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Original Research Article

Potential Role of Magnesium and Uric Acid in Metabolic Syndrome

Yogita Joshi[1], Jaya Jain[2], Ashutosh Jain[3], Krishna Murari Lodha[4*]

[1]PhD Research Scholar, Department of Biochemistry, Index Medical College, Indore
[2]Associate Professor, Department of Biochemistry, Index Medical College, Indore
[3]Assistant Professor, Department of Biochemistry, Index Medical College, Indore
[4]Associate Professor, Department of Biochemistry, Jhalawar Medical College, Jhalawar, Rajasthan

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Corresponding author: Dr. Krishna Murari Lodha
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Abstract:

Introduction: Metabolic syndrome is a well-recognized risk factor for cardiovascular diseases. It is associated with various disorders such as overweight and obesity, insulin resistance, type 2 diabetes mellitus and hypertension. Magnesium is an essential nutrient for maintaining vital physiological functions. Hypomagnesaemia may be implicated in the pathogenesis of various metabolic disorders such as overweight and obesity, insulin resistance, type 2 diabetes mellitus and hypertension. Hyperuricemia reflects defect in insulin action on the renal tubular reabsorption of uric acid in the renal system and may contribute to hypertension through its effect on the endothelium in the blood vessels.

Objectives: To evaluate the role of serum Magnesium and Uric acid level in patients with metabolic syndrome.

Methodology: We conducted an analytical case-control study on Metabolic Syndrome patients (N=90) and age matched healthy controls (N=90). Serum magnesium and Uric acid level were measured by colorimetric and Uricase-PAP method respectively.

Results: We found that serum Magnesium levels were significantly decreased (0.8 ± 0.4 Mg/dl) in patients having metabolic syndrome as compared to healthy controls 2.0 ± 0.2 Mg/dl), whereas there were elevated levels of serum uric acid (10.5± 2.5 Mg/dl) in metabolic syndrome patients as compared to healthy controls (6.5 ±2.5 Mg/dl).

Conclusions: Low serum magnesium levels have been associated with risk factors of metabolic syndrome, such as hyperglycemia, hypertension, hypertriglyceridemia and insulin resistance. Increased serum uric acid levels are commonly seen in patients with metabolic syndrome and are widely accepted as risk factors for hypertension and cardiovascular diseases.

Keywords: Metabolic Syndrome Hypertension Magnesium Uric acid.

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Introduction

Metabolic syndrome is a clustering phenomenon of metabolic phenotypes such as obesity, dyslipidaemia, and hypertension and insulin resistance. Metabolic syndrome is an important precursor of cardiovascular disease and type 2 diabetes. Metabolic syndrome is a major public health problem in both developed and developing countries, and the prevalence of diseases related to metabolic syndrome shows an increasing trend. The prevalence of metabolic syndrome around the world is in the range of 7.9-43% in males and 7-56% in females. It was reported that the prevalence of metabolic syndrome varies between 21.7% and 30.2% in males, 35.6% and 42.0% in females in previous studies conducted in different parts of India. [1]

Overweight and obesity represent a rapidly growing threat to the health of populations in an increasing number of countries. The rising epidemics reflect the profound changes in society and in behavioural patterns of communities over recent decades. While genes are important in determining a person's susceptibility to weight gain, energy balance is determined by calorie intake and physical activity.

Thus societal changes and world-wide nutrition transition are driving the obesity epidemic. Economic growth, modernization, urbanization, and globalization of food markets are just some of the forces thought to underlie the epidemic. [2] The prevalence of overweight and obesity is commonly assessed by using body mass index (BMI), defined as the weight in kilograms divided by the square root of the height in meters (kg/m2). A BMI over 25 kg/m2 is defined as overweight, and a BMI of over 30 kg/m2 as obese. These markers provide

common benchmarks for assessment, but the risks of disease in all populations can increase progressively from lower BMI levels. [3]

