Brief Report

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A Comparison of Serum Magnesium Level in Pregnant Women with and without Gestational Diabetes Mellitus (GDM)

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ABSTRACT

BACKGROUND AND OBJECTIVE: Intracellular magnesium is a cofactor for several enzymes in carbohydrate metabolism. The aim of this study is to demonstrate the role of magnesium as an effective and an underlying factor in disrupted glucose metabolism among pregnant women with and without gestational diabetes mellitus (GDM).

METHODS: This cross-sectional was conducted among 24-32 weeks pregnant women admitted to gynecology clinic of Ayatollah Rohani Hospital in Babol. Patients were divided into four groups: healthy pregnant women, pregnant women with high-risk gestational diabetes, pregnant women with gestational diabetes mellitus and pregnant women with overt diabetes. The demographic information was gathered using a questionnaire and the serum level, magnesium RBC and the fasting blood sugar were measured by laboratory methods and were compared between the four groups.

FINDINGS: 399 patients with mean age of 26.53±5.54 participated in this study. Overall, mean serum magnesium level was 1.71±0.12 mg/dL and magnesium level in RBC was 4.88±0.29 mg/dL. The mean serum magnesium level was 1.73±0.10 in healthy pregnant women, 1.73±0.12 in pregnant women with high-risk gestational diabetes, 1.71±0.13 in pregnant women with gestational diabetes mellitus and 1.64±0.15 in pregnant women with overt diabetes and there was a significant difference between the four groups (p=0.001). The result regarding RBC magnesium level was found to be 5.12±0.18, 4.81±0.23, 4.77±0.24 and 4.66±0.38 in healthy pregnant women, pregnant women with high-risk gestational diabetes, pregnant women with gestational diabetes mellitus and pregnant women with overt diabetes, respectively, which was significant (p=0.001). Serum level and RBC magnesium in diabetic women was less than non-diabetic women.

CONCLUSION: Results of the study demonstrated that magnesium could be an effective and an underlying factor in identification of disrupted glucose metabolism in pregnant women.

KEY WORDS: *Magnesium, Diabetes, Pregnancy, Glucose.*

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Introduction

Magnesium is the second abundant cation after potassium in living cells. Of 21-28 g magnesium that is present in an adult's body, 99% is present in intracellular space and only 1% is present in extracellular fluid (1). Magnesium acts as a major cofactor in most enzymatic processes. On the other hand, magnesium plays a key role in calcium homeostasis and calcium plays an important role in insulin release and glucose metabolism. This cation also plays an important role in the process of glucose uptake by cells and supplying the oxygen needed for cellular oxidation of glucose (2).

Intracellular magnesium is a critical cofactor for several enzymes in carbohydrate metabolism. Lack of magnesium may disrupt the activity of tyrosine kinase in the insulin receptor and may also be related to insulin resistance and decreased cellular glucose consumption (3). The lower the level of basic magnesium, the more insulin is required for metabolizing of the same amount of glucose, which indicates reduced sensitivity to insulin. Insulin resistance is the expected result in the presence of intracellular magnesium (4).

In many cases, magnesium increase or hypomagnesemia improvement occurs at the same time with improvement of glucose metabolism such as the use of hypoglycemic drugs and glucose- lowering foods (fibers). Insulin and magnesium have a complicated relationship (5).

Insulin, which is an effective hormone in glucose metabolism, increases permeability of the cell in exposure to magnesium and thus increases intracellular magnesium. This ability of insulin to increase intracellular magnesium is impaired in people with diabetes and increase in magnesium increases the effect of insulin in glucose uptake and intracellular oxidation (4, 5).

