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ORIGINAL ARTICLE

Evaluation of serum magnesium levels in hypertensive patients

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ABSTRACT:

Background: Hypertension is a condition marked by elevation in the systolic blood pressure (SBP) and/or diastolic blood pressure (DBP). The present study was conducted to assess serum magnesium levels in hypertension and its association with cardiovascular changes. **Materials & Methods:** 110 patients of essential hypertension of both genders. Patients were divided into two groups. Group I had patients with systolic BP of 140-159 mm Hg or diastolic BP of 90-99 mm Hg and group II, patients with systolic BP of ≥160 mm Hg or diastolic BP of ≥100 mm Hg. Assessment of serum magnesium, calcium, potassium and sodium and creatinine levels were measured by isotope dilution mass spectrometry. Ventricular hypertrophy was determined using Sokolow-Lyon criteria by performing electrocardiography. **Results:** Group I had 35 males and 20 females and group II had 22 males and 33 females. The mean calcium was 8.21 in group I and 8.69 in group II, sodium was 134.2 in group I and 139.5 in group II, magnesium was 2.31 in group I and 1.80 in group II, potassium was 4.19 in group I and 4.06 in group II and creatinine was 0.82 in group I and 0.94 in group II. The difference was non- significant (P> 0.05). **Conclusion:** The level of magnesium level decreased as the grade of hypertension increased.

Key words: Hypertension, Magnesium, Ventricular hypertrophy

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INTRODUCTION

Hypertension is a condition marked by elevation in the systolic blood pressure (SBP) and/or diastolic blood pressure (DBP). Hypertension is defined variably in clinical practice guidelines as either SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg or SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg.[1]Hypertension is implicated to be one of the predominant co-morbidities of chronic diseases such as diabetesand neurological and cardiovascular diseases. This may be due to a common factor bringing about changes in vascular conditions and metabolic stability-serum magnesium.[2]Hypertension is a leading risk factor for cardiovascular diseases (hemorrhagic stroke, ischemic stroke, myocardial infarction, angina, heart failure, peripheral artery disease, and aortic aneurysm), end-stage renal disease, death, and disability. Hypertensive crises are defined as SBP greater than 180 mmHg and/or DBP greater than 120 mmHg. Hypertensive crises can be further classified into: hypertensive emergency (when there is evidence of target organ damage) and hypertensive urgency (where there is no evidence of target organ damage).[3] Although hypertensive urgency reflects a marked elevation in blood pressure, it can be managed with maximizing of oral antihypertensive agents; however, hypertensive emergency is characterized with organ damage and is associated with a 1-year mortality rate of >79% thus necessitating swift blood pressure reduction with intravenous antihypertensive agents to prevent sustained deterioration of target organ damage.[4]

Magnesium is an essential mineral, found abundantly in legumes, nuts, whole grains, and leafy green vegetables. Magnesium is involved in the synthesis of many proteins, and it also acts as a cofactor in certain enzymes in our body.[5] In the human body, magnesium plays key role in hundreds of physiological processes to maintain homeostasis. One of the main homeostatic functions of magnesium is the regulation of blood pressure (BP).[6]The present study was conducted to assess serum magnesium levels in hypertension and its association with cardiovascular changes.

MATERIALS & METHODS

The present study comprised of 110 patients of essential hypertension of both genders. All were informed regarding the study and their written consent was obtained.

Data such as name, age, gender etc. was recorded. Patients were divided into two groups. Group I had patients with systolic BP of 140-159 mm Hg or diastolic BP of 90-99 mm Hgand group II, patients with systolic BP of ≥160 mm Hg or diastolic BP of ≥100 mm Hg. Physical examination, blood pressure (BP) and systemic examination, fasting blood sugar and HbA1c levels along with serum magnesium, calcium, potassium and sodium and creatinine levels were measured by isotope dilution mass spectrometry. Serum magnesium levels were determined by xylidyl blue dye method. Left ventricular hypertrophy was determined using

Sokolow-Lyon criteria by performing electrocardiography. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Groups	Group I	Group II
Male	35	22
Female	20	33

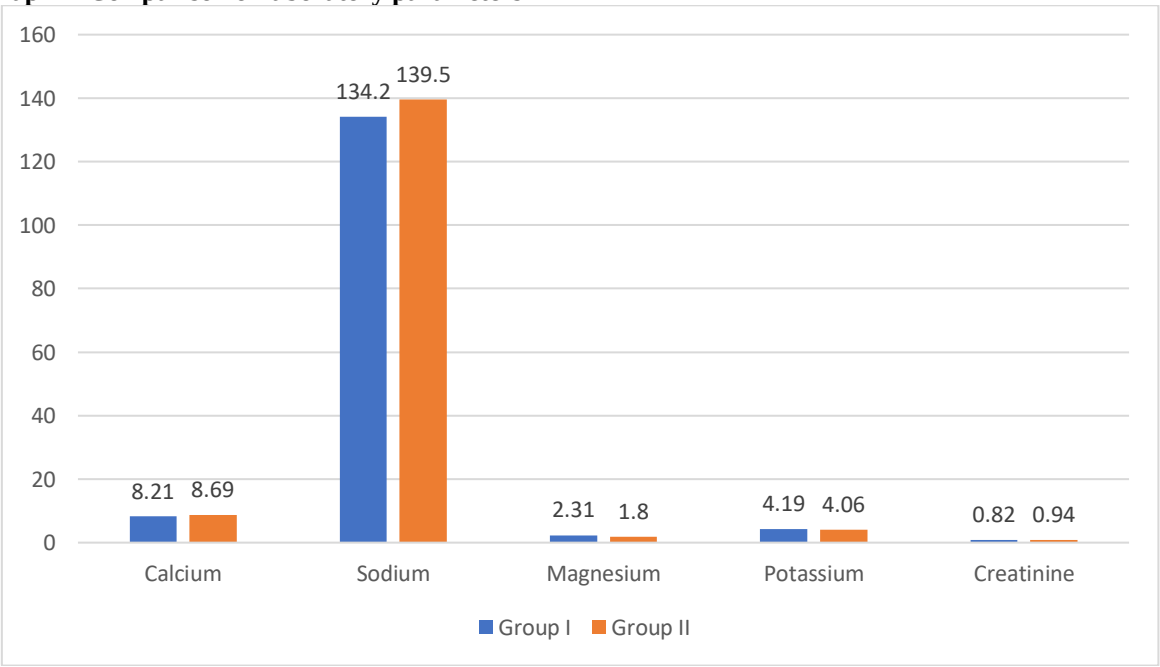
Table I shows that group I had 35 males and 20 females and group II had 22 males and 33 females.