Magnesium (Mg) is an essential nutrient for maintaining vital physiological functions. It is involved in many fundamental processes, and Mg deficiency is often correlated with negative health outcomes. On the one hand, most western civilizations consume less than the recommended daily allowance of Mg. On the other hand, a growing body of evidence has indicated that chronic hypomagnesemia may be implicated in the pathogenesis of various metabolic disorders such as overweight and obesity, insulin resistance (IR) and type 2 diabetes mellitus (T2DM), hypertension (HTN), changes in lipid metabolism, and low-grade inflammation. [3] Uric acid (UA) is the final product of purine metabolism which is produced by xanthine oxidase. [4] Hyperuricemia is associated with hypertension, heart failure, stroke, obesity, metabolic syndrome, insulin resistance, type 2 diabetes mellitus, dyslipidemia, chronic kidney disease, non-alcoholic fatty liver disease, and cardiovascular diseases.

The role of UA in metabolic syndrome and its pleiotropic effects in multiple organ systems has been a matter of discussion due to its complicated and outrageous connections within cellular metabolism and between signalling pathways. Hyperuricemia reflects defects in insulin action on the renal tubular reabsorption of uric acid in the renal system and may contribute to hypertension through its effect on the endothelium in the blood vessels. [5]

Materials and Methods

Inclusion criteria: We conducted an analytical case-Control study on Metabolic Syndrome patients (N=90) and age matched healthy controls (N=90). Serum magnesium and Uric acid level were measured by colorimetric and Uricase-PAP method respectively. We recruited the metabolic syndrome patients diagnosed by clinicians of age between 20 to 60 years, parity, or socioeconomic status and healthy controls. A verbal consent was given by subjects to participate in this study. Study subjects have been explained about the nature and reason for the study.

Exclusion criteria: Study subjects who were less than 18 years and above 60 years not participated in this study. We excluded participants who had history of taking medicines, known renal disease or patients with hepatic disorder.

Results

We found that serum Magnesium levels were significantly decreased (0.8 ± 0.4 Mg/dl) in patients having metabolic syndrome as compared to healthy controls 2.0 ± 0.2 Mg/dl), whereas there were elevated levels of serum uric acid (10.5± 2.5 Mg/dl) in metabolic syndrome patients as compared to healthy controls (6.5 ±2.5 Mg/dl).

Statistical Analysis

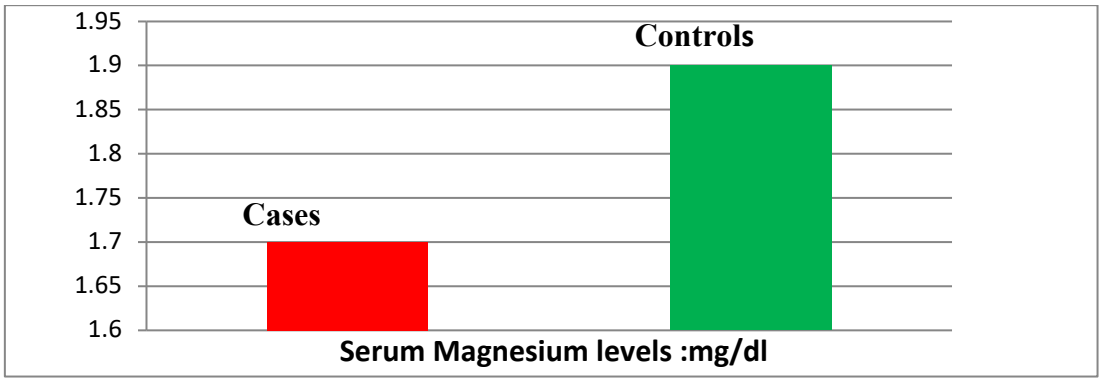
Unpaired student't' test was used to compare serum magnesium and Uric acid levels between cases and controls. Results were expressed as mean± S.D. A p-value 0.05 or less is considered to be statistically significant.

