|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||
International Journal of Medical and Biomedical Studies
Available Online at www.ijmbs.info
NLM (National Library of Medicine ID: 101738825)
Index Copernicus Value 2019: 79.34
Volume 5, Issue 6; June: 2021; Page No. 110-116

Original Research Article

ALTERATION IN SERUM MAGNESIUM LEVELS IN PATIENTS WITH ESSENTIAL HYPERTENSION

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Article Info: Received 13 April 2021; Accepted 20 June 2021

DOI: https://doi.org/10.32553/ijmbs.v5i6.1974

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Conflict of interest: No conflict of interest.

Abstract

Introduction: Essential hypertension (EHTN) accounts for 95% of all cases of hypertension affecting approximately one billion individuals worldwide. Alteration in trace elements like magnesium can be helpful in knowing the elemental involvement in the pathophysiology of EHTN and its associated complications.

Aims and Objectives: 1. To estimate serum levels of magnesium in patients of EHTN and compare it with normotensive healthy subjects. 2. To find the correlation of serum levels of magnesium with systolic blood pressure (SBP) and diastolic blood pressure (DBP) in patients of EHTN.

Materials and Methods: The study was conducted in 100 subjects, out of which 50 were essential hypertensive patients (cases) and 50 were normotensive healthy subjects (controls), within the age group of 25-65 years. Serum magnesium were measured by using the auto analyzer Beckman Coulter DXC 600. The results were analysed by using students 't' test and pearson's correlation.

Results: Our study found a significantly ($p<0.001$**) decreased levels of serum magnesium in cases as compared to controls. Our study also revealed a significant negative correlation between serum magnesium with SBP ($r= -0.805$, $p<0.001$**) and DBP ($r= -0.395$, $p=0.005$**) among essential hypertensives.

Keywords: EHTN- Essential hypertension, HTN – Hypertension, SBP – Systolic blood pressure, DBP – Diastolic blood pressure

Introduction:

Hypertension is a major risk factor for cardiac, cerebrovascular and renal diseases. HTN is associated with increased vasomotor tone and remodeling of blood vessels[1,2]. A log linear correlation exists between elevated arterial pressure and increased mortality[3].

HTN often coexists with other cardiovascular risk factors such as diabetes, hyperlipidemia and obesity, resulting in high morbidity and mortality. Treatment of HTN is associated with 40% reduction in the risk of stroke, 15% reduction in the risk of myocardial infarction[4]. Thus, the objective of identifying and treating high BP reduces risk of cardiovascular disease and associated morbidity and mortality[5].

The prevalence of EHTN increases with age, and individuals with high BP at younger ages are at increased risk for the subsequent development of HTN[6].

Many hypotheses were proposed in the past about the possible mechanisms of EHTN which are incompletely understood[7].

The role of divalent cat ions in the pathogenesis of EHTN has recently received increasing attention. Accumulating evidences implicates the role of serum calcium and magnesium in pathophysiology of EHTN[8].

Magnesium is a biologically essential cation, its depletion in cardiovascular pathophysiology has gained attention recently[9]. Magnesium regulates BP due to its role in cellular cation metabolism[10]. Magnesium modulates vascular tone by modulating endothelial function. Magnesium deficiency is associated an inverse correlation between BP and serum magnesium levels[11].

Our study is to estimate the serum levels magnesium and its involvement in the pathophysiology of EHTN.

AIMS AND OBJECTIVES

1. To estimate serum levels of magnesium in patients with essential hypertension and compare it with normotensive healthy subjects.

2. To find the correlation of serum levels of magnesium with systolic blood pressure and diastolic blood pressure in patients with essential hypertension.

MATERIALS AND METHODS

The study was carried out for one year on confirmed essential hypertensive patients as cases visiting department of Medicine, at Vydehi Institute of Medical Sciences & Research Centre, Bangalore; and age, sex matched normotensive healthy individuals as controls. Total 50

essential hypertensive cases and 50, age and sex matched apparently healthy controls were selected with age group between 25-65 years of which 25 males and 25 females.

