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Original Research Paper

The effect of antihypertensive drugs on serum magnesium level

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Abstract hypertension is a complicated condition in which many mechanisms collaborate, causing cardiovascular and cerebrovascular implications that are now among the most common causes of death, illness, and medical expenses globally. Currently, 1.13 billion individuals are suffering from hypertension, as reported by the World Health Association. The level of incidence of hypertension rises substantially with age, and due to the continuing aging of the population around the world, both the overall incidence of hypertension and the adverse outcomes continue to keep growing. Some clinical trials and reports suggest that hypertensive individuals possess deficient in serum magnesium level, with reduced levels of magnesium connected to adverse consequences on blood pressure levels. The aim of the study was to evaluate the effect of antihypertensive drugs on serum magnesium levels. The materials and methods: this study include 150 individuals with hypertension who have been recruited in this research from Al-Hakim General Hospital between October 2, 2024, and December 31, 2024. The concentration of magnesium in the patients' serum was determined by the xylidyl blue technique (magnesium liquicolor-human reagent). The results illustrate that patient with hypertension using beta-blocker drugs had significantly low serum magnesium levels. Conclusion: Hypertensive patients taking antihypertensive drugs, particularly beta blockers, had reduced mean serum magnesium level .

Keywords: *hypertension, serum magnesium, beta-blocker drugs*

1.Introduction

A significant worldwide medical concern, hypertension is most commonly connected with heart attack, stroke, and cerebrovascular accidents [4]. The risk factors of hypertension are insufficient sodium consumption, inadequate potassium dietary intake, gaining weight, consumption of alcohol, insufficient regular physical activity, and poor lifestyle habits . The difference in these risk factor might be responsible for the majority of the geographic variation in the overall prevalence of hypertension [11].
On average, 1.4 billion individuals globally are affected by hypertension, a medical issue whose incidence is projected to increase to 1.6 billion until 2025 [10]. In accordance with the suggestions of the vast majority of international guidelines, an individual can potentially be identified as having hypertension if, following a regular assessment, their diastolic arterial blood pressure is 90 mm Hg and their systolic arterial pressure as measured in the medical center or office is 140 mm Hg [17]. There are several ways that sympathetic activity affects high blood pressure. These include improving the absorption of sodium by tubules, changing the shape and size of blood vessels, and making renin in the kidneys through beta 1 adrenergic receptors [5].
Hypertension is the main reason for serious cardiovascular conditions, considering people can suffer from uncontrolled hypertension for a long period of time without adequately recognizing it. Furthermore, becoming the main trigger of heart failure in the Middle East, hypertension is additionally responsible for just over half of heart disease deaths globally and over fifty percent of stroke mortality [6].

Multiple variables, involving the calcium antagonist features of magnesium and its impact on vascular cell activity, coronary vessel tone, vascular cell development, calcification of the arteries, oxidative injury, long-term inflammation, and the breakdown of sugar, could have contributed to the correlation between magnesium and high blood pressure [7]. Magnesium could potentially have an important role in cardiovascular illness progression. A higher likelihood of atherosclerosis, coronary artery disease (CAD), and heart attack and stroke may have been associated with low dietary intakes or serum magnesium levels, as demonstrated by studies based on observation [8].

The cardiovascular system can additionally become more reactive to vascular constrictors like angiotensin II and catecholamines whenever there is a magnesium shortage. The rise in intracellular calcium caused by insufficient magnesium could, in fact, encourage resistance to insulin and high blood pressure [16]. Magnesium possesses significant effects on lipid breakdown through improving the enzyme activity of lecithin-cholesterol acyltransferase and lipoprotein lipase by adjusting the action of HMG-CoA reductase [15], considering lipid and lipoprotein irregularities are controllable risk factors for cardiovascular illnesses because of their dangerous impact on atherosclerosis [11]. The goal of the study was to evaluate the effect of antihypertensive drugs on serum magnesium levels.

