Study of Magnesium in Sera of Patients with Metabolic Syndrome

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Abstract

Background:The metabolic syndrome is a constellation of interrelated risk factors of metabolic origin that appear to directly promote the development of atherosclerotic cardiovascular disease.

Objective:The goal of the study is to assess the serum level of magnesium in patients with metabolic syndrome in an attempt to utilize this parameter for confirming the diagnosis.

Materials &methods:A total of 100 patients with metabolic syndrome and 90 control subjects were involved in this cross-sectional study during the period from April 2014 to January 2015 in Baghdad city. The diagnosis of metabolic syndrome among patients was according to IDF criteria. General information for each patient was obtained by a questionnaire designed for the study. Waist circumference measurement, fasting serum glucose, serum HDL level, serum triglyceride, serum magnesium and blood pressure estimation were done for each patient.

Results: The patients with metabolic syndrome had lower serum mean level of magnesium from control subjects. The prevalence of marginal magnesium deficiency was higher in metabolic syndrome patients than control subjects. The prevalence of high fasting serum glucose, high blood pressure, low HDL-cholesterol and high triglyceride was higher in subjects with low serum magnesium level than sufficient subjects.

Conclusion:Patients with metabolic syndrome show significantly high prevalence of magnesium deficiency compared with individuals who donot fulfill criteria for the diagnosis of this syndrome.

Keywords**:** metabolic syndrome, magnesium.

Introduction

The metabolic syndrome is a constellation of interrelated risk factors of metabolic origin that appear to promote the development of atherosclerotic cardiovascular disease[1].The predominant underlying risk factors are abdominal obesity and insulin resistance, atherogenic dyslipidemia,elevated blood pressure and elevated plasma glucose[2]. In 2005, the International Diabetes Foundation (IDF) considered that abdominal obesity is so highly correlated with insulin resistance. The IDF clinical definition makes the presence of abdominal obesity necessary for diagnosis, specified thresholds for abdominal obesity to be waist circumferences ≥94 cm in men and ≥80 cm in women[3].Magnesium is an essential mineral that make up about 0.05 percent of body's weight, is a cofactor for more than 300 enzymes in the body[4].It help maintain normal muscle and nerve function, keeps heart rhythm steady, support a healthy immune system, keeps bones strong.Magnesium also help regulate blood sugar levels, promotes normal blood pressure, and involved in energy metabolism and protein synthesis[5].Hypomagnesemia is a common feature in subjects with hyperlipidemia, hypertension, and type 2 diabetes mellitus. Patients with metabolic syndrome have low serum magnesium levels and intracellular magnesium deficiency[6].Hypomagnesemia may cause an increase of vascular tonus by intracellular magnesium depletion, resulting in an increase of blood pressure, it might cause impairedinsulin secretion , insulin resistance, and hyperlipidemia and finally leading to the development of metabolic syndrome[7].

Materials and methods

This study was conducted at Baghdad Medical City Hospital during the period from April 2014 to January 2015. Two groups of subjects included in this study, the metabolic syndrome group and the control group .100 patients with metabolic syndrome , aged 40-60 years were chosen from patients with Cerebrovascular disease. 90 healthy subjects were selected from the workers in the same hospital as control group.

Blood samples:About10 ml of venous blood was obtained after an overnight fast using disposable needles and syringes. The blood was allowed to clot in plain tubes for 30-45 minutes at room temperature and the serum was recovered by centrifugation at 3000 rpm for 10 minutes and transferred into plain plastic tubes and kept frozen until the time of assay.

Methods: Magnesium ion in serum was measured by direct enzymatic colorimetric method. Magon ,orxylidyl blue(1-azo-2-hydroxy-3-dimethylcarboxanilido]-naphthalene-1-[2-hydroxybenzene]), binds magnesium ion in alkaline solution, causing a spectral shift and forming a red complex. The absorbance has been measured at 512 nm[4].

Statistical Analysis **:**Data were collected and analyzed using SPSS version 10.0 for windows (SPSS, Chicago, Illinois, USA).Statistical tests used according to the need .P value < 0.05 was considered as statistically significant.

Results

Results showed that mean serum magnesium level was lower in metabolic syndrome subjects than control subjects, but the difference was not significant. The prevalence of marginal magnesium deficiency was significantly higher in metabolic syndrome subjects than control subjects (P<0.05),as in table 1.

A comparison between the mean values of serum magnesium in males and females. Percentage of other related variables of the metabolic syndrome between males and females are shown. No significant sex difference in serum mean values and percentage was found as in Table 2.

Figure1 show the prevalence of marginal magnesium deficiency among metabolic syndrome subjects and control subjects, 35 of 100(35%) subjects with metabolic syndrome had serum magnesium below the cutoff of 1.21 mg/dL, and 65 of them (65%) had serum magnesium above 1.21 mg/dL; 19 of 90(21.1%) control subjects had serum magnesium below 1.21 mg/dL, and 71of them(78.8%) had serum magnesium above 1.21 mgldL.

Data analysis of marginally low serum magnesium according to the cutoff values of magnesium < 1.21mg/dL among metabolic syndrome subjects revealed that 77.1% (n=27) had high blood pressure, 88.6% (n=31) had high gluco se, 51.4% (18) had high triglyceridemia and 77.1% (n=27) had low HDL-cholesterol as in table 3.

Table 1 :Clinical and biochemical data of metabolic syndrome and control subjects.