In conditions associated with hypomagnesaemia, impaired secretion or insulin resistance is observed and long-term administration of magnesium is associated with improvement of this disorder in insulin and thus effective reduction of glucose. This effect of magnesium can be used as a protective factor for patients with diabetes. On the other hand, the concentration of intracellular magnesium has inverse relationship with well-known tests of blood sugar control such as glycosylated hemoglobin and fructosamine as well as the intensity of side effects of diabetes (4, 5). Lin et al. demonstrated that serum magnesium level in young adults with diabetes type 1 is significantly lower than control group (6). Mostafavi et al. demonstrated that serum magnesium and magnesium RBC in patients with gestational diabetes mellitus decreased significantly compared with the group of healthy pregnant women and nonpregnant women (5).

This study was conducted to clarify the relationship between this cation and diabetes during pregnancy and since gestational diabetes mellitus has increased in the last two decades in Babol (7), it can be very useful to know if hypomagnesemia can independently act as an effective factor and disrupt the glucose metabolism. This can effectively help us identify people prone to diabetes.

Hence, this study was conducted to demonstrate the role of magnesium as an effective and an underlying factor in disrupted glucose metabolism among pregnant women with and without gestational diabetes mellitus (GDM).

Methods

This cross-sectional was conducted among 399 pregnant women (24-32 weeks) admitted to gynecology clinic of Ayatollah Rohani Hospital in Babol. Patients were divided into four groups using simple random sampling technique (2014-2015). Patients with history of hypertension and kidney, cardiovascular and gastrointestinal diseases were excluded from study.

First group: control group including healthy pregnant women; Second group: pregnant women at risk for gestational diabetes; Third group: pregnant women with gestational diabetes mellitus and Fourth group: pregnant women with overt diabetes. The high-risk patients were those with family history of gestational diabetes in first degree relatives, history of previous gestational diabetes or had fetal macrosomia, obesity and glycosuria (8).

After getting a permission from the ethics committee of Babol University of Medical Sciences and obtaining a written informed consent, the participants were asked to complete a questionnaire about their physical condition. This questionnaire included pregnancy information, history of chronic disease, history of diabetes mellitus, history of abortion, gestational age and a history of high-risk labor and weight and height at the beginning of pregnancy. Pregnant women without history of

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diabetes underwent GCT test (50 g oral glucose) at 24-28th week and one hour later, blood samples were taken to check blood sugar. 130 mg/dL blood sugar in GCT was considered as the threshold limit and blood sugar at a higher or lower level was considered a positive result (5).

Women with positive GCT, were followed with 100 g oral glucose (after three days of diet without carbohydrate limitation) while doing a 3-hour OGTT test. Carpenter and Coustan criteria were used to detect gestational diabetes (5). FBS, serum magnesium and magnesium RBC were measured for all the participants in the fasting state. The gathered data were analyzed using SPSS 18 software and tests of smirnov-kolmogorov, Independent Sample T-test, fisher exact test, one-way ANOVA, post-hoc Tukey and Chi-square test and $p<0.05$ was considered significant..

Results

This study was conducted among 399 patients with mean age of 26.53±5.54. The mean body mass index of the participants was 27.48±4.90 kg/m^2. Overall, mean serum magnesium level was 1.71±0.12 mg/dL (1.4-2.1). Magnesium level in RBC was 4.88±0.29 mg/dL (Table 1). Serum magnesium level in mothers with overt diabetes was significantly lower than other groups (Table 2).

The mean serum magnesium level was 1.73±0.10 mg/dL in healthy pregnant women and 1.71±0.13 mg/dL in pregnant women with gestational diabetes mellitus (p=0.001). Magnesium RBC level was 5.12±0.18 mg/dL in healthy women and 4.77±0.24 mg/dL in pregnant women with gestational diabetes mellitus (p=0.001). The serum magnesium level was 1.69±0.14 mg/dL in diabetic groups (gestational diabetes and overt diabetes) and 1.73±0.11 mg/dL in non-diabetic groups (healthy pregnant women and women at risk for gestational diabetes) (p=0.001). Magnesium RBC level was 4.74±0.29 mg/dL in diabetic groups (gestational diabetes and overt diabetes) and 4.97±0.26 mg/dL in non-diabetic groups (healthy pregnant women and women at risk for gestational diabetes) (p=0.001).