An ethical clearance and an informed consent from the study subjects were duly obtained. Pregnant women, patients suffering from diseases of liver and kidney, diabetes mellitus, post myocardial infarction, congestive cardiac failure, hyperaldosteronism, cushing's disease or pheochromocytoma, patients on diuretics, calcium channel blockers or angiotensin converting enzyme inhibitors were excluded from the study. Blood samples were collected and analysed for serum magnesium by using Calmagite method using Beckman coulter SYNCHRON CX system DXC 600.

STATISTICAL ANALYSIS:

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale on metric parameters and pearsons correlation between SBP and DBP with serum magnesium in cases and controls was performed using statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 ,Systat 12.0 and R environment ver.2.11.1.

SIGNIFICANT FIGURES:

+ Suggestive significance (P value: 0.05<P<0.10)

* Moderately significant (P value: 0.01<P ≤ 0.05)

** Strongly significant (P value: P≤0.01) (12,13,14)

RESULTS

Study Design: A Comparative case-control study with 50 controls and 50 cases is undertaken to study the levels of serum magnesium. The cases and controls were age and sex matched. The age group was between 25-65 years.

Table 1: Age distribution of patients in the study groups

Age in years	Cases		Controls	
	No	%	No	%
25-30	7	14.0	9	18.0
31-40	11	22.0	15	30.0
41-50	15	30.0	13	26.0
51-60	14	28.0	10	20.0
61-65	3	6.0	3	6.0
Total	50	100.0	50	100.0
Mean ± SD	**43.76±11.72**		**39.28±11.23**	

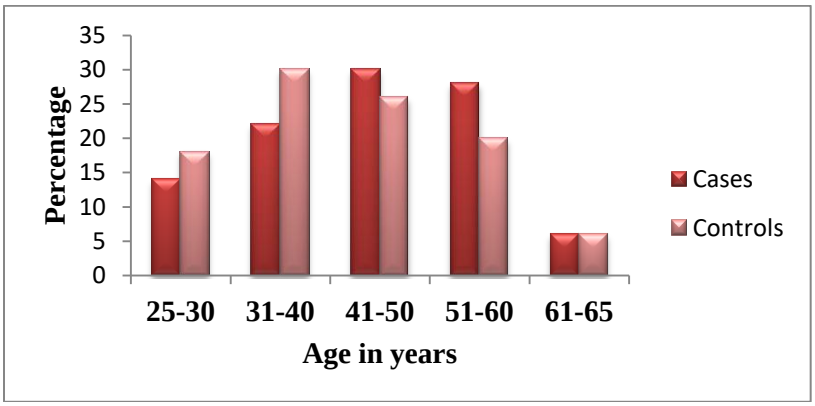


Figure 1: Bar diagram showing age distribution in the study groups

As represented in the above table and figure, samples were matched according to their age. Maximum number of cases, 30% were in the age group of 41-50 yrs followed by 28% patients in 51-60 yrs. The mean age in cases was 43.76±11.72 yrs and in controls, it was 39.28±11.23 yrs.

Table 2: Gender distribution in the study groups

Gender	Cases		Controls	
	No	%	No	%
Female	25	50.0	25	50.0
Male	25	50.0	25	50.0
Total	50	100.0	50	100.0