Table 1: Showing age and sex-wise distribution of controls and cases

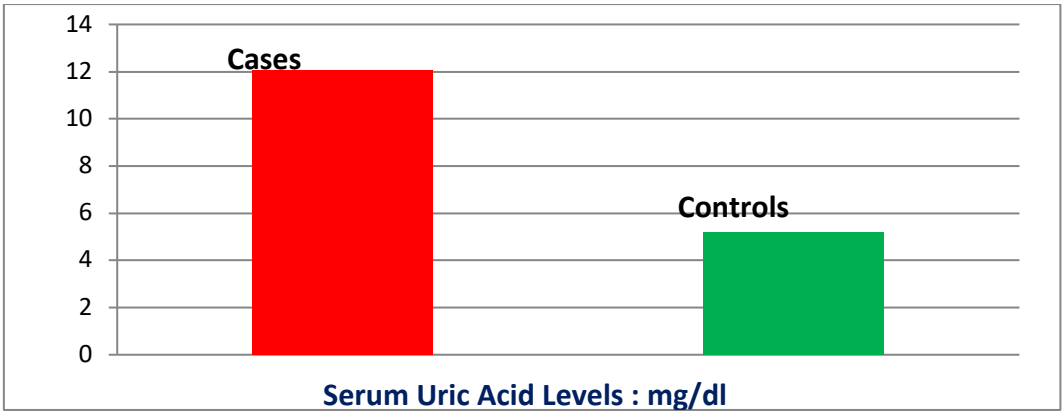
Variables	Controls	Metabolic Syndrome cases	p-Value
Male (No.)	60	60	>0.05 NS
Female (No.)	30	30	>0.05 NS
Age in years (Mean ± SD)	45±12	45±12	>0.05 NS

Table2: Mean levels of serum magnesium and uric acid in controls and metabolic syndrome patients

Parameters	Cases Mean (±S.D.)	Controls Mean (±S.D.)	p-Value
Serum Magnesium	1.7±0.15	1.9±0.25	<0.0001
Serum Uric Acid	12.04±2.5	5.21±1.12	<0.0001



Graph 1: Mean levels of serum magnesium in controls and metabolic syndrome patients



Graph 2: Mean levels of serum uric acid in controls and metabolic syndrome patients

Discussion

Mg is principally an intracellular cation, with less than 0.3 % of total body content present in serum. Magnesium is a critical mineral in the human organism involved in regulating many physiological functions. [6] This micronutrient acts as a cofactor or activator in more than 300 enzymatic reactions, participates in RNA and DNA synthesis, protein, lipids and carbohydrate metabolism, stability of cell membranes, bone and calcium (Ca) metabolism, or nervous and immune system functioning. [7] Changes in Mg metabolism have been observed in metabolic syndrome patients, leading to the reduction in the serum, plasma, and erythrocytes concentration of this micronutrient. A recent meta-analysis showed that overweight and obese women with polycystic ovary syndrome had lower Mg concentrations. Another population-based cross-sectional study involving 130 healthy adults found a significant negative correlation between body weight and total Mg serum levels. It is indicated, that not only adult obese subjects can be predisposed to Mg deficiency but children as well. [7] The analysis conducted by Hassan et al. evaluated a significantly lower Mg concentration in overweight and obese children as compared to the normal-weight participants. Moreover, the authors showed a strong inverse correlation between Mg serum levels and BMI. Obesity often results from unhealthy diets, rich in calories and poor in essential nutrients. [8]

Understanding the effect of uric acid in metabolic syndrome cases is very important as it leads to many debilitating complications, which further leads to morbidity and mortality. [9] Serum uric acid concentrations are positively correlated with the insulin resistant, obesity, diabetes and essential hypertension. In metabolic syndrome patients elevated levels of serum uric acid provide a potential link with morbidity and mortality. [10]

Conclusion

Serum magnesium and uric acid levels are potential indicators to estimate the severity of complications in metabolic syndrome patients. These markers should be included in diagnostic work-up to stratify disease severity. Therefore, full monitoring of metabolic syndrome patients and effective early intervention are the fundamental measures for reducing mortality. Our research work will be helpful in making novel strategies for diagnosis, treatment and prognosis of metabolic syndrome. This study may be helpful to reduce mortality

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