Table 1. The demographic information of healthy pregnant women, pregnant women at risk for gestational diabetes, pregnant women with gestational diabetes mellitus and pregnant women with overt diabetes

Variable	Group	Healthy N=129 N(%)	At risk N=121 N(%)	Gestational diabetes mellitus N=99 N(%)	Overt diabetes N=50 N(%)	P-value
Age (year) Mean±SD		26.60±6.01	26.37±5.31	26.54±5.14	26.70±5.77	0.98
BMI (kg/m^2)Mean±SD		26.70±4.57	27.80±5.23	27.81±4.89	28.09±4.79	0.17
Gravid	1	62 (48.1)	46 (38)	45 (45.5)	23 (46)	0.303
	2	41 (31.8)	45 (37.2)	39 (39.4)	21 (42)	
	3 and more	26 (20.2)	30 (24.8)	15 (15.2)	6 (12)	
Parity	Nullipara	111 (86)	88 (72.7)	77 (77)	42 (84)	0.054
	Multipara	18 (14)	33 (27.3)	22 (22.2)	8 (16)	
History of abortion	Yes	99 (78)	77 (63.6)	82 (82.8)	41 (82)	0.001
	No	22 (22)	44 (36.4)	17 (17.2)	9 (18)	

Table 2. Comparison of serum magnesium level and magnesium RBC level in healthy pregnant women, pregnant women at risk for gestational diabetes, pregnant women with gestational diabetes mellitus and pregnant women with overt diabetes

Variable	Group	Healthy N=129 N(%)	At risk N=121 N(%)	Gestational diabetes mellitus N=99 N(%)	Overt diabetes N=50 N(%)	P-value*
Serum magnesium level(mg/dL)		[a] 1.73±0.10	[a] 1.73±0.12	[a] 1.71±0.13	1.64±0.15 [b]	0.001
Magnesium RBC level(mg/dL)		5.12±0.18 [a]	[b] 4.81±0.23	4.77±0.24 [c]	[d] 4.66±0.38	0.001

According to Tukey test, dissimilar letters in each horizontal low indicate significant difference between group at $p<0.05$ level.

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Discussion

In this study, serum magnesium level in women with overt diabetes was less than women with gestational diabetes, healthy women and women at risk. In addition, serum magnesium level in diabetic groups was less than non-diabetic groups. Results of a study by Goker Tasdemir et al. demonstrated that there is a significant difference in serum magnesium level between the group of women with gestational diabetes with abnormal OGTT and the group of pregnant women with normal OGTT and total and ionized magnesium level in pregnant women with diabetes is significantly lower than healthy women. In their study, magnesium level was 1.9 mg/dL and 1.8 mg/dL in non-diabetic group and diabetic group, respectively, which is a little higher than our results (9).

However, in our study, serum magnesium level in women with gestational diabetes, overt diabetes, at risk of diabetes revealed a significant difference with healthy mothers. Lin et al. demonstrated that serum magnesium level in young adults with diabetes type 1 is significantly lower than control group (6), which is in line with our results. Since our participants were pregnant women, serum magnesium level in our study was lower than the study of Lin. Serum magnesium level generally declines during pregnancy and the presence of diabetes accelerates this process (10).

Simmons et al. reported that hypomagnesemia is associated with known diabetes, but in patients who were newly diagnosed with diabetes, the relationship is not significant (11), which is in line with the present study. Men and women (mean age of 53) with diabetes were examined in the study of Simmons et al. and it was shown that aging alone decreases serum magnesium level. Study of Mostafavi et al. revealed that serum magnesium and magnesium RBC in patients with gestational diabetes is significantly lower than healthy pregnant and nonpregnant women (5), which is not in line with our study. One of the possible causes of this difference may be related to different sample size in the two studies. Serum magnesium level in women with gestational diabetes was similar in both studies. Serum magnesium level in healthy women was also similar. 99 people suffered from gestational diabetes in our study, which was notably higher than the study of Mostafavi (5).