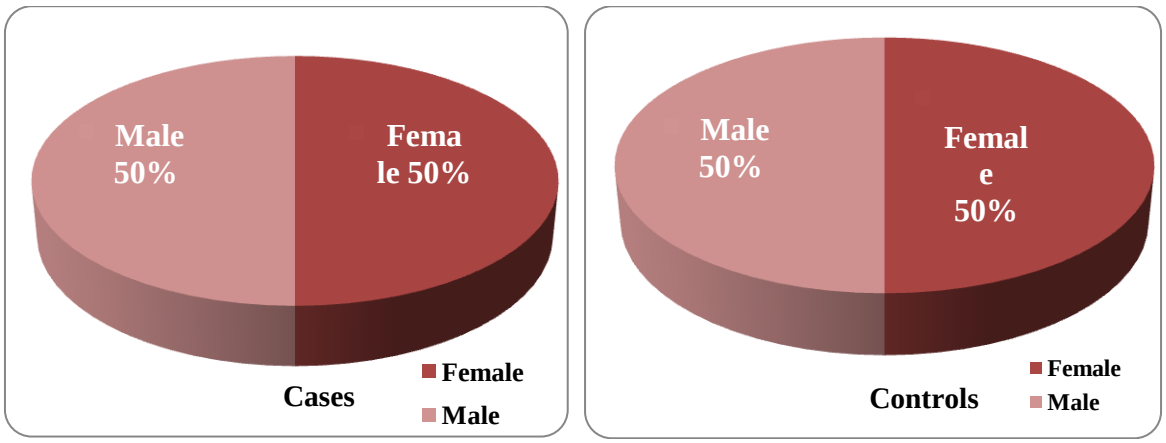


Figure 2: Pie chart showing the samples are gender matched

As represented in the above table and figure, among the cases, the number of males was 25 and females was 25 and controls number of males was 25 and females was 25 . The cases and controls were sex matched with p=1.000.

Table 3: SBP (mm Hg) in the study groups

SBP (mm Hg)	Cases		Controls	
	No	%	No	%
<100	0	0.0	0	0.0
100-140	0	0.0	50.0	100.0
>140	50	100.0	0	0.0
Total	50	100.0	50	100.0

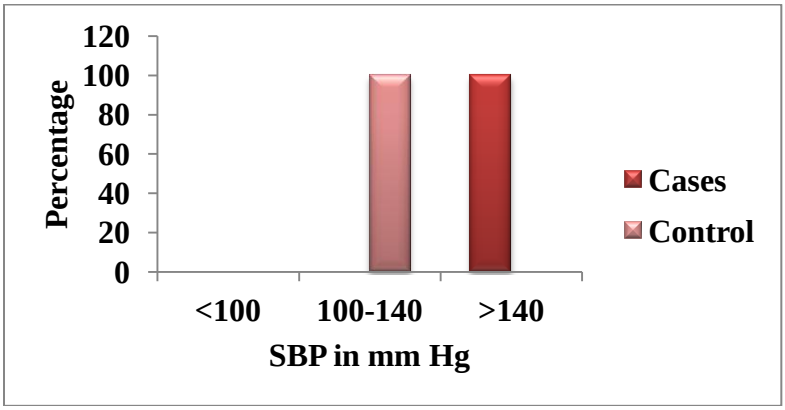


Figure 3: Bar diagram showing SBP in the study groups

As represented in the above table and figure, higher SBP is significantly more associated with cases than controls with P<0.001**.

Table 4: DBP (mm Hg) in the study groups

DBP (mm Hg)	Cases		Controls	
	No	%	No	%
<70	0	0.0	0	0.0
70-90	17	34.0	50	100.0
>90	33	66.0	0	0.0
Total	50	100.0	50	100.0

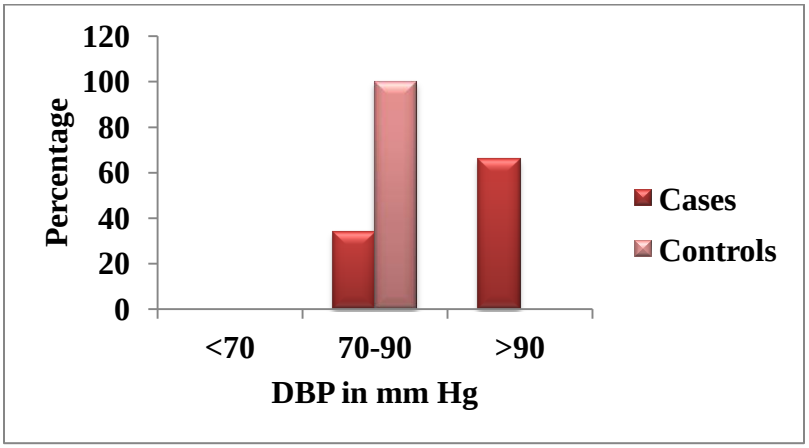


Figure 4: Bar diagram showing DBP in the study groups

As represented in the above table and figure, higher DBP is significantly more associated with cases than control with P<0.001**.

