and on long term medication that may influence cardiovascular system, and patients on vitamin D or any other supplements that can affect the study.

Patients diagnosed with new onset of essential hypertension without any other co-morbidities along with age and gender match healthy control group were selected according to inclusion criteria after taking written informed consent. The study protocol was explained and informed written consent was taken from the subjects. Detailed personal, medical and family history including history of parental cardiovascular disease was taken. Anthropometrical parameters like height and weight were taken and body mass index (BMI) was calculated using the Quetelet's index.

$$BMI = Weight\ (in\ kg)/height\ (m^2)$$

Standardized mercury sphygmomanometer was used to record the BP. Patients were informed to refrain from smoking or drinking tea or coffee for at least 30 minutes before measuring blood pressure. Blood pressure was measured in the right arm of the subject in sitting position after resting for 10 minutes. Two readings were recorded using sphygmomanometer in a 5 min interval and mean of these readings was noted as the final blood pressure.

Five ml of venous blood sample was obtained from both cases and controls by the technician of central laboratory of PBM hospital. Serum was separated and processed immediately. The serum calcium and magnesium were estimated by the method of semi-automated photometric analysis by using model RA-50. Calcium was measured by

cresolphthalein-complexone method and magnesium was measured by xylidyl blue method.

Data was compiled and entered into Microsoft software statistical package for the social sciences (SPSS) version 22.0. Data was summarised as frequencies, mean and standard deviations. For continuous data the means were compared between cases and controls using unpaired or independent t test; and for nominal data, Chi-square or Fisher's exact tests were applied to compare frequency distribution between cases and controls to see the statistical significance. The data was expressed as mean±standard deviation (SD).

P value ≤0.05 was considered significant.

RESULTS

The groups of cases and controls were compared for anthropometric measures. It was shown that age, height, weight, BMI, were comparable and there were no significant differences between cases and controls in subject characteristics and anthropometric measures.

Table 1 shows subject characteristics and anthropometric measures of study population in two groups.

Table 1: Subject characteristics and anthropometric measures of study population in two groups.

Variables	Cases (n=30)	Controls (n=30)	P value
Age (years)	49.42±1.727	49.88±1.923	0.21 NS
Height (meters)	1.67±8.22	1.69±7.97	0.25 NS
Weight (kgs)	62.38±14.20	61.32±8.77	0.65 NS
Body mass index (kg/m^2)	22.04±4.15	21.44±2.32	0.36 NS

Table 2 shows mean values of serum calcium and magnesium level of cases and controls.

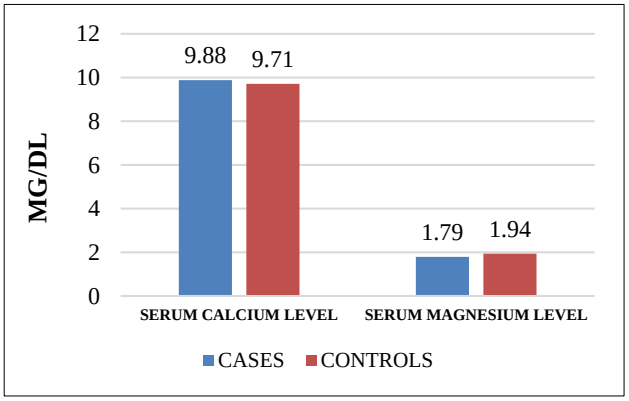

Figure 1: Serum calcium and magnesium level of cases and controls.

Table 2: Mean values of serum calcium and magnesium level of cases and controls.

Parameters	Cases	Controls	P value
Serum calcium (mg/dl)	9.88±0.748	9.71±0.606	0.324 NS
Serum magnesium (mg/dl)	1.79±0.445	1.94±0.344	0.159 NS

Table 3: Comparison of mean serum calcium and magnesium level between stage I and stage II hypertensive subjects.