Jeong et al., investigated serum magnesium level in 116 pregnant women with gestational diabetes. After delivery, subjects were divided into three groups (OGTT with 75 mg unnatural glucose, prediabetes changes and natural OGTT) and concluded that serum magnesium level in impaired OGTT group was the lowest among these three groups. However, there was no significant difference in serum magnesium level between mothers with natural OGTT and the group with prediabetes changes (12).

The results of this study were in line with our study, although this study was dedicated to serum magnesium level after delivery. In our study, serum RBC level in healthy pregnant women was significantly higher than other women and this result remained significant after separation based on body mass index. One of the limitations of this study was ignoring duration of diabetes and its relationship with magnesium level. This study did not consider the type of diabetes (type 1 or 2) and its effect on magnesium level. Other limitations of the study include ignoring mothers' diet and its effect on magnesium level. Results of this study indicated that serum magnesium level and magnesium RBC level in women with diabetes is lower than healthy women. Hence, magnesium can be an effective and underlying factor in identification of disorders in glucose metabolism among pregnant women.

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References

1.Barbagallo M, Dominguez LJ, Galioto A, Ferlisi A, Cani C, Malfa L, et al. Role of magnesium in insulin action, diabetes and cardio-metabolic syndrome X. Mol Aspects Med. 2003;24(1-3):39-52.

2.Assadi F. Hypomagnesemia: an evidence-based approach to clinical cases. Iran J Kidney Dis. 2010;4(1):13-9.

3.Kolterman OG, Gray RS, Griffin J, Burstein P, Insel J, Scarlett JA, et al. Receptor and postreceptor defects contribute to the insulin resistance in noninsulin-dependent diabetes mellitus. J Clin Invest.1981;68(4):956-69.

4.Barbagallo M, Gupta RK, Bardicef O, Bardicef M, Resnick IM. Altered ionic effects of insulin in hypertension: role of basal ion levels in determining cellular responsiveness. J Clin Endocrinol Metab. 1997;82(6):1761-5.

5.Mostafavi A, Nakhjavani M, Niromanesh SH. Hypomagnesemia and Diabetes Mellitus. IJEM. 2003;5(2):111-9.

6.Lin CC, Tsweng GJ, Lee CF, Chen BH, Huang YL. Magnesium, zinc, and chromium levels in children, adolescents, and young adults with type 1 diabetes. Clin Nutr .2016;35(4):880-4.

7.Bouzari Z, Yazdani S, Abedi Samakosh M, Mohammadnetaj M, Emamimeybodi S. Prevalence of Gestational Diabetes and Its Risk Factors in Pregnant Women Referred to Health Centers of Babol, Iran, from September 2010 to March 2012. Iran J Obstetric, Gynecol. 2013;16(43):6-13.

8.Pathak P, Kapoor S, Kapil U, Dwivedi S. Serum magnesium level among pregnant women in a rural community of Haryana State, India. Eur J Clin Nut. 2003;57(11):1504-6.

9.Goker TasdemirU, Tasdemir N, Kilic S, Abali R, Celik C, Gulerman HC. Alterations of ionized and total magnesium levels in pregnant women with gestational diabetes mellitus. Gynecol Obstet Invest. 2015;79(1):19-24.

10.Sales CH, Pedrosa FC. Magnesium and diabetes mellitus: their relation. Clin Nut. 2006;25(4):554-62.

11.Simmons D, Joshi S, Shaw J. Hypomagnesaemia is associated with diabetes: not pre-diabetes, obesity or the metabolic syndrome. Diabetes Res Clin Pract. 2010;87(2):261-6.

12.Jeong Yang S, Young Hwang S, Hyun Baik S, Woo Lee K, Suk Nam M, Soo Park Y, et al. serum magnesium level is associated with type 2 diabetes in women with a history of gestational diabetes mellitus: the korea national diabetes program study. J Korean Med Sci . 2014;29(1):84-9.

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