Table II Comparison of laboratory parameters

Parameters	Group I	Group II	P value
Calcium	8.21	8.69	0.21
Sodium	134.2	139.5	0.36
Magnesium	2.31	1.80	0.02
Potassium	4.19	4.06	0.95
Creatinine	0.82	0.94	0.82

Table II, graph I shows that meancalcium was 8.21in group I and 8.69 in group II, sodium was 134.2in group I and 139.5 in group II, magnesium was 2.31 in group I and 1.80 in group II, potassium was 4.19 in group I and 4.06 in group II and creatinine was 0.82 in group I and 0.94 in group II. The difference was non- significant (P> 0.05).

Graph II Comparison of laboratory parameters



DISCUSSION

Magnesium is an essential ion in the human body due to its numerous roles, which includes maintaining electrolyte balance and enzymatic pathways; regulating insulin-mediated glucose uptake, blood pressure and insulin action; and involvement in processes to maintain endothelial cell function and modulate smooth muscle tone, all of which influence the development of several chronic diseases.[7]

Hypertension is a leading risk factor for cardiovascular diseases (hemorrhagic stroke, ischemic stroke, myocardial infarction, angina, heart failure, peripheral artery disease, and aortic aneurysm), end-stage renal disease, death, and disability.[8] Hypertensive crises are defined as SBP greater than 180 mmHg and/or DBP greater than 120 mmHg.[9]The present study was conducted to assess serum magnesium levels in hypertension and its association with cardiovascular changes.

We found that group I had 35 males and 20 females and group II had 22 males and 33 females.Resnick et al reported that in essential hypertension, there is a continuous negative correlation of serum magnesium with plasma renin activity ($r = -0.60$, $P < 0.001$). Ferdousi et al[10] reported in their study that the serum magnesium level (mg/dl) was significantly lower in 30 offsprings of essential hypertensive parents when compared to the 30 age- and sex-matched offsprings

of normotensive parents (1.90 ± 0.210 vs. 2.13 ± 0.366, P < 0.01) and also he found that the erythrocyte magnesium level (mg/dl) was lower in cases when compared to controls (4.46 ± 0.699 vs. 5.43 ± 0.775, P < 0.001).

We found that mean calcium was 8.21 in group I and 8.69 in group II, sodium was 134.2 in group I and 139.5 in group II, magnesium was 2.31 in group I and 1.80 in group II, potassium was 4.19 in group I and 4.06 in group II and creatinine was 0.82 in group I and 0.94 in group II. Ohira et al[11]examined the relation between serum or dietary magnesium and the incidence of ischemic stroke among blacks and whites. Between 1987 and 1989, 14,221 men and women aged 45–64 years took part in the first examination of the Atherosclerosis Risk in Communities Study cohort. The incidence of stroke was ascertained from hospital records. Higher serum magnesium levels were associated with lower prevalence of hypertension and diabetes mellitus at baseline. During the 15-year follow-up, 577 ischemic strokes occurred. Serum magnesium was inversely associated with ischemic stroke incidence. The age-, sex-, and race-adjusted rate ratios of ischemic stroke for those with serum magnesium levels of ≤1.5, 1.6, 1.7, and ≥1.8 mEq/L were 1.0, 0.78, 0.70 and 0.75. After adjustment for hypertension and diabetes, the rate ratios were attenuated to nonsignificant levels. Dietary magnesium intake was marginally inversely associated with the incidence of ischemic stroke. Low serum magnesium levels could be associated with increased risk of ischemic stroke, in part, via effects on hypertension and diabetes.

Magnesium gains its importance by mediating these processes involving in the regulation of normal BP. There are various proposed mechanisms by which magnesium deficiency results in hypertension. Along with nitric oxide (NO); magnesium alters the vascular tone by influencing the smooth muscle and endothelium functions. Any alteration in the magnesium concentration leads to changes in the NO production and release, which in turn by modifying the calcium concentration causes an alteration in the arterial smooth muscle tone. Many experimental animal studies have shown that magnesium increases the production of prostacyclin and NO which, in turn, promotes both endothelin dependent and independent vasodilation.[12] Low serum magnesium levels augment the reactivity of the arterial system to the vasopressor substances and promote vasoconstriction, decreases the response to vasodilators, elevation of peripheral resistance, and finally leading to a rise in BP. Added to this magnesium improves insulin sensitivity and also has protective anti-inflammatory and antioxidant property. It also plays a key role in reducing the cholesterol level in our body. Haenni et al[13] found that after magnesium infusion, there is an increased endothelium-dependent vasodilation, and hence, this study confirms the relationship between the metabolism of magnesium and alteration in the endothelial function.

The shortcoming of the study was small sample size.

CONCLUSION

Authors found that the level of magnesium level decreased as the grade of hypertension increased.

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