Distribution of serum magnesium in the study groups

Table 5: Serum magnesium levels in the study groups

Magnesium (mg/dl)	Cases		Controls	
	No	%	No	%
<1.7	45	90.0	0	0.0
1.7-2.8	5	10.0	50	100.0
>2.8	0	0.0	0	0.0
Total	50	100.0	50	100.0

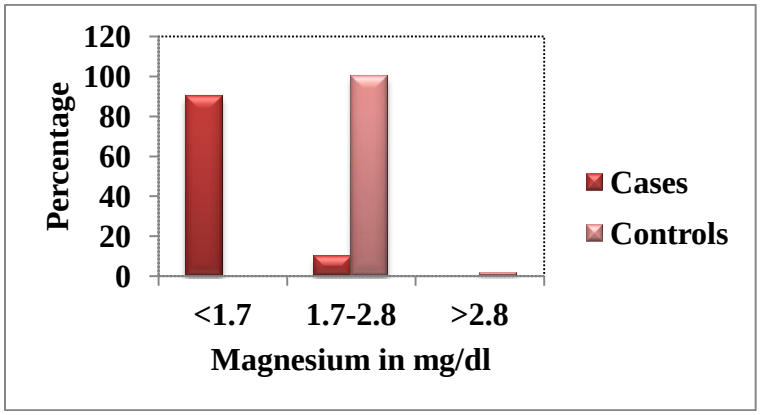


Figure 5: Bar diagram showing serum magnesium levels in the study groups

As represented in the above table and figure, serum magnesium levels were compared in both cases and controls. The normal level of serum magnesium level is 1.7-2.8 mg/dl. 90% of cases had magnesium levels below 1.7 mg/dl, none of the control levels had magnesium levels below 1.7 mg/dl. 10% of cases and 100% of controls had magnesium levels between 1.7-2.8 mg/dl.

Serum magnesium levels are significantly less associated with cases with P<0.001**.

Table 6: Comparison of serum magnesium in the study groups

Parameters	Cases	Controls	P value
Magnesium in mg/dl	1.46±0.19	1.98±0.15	<0.001**