	Metabolic syndrome subjects Mean± SD	Control subjects Mean ± SD	P value
Number	100	90	
Age (Year)	53.6 ± 6.3	51.9 ± 6.3	NS
Male sex (%)	42.0	46.6	NS
Waist circumference (cm)	105.2 ± 9.7	82.2 ± 8.8	<0.001
Systolic BP	142 ± 22.3	119.5 ± 9.3	<0.001
Diastolic BP	84.3 ± 11.4	77.3 ± 8.8	<0.001
Magnesium (mg/dl)	1.5 ± 0.7	1.6 ± 0.5	NS
Prevalence of magnesium deficiency n (%)	35 (35.0)	19(21.1)	<0.05

Table 2: Comparison of clinical and biochemical measurements between males and females with metabolic syndrome.

	Males Mean ± SD	Female Mean ± SD	P-value
Number	42	58	
Age (year)	52.8 ± 6.4	54.2 ± 6.2	NS
Magnesium (mg/dl)	1.6 ± 0.7	1.5 ± 0.7	NS
High blood pressure[n(%)]	32 (76.2)	45 (77.6)	NS
Prevalence/magnesium deficiency [n(%)]	13 (30.9)	22 (24.4)	NS

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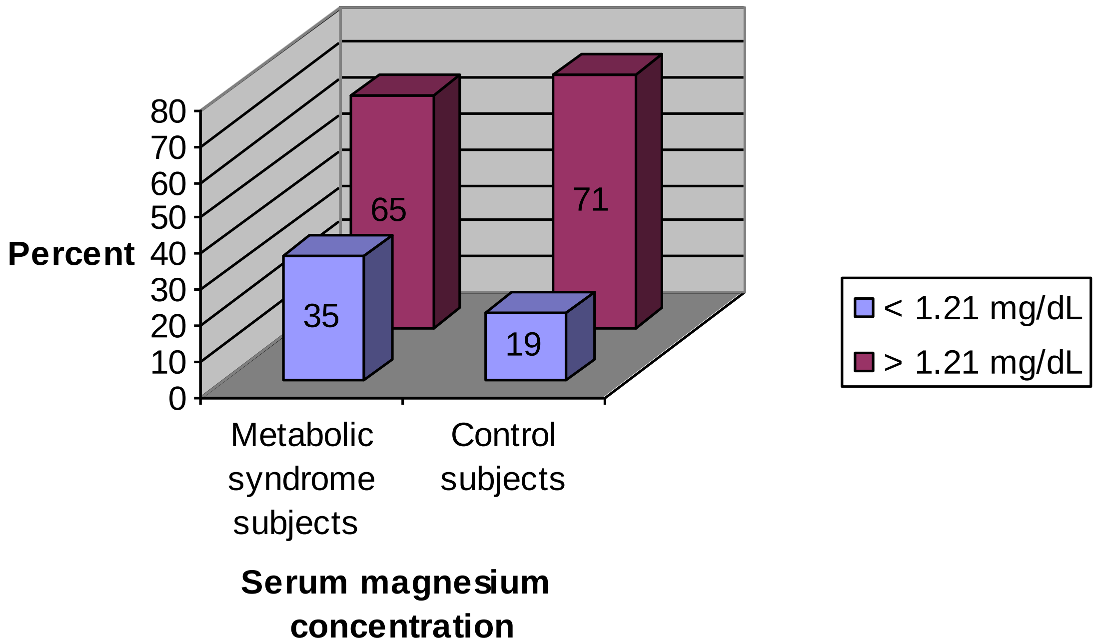

Figure 1: Distribution of serum magnesium in metabolic syndrome and control

Table 3 Characteristics of metabolic syndrome subjects with low serum magnesium concentration.

Characteristics	**Serum magnesium <1.21 mgldL**	**Serum magnesium >1.21 mg/dL**
Number	35	65
Mean age (Years)	54.1 ± 6.1	53.4 ± 6.5
Males [n (%)]	14 (40)	28 (43)
Females [n (%)]	21 (60)	37 (57)
High blood pressure [n (%)]	27 (77.1)	50 (76.9)
High glucose [n (%)]	31 (88.6)	48 (73.8)
High triglycerides	18 (51.4)	33 (50.7)
Low HDL-Cholesterol [n (%)]	27 (77.1)	36 (55.4)

Discussion

Metabolic syndrome is a cluster of cardiovascular disease and diabetes risk factors, including excess waist circumference, high blood pressure, elevated triglyceride, low level of high density lipoprotein(HDL), and increased fasting glucose levels .Previous studies indicate that magnesium can reduce the risk of the individualcomponents of metabolic syndrome, but scientists lacked evidence of its efficacy against the syndrome [8,9]. Accumulating evidence generated from both experimental and observational studies suggest that magnesium intake may have beneficial effects on individual components of metabolic syndrome [9].The researchers found that magnesium intake was associated with improvements in individual components of metabolic syndrome that included fasting glucose level, waist circumference, fasting insulin level, and HDL cholesterol [10].Magnesium may directly regulate cellular glucose metabolism through its role as a cofactor for number of relevant enzymes and may influence insulin secretion by interacting with cellular calcium homeostasis [12, 11]. A negative correlation between dietary

magnesium and fasting insulin level was observed in various populations [12].The mechanisms for a negative correlation between magnesium and abdominal obesity are unclear. It was hypothesized that magnesium may have an antiobesity effects because of its capability of forming soaps with fatty acid in the intestine and thus reducing the digestible energy content of the diet [13].Small changes in magnesium level may have significant effects on cardiac excitability and on vascular tone, contractility and reactivity. Epidemiological and experimental studies demonstrate a negative association between magnesium and blood pressure and support a role for magnesium in the pathogenesis of hypertension [14]. One possible explanation is that magnesium intake may increase lipoprotein lipase activity, which is involved in the conversion of triglyceride to HDL cholesterol [15].

Conclusion:

The results clearly demonstrate that patients with metabolic syndrome have a higher prevalence of marginal magnesium deficiency in comparison to healthy controls.

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