Parameters	Hypertension stage (according to JNC-VIII)		P value
	Stage I	Stage II	
Serum calcium (mg/dl)	9.71±0.73	10.29±0.65	0.052
Serum magnesium (mg/dl)	1.76±0.45	1.86±0.44	0.598

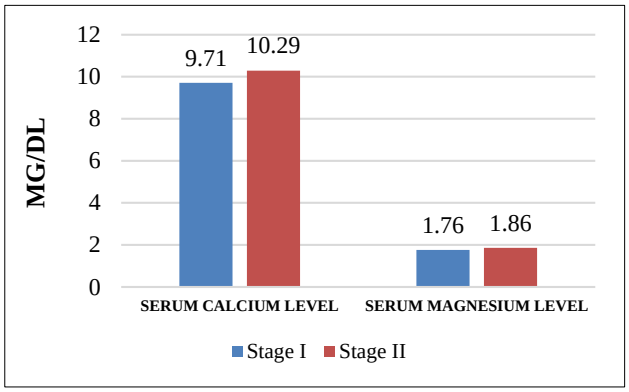

Figure 2: Mean serum calcium and magnesium level between stage I and stage II hypertensive subjects

DISCUSSION

The present study shows no statistically significant difference in serum calcium and magnesium level in hypertensive group compared with normotensive group which is consistent with the findings of study done in 2011 by Kosch et al.[10] In their study, there was no statistically significant difference in serum and intracellular Ca concentrations between patients and control subjects. In contrast, membrane Ca content was found to be significantly higher in patients with hypertension compared to controls ($p<0.01$). Since serum and intracellular concentrations were not statistically significantly different in patients, they suggested that serum and intracellular measurements alone may not be adequate in determining calcium metabolism in hypertension and to study the nature of underlying cellular defect in primary hypertension both intracellular and membranous calcium concentrations have to be considered.

Our study is consistent with findings of the study done in 2012 by Hazari et al.[11] They also found no statistically significant difference in serum calcium level between normotensive and hypertensive groups. In their study, they have found that serum calcium levels did not correlate with severity of HTN similar to the findings in our study in which there was no statistically significant difference between stage 1 and stage 2 hypertension. We have excluded patients on antihypertensive treatment in our study unlike this study which found out that hypertensive patients on calcium channel blockers (CCB) have serum calcium levels more than those on antihypertensive medications other than CCB, although the difference is statistically not significant.

Singh et al in their 2013 publication, "a study of serum calcium and magnesium levels in essential hypertension" concluded that serum calcium level of hypertensives and normotensives of different age groups was found to be variable.[22] In their study serum calcium concentration level in 50 hypertensive subjects was found within normal limits in both control and hypertensive groups similar to the findings in our study. Bande et al in 2016, attempted to study the serum calcium level among essential hypertensives.[23] The result showed that serum calcium levels were significantly decreased in grade I as well as grade II ($p<0.0001$) hypertension cases when compared to age matched normotensive controls.

Our results are in line with the findings of the study done in 2014 by Ravi et al they have found no statistically significant difference in serum magnesium levels between cases and controls.[24] Similarly, no significant difference was observed in serum magnesium levels in cases and controls across the grades of hypertension.

Our study is consistent with the findings by Fu et al in relation to serum magnesium levels.[13] Their study suggested that no statistically significant differences were found in either serum Mg or intracellular Mg levels between cases and controls. In our study, only serum magnesium levels were observed and correlated with newly detected hypertension. ATPase activity or intracellular magnesium levels were not observed which was done in this study.

Limitations

This cross-sectional study was conducted on a small sample size. However, we recommend experimental studies with larger samples to be conducted to evaluate the role of serum calcium and serum magnesium level in hypertensive patients.

CONCLUSION

This study did not find any association between serum calcium, serum magnesium level and hypertension. However, we recommend experimental studies with larger samples to be conducted to evaluate the role of serum calcium and serum magnesium level in hypertensive patients.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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