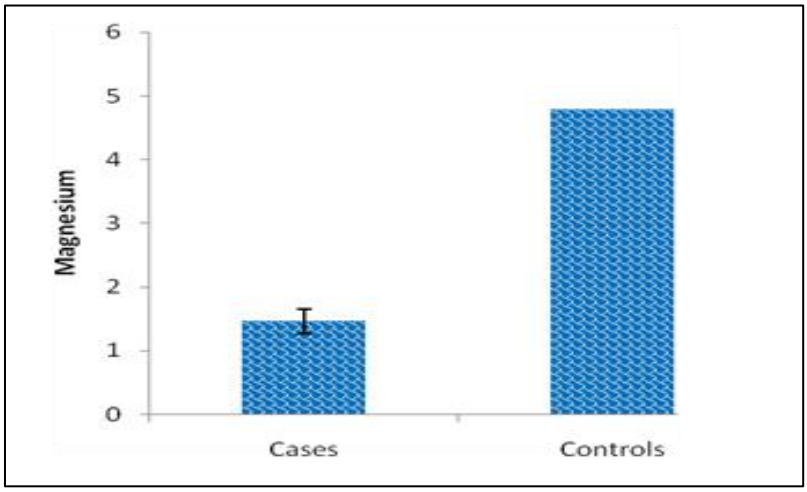


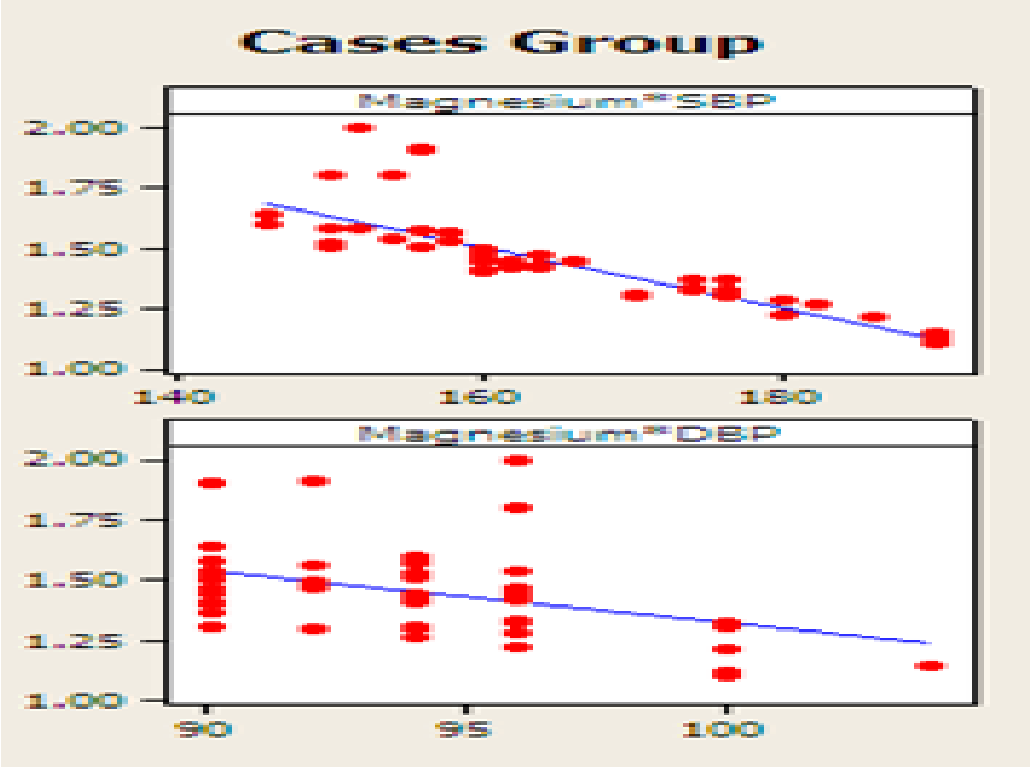
Figure 6: Bar diagram showing serum magnesium in the study groups

As represented in the above table and figure, the mean serum magnesium level in cases was 1.46±0.19 mg/dl, and in controls was 1.98±0.15 mg/dl.

- Serum magnesium is significantly decreased in cases when compared to controls, with p<0.001**.

Table 7: Pearson correlation of serum magnesium with BP in the study groups

Pair	Cases		Controls	
	r value	p value	r value	p value
Magnesium vs SBP	-0.805	<0.001**	-0.002	0.991
Magnesium vs DBP	-0.395	0.005**	-0.016	0.914