2. Methodology

Sample collection

One hundred and fifty individuals with hypertension, either with or without ischemia-related cardiovascular disease, were enrolled in the cross-sectional study. Within those participating, 48 were male and 102 were female between the ages of 25 and 75 years. In the period from October 2 until December 31, 2024, all of the patients were collected from Al-Hakim General Hospital, situated in Al-Najaf City. The intended objectives of the research project were presented to the patients, and ultimately, they became convinced to participate. The patients on antihypertensive treatment, which included ACEi/ARBs, Ca channel blockers, B-blockers, or combination therapy in addition to statin therapy, had

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a comprehensive medical record. A medical examination, estimation of body weight index, and arterial pressure reading were all part of each patient's thorough evaluation. The following were excluded from the study: pregnant women, patients on diuretics, chronic diarrhea, and chronic renal diseases.

Biochemical analysis

Serum magnesium level evolution

A three-milliliter venous blood sample was collected from each participant with disposable syringes and needles that afterwards went into a gel tube. Following being stored for a period of five minutes, the taken specimen went through a centrifuge about four minutes at an intensity of 4000 rounds per minute in order for separating the serum from the whole blood. The serum was subsequently extracted for biochemical investigation. utilizing the Magnesium Liquicolor reagent (Human, Germany) and the Spectrophotometer V-1000 apparatus (AOELAB, China) for determining each participant's serum magnesium concentration employing the xylidyl blue procedure.

Evolution of lipid profile

Lipid profile (cholesterol, triglyceride, LDL, and HDL) were assessed using a Mindray kit (Germany) with approximately 3 ml of each patient's serum analyzed by the chemical biochemistry analyzer Mindray (BS-230-Germany).

Statistical analysis

SPSS was utilized for entering and analyzing the collected information (version 26). For continuous variables, the descriptive statistics comprised means with standard deviations, and for categorical variables, frequencies and percentages. Data homogeneity has been assessed through the test developed by Shapiro-Wilk. Independent t-tests were used to compare mean serum magnesium levels based on statin administration and lipid profile. Chi-square testing was used to compare mean serum magnesium levels across types of antihypertensive drugs. Statistical significance was defined as a p-value of less than 0.05.

3. Results and discussion

One hundred and fifty individuals with hypertension, aged 59.53 ± 10.4, were involved in this study; of these, 102 (68%) were female and 48 (32%) were male, BMI 30.9 ± 6.4 kg/m². Table 1 illustrates that 56 (37.3%) of patients experienced diabetes, and 60 (40%) developed ischemic heart disease. 55 (36.7%) developed cerebrovascular accident, whereas 33 (22%) smoked cigarettes.

Table 1. The patients' clinical and demographic information

characteristic	**Sub category**	**percentage**
Age (years) Mean±SD (59.53±10.4)	25-40	6.7
	41-60	44
	61-75	49.3
Sex	Female	68
	Male	32
BMI (Kg/m^2) Mean±SD(30.9±6.4)	Normal	13.3
	Overweight	32.7
	Obese	54
DM	Yes	37.3
	No	62.7
IHD	Yes	40
	No	60
CVA	Yes	36.7
	No	63.3
Smoking	Yes	22
	No	78

Table 2. Comparison of mean serum magnesium level (mg/dl) according to the type of antihypertensive drugs

		Magnesium level		Total	P
		Low No.(%)	Normal No.(%)	No.(%)	
Type of antihypertensive Treatment	ACEi/ARBs*	16(40%)	24(60%)	40(100%)	0.03
	Ca channel blocker	10(33.3%)	20(66.7%)	30(100%)	
	B-blocker	13(56.5%)	10(43.5%)	23(100%)	
	Combination	13(22.8%)	44(77.2%)	57(100%)	
Total		52(34.7%)	98(65.3%)	150(100%)	

* Angiotensin converting enzyme inhibitors / Angiotensin receptor blockers.

Table 2 demonstrates that the serum magnesium level is significantly reduced in patients who were administered beta blockers. Magnesium homeostasis control is not generally recognized. However, hypomagnesaemia has been observed among people in medical situations when circulating catecholamines become elevated, such as myocardial infarction and cardiac surgical procedures, where fluctuations in plasma magnesium levels are frequently triggered on by adrenergic stimulation, especially that from beta-blockers [12]. As reported by Brembilla-Perrot et al. (1993), an infusion of isoproterenol may trigger a substantial reduction in the level of serum magnesium [3]. Decreased renal perfusion pressure and impairment of kidney function can happen from non-selective beta-blockers and may lead to alteration of circulatory homeostasis. The level of magnesium and the equilibrium of electrolytes could potentially be disturbed by this imbalance.

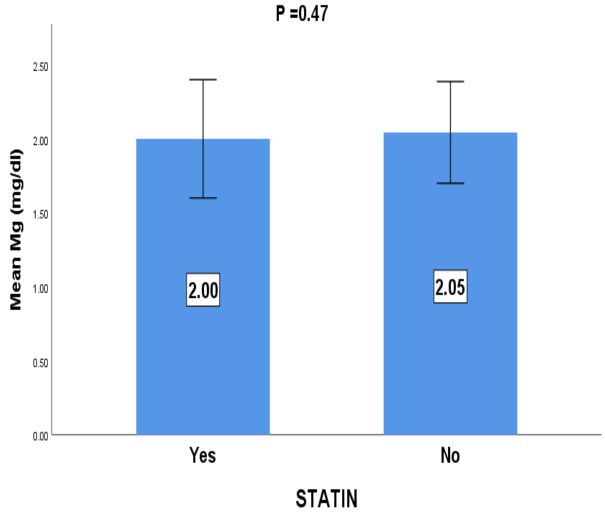

Fig 1. The relation between mean serum magnesium level and statin therapy.

Figure 1. show that statin therapy (lipid lowering agents) has no significant effect on mean serum magnesium level . The HMG-CoA reductase inhibiting agents, or statins, are utilized for the treatment of elevated cholesterol levels or familial dyslipidemias [14] as well as to prevent atherosclerotic vascular disease (ASCVD) in either the direct or indirect manner [13]. Several studies suggest that through improving endothelial function and decreasing inflammation, supplementation with magnesium could improve the effectiveness of statins. However, these beneficial effects are not due to alterations in serum magnesium levels triggered by statin medication [18].

Table 3. The association between lipid profile and mean serum magnesium level

Variable	Subgroup	No.	Serum Mg (mg/dl) (Mean±SD)	P
Cholesterol	High	33	2.079±0.4	0.3
	Normal	117	2.009±0.4	
Triglyceride	High	78	2.035±0.4	0.7
	Normal	72	2.014±0.4	
HDL	Desirable	22	2.032±0.3	0.9
	Not	128	2.024±0.4	
LDL	High	93	2.039±0.3	0.5
	Normal	57	2.001±0.4	

In addition, there was no significant association between serum lipid profile (cholesterol, triglyceride, HDL, and LDL) and mean serum magnesium level, as shown in Table 3.A condition referred to as hyperlipidemia occurs when the blood levels of all or some lipids and/or lipoproteins are unusually elevated. It is the most widespread type of dyslipidemia, which encompasses any decrease in lipid levels [1]. A cross-sectional study that investigated the association between the serum concentrations of six mineral components, which include magnesium, and the likelihood of dyslipidemia in Chinese adults demonstrated no significant differences in serum magnesium levels among individuals with dyslipidemia versus those with normal lipidemia, as suggested by the research of Khatami et al. [9].

Barragán et al.'s investigation particularly evaluated the correlation between cardiovascular disease risk and plasma magnesium concentration in adults from the entire Mediterranean, which shows that hypomagnesemia and hypercholesterolemia were not significantly associated [2].

The connection between serum magnesium levels, dietary magnesium consumption, or magnesium nutritional supplementation and the development of issues associated with lipid metabolism has become the focal point of multiple previous studies.The substantial heterogeneity of the groups during the study, the variety of methods used for determining the magnesium concentration in the blood serum, and the absence of stratification of the patient subgroups under evaluation are some of the main factors why the findings in this specific field are still confusing.

Conclusion

In conclusion Hypertensive patients taking antihypertensive drugs, particularly beta blockers, had reduced mean serum magnesium level.

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Author’s Contributions

All of the contributing authors put up equal effort in completing this research.

Ethics

The internal ethical committee of the University of Kufa's Medical Physiology Department/Faculty of Medicine and the Health Directorate in the province of Najaf granted ethical approval for this study. Further, all patients who participated in this study gave their transparent, voluntary agreement.

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