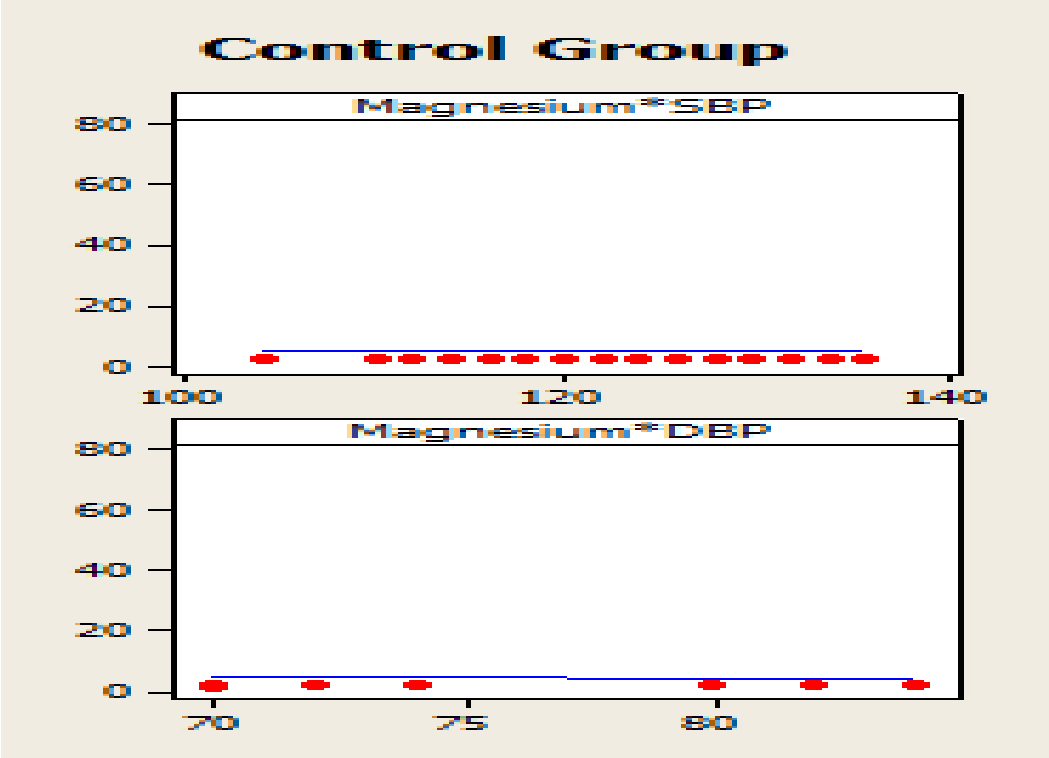


Figure 25: Scatter plot showing Pearson correlation of serum magnesium with SBP & DBP in the study groups

The above table and figure, shows that there was a:

- Significant negative correlation between serum magnesium with, SBP (r= -0.805, p-value: <0.001**) and DBP (r= -0.395, p-value: 0.005**) in cases.

Discussion

Essential hypertension accounts for 95% of all cases of HTN affecting approximately 1 billion individuals worldwide[8].

Vascular tone, contractility, reactivity and transmembrane potential are factors determining the development and maintenance of arterial hypertension, which are influenced by extracellular magnesium and calcium levels[15].

Our study is designed to evaluate and compare the serum levels of Magnesium in essential hypertensive patients and normotensive healthy subjects.

Our study showed a significant (p<0.001**) decrease in serum magnesium level 1.46±0.19 mg/dl in cases as compared to controls.

Study done by Tammaro P et al found decreased concentrations of magnesium[16].

Magnesium acts as a calcium channel blocker, reduces the release of calcium, thus reducing vascular resistance. Reduced magnesium activates calcium influx via calcium channels. Low intracellular magnesium concentrations stimulate inositol-tri-phosphate (IP3) mediated mobilization of intracellular calcium and reduce calcium-ATPase activity, leading to cytosolic accumulation of calcium and increased calcium concentration, which is a crucial factor for vasoconstriction[17].

In our study, we found negative correlation between serum magnesium with systolic blood pressure r= -0.805 (p<0.001**) and with diastolic blood pressure r= -0.395 (p=0.005**) in essential hypertensive patients. Our findings are in agreement with study done by Staessen et al who found magnesium to be negatively correlated with blood pressure[18].

Resnick LM et al found an inverse association between magnesium with both systolic and diastolic blood pressure[19].

The patients of essential hypertension with altered metabolism of serum magnesium play a contributory role in the pathophysiology of essential hypertension and its associated complications.

Conclusion

In conclusion, the present findings shows the imbalance in levels of serum magnesium in patients with essential hypertension compared to controls. Magnesium plays an important role in the pathogenesis of essential hypertension by altering endothelial function, imbalance in ionic channels and oxidative stress.

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