Original Article

Serum magnesium and copper levels in Bangladeshi women with gestational diabetes mellitus

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Abstract

Background and objectives: Alteration of magnesium (Mg) and copper (Cu) concentrations in blood has been observed in normal pregnancy as well as in gestational diabetes mellitus (GDM). The present study was aimed to evaluate the serum Mg and Cu levels in Bangladeshi women with GDM in their second and third trimester of pregnancy.

Methods: The study was conducted at Mymensingh Medical College Hospital from July 2013 to June 2014. Pregnant women, in their second and third trimester, attending the outpatient department of Obstetrics and Gynecology and the Department of Endocrinology of Mymensingh Medical College Hospital were enrolled by purposive sampling technique. GDM was diagnosed on the basis of oral glucose tolerance test (OGTT) as defined in WHO criteria 2013. Blood glucose was estimated by enzymatic GOD-PAP colorimetric method. The cut off value for fasting plasma glucose level was $\geq$6.1 mmol/L or $\geq$7.8 mmol/L 2 hours after glucose load. Serum Cu was estimated by 3, 5-DiBr-PAESA method and Mg by Xylidyl Blue-I Method as per manufacturer's instruction.

Results: A total of 172 pregnant women in their second and third trimester were enrolled. Out of 172 participants, 86 had GDM and 86 were normoglycemic (control). The mean age of GDM and control groups was 28.6$\pm$3.2 years and 27.3$\pm$3.1 years respectively. The BMI was 26.4$\pm$1.5 m/kg^2 and 26.3$\pm$1.3 m/kg^2. Serum Mg level was significantly low ($p< 0.001$) in 2nd and 3rd trimesters in GDM cases (1.39$\pm$0.26 mg/dl and 0.93$\pm$0.15 mg/dl) compared to control group (1.67$\pm$0.3 mg/dl and 1.67$\pm$0.31mg/dl). On the contrary, serum Cu levels in GDM cases were significantly ($p<0.002$) higher in both trimesters (224$\pm$333.8 μg/dl and 243.91$\pm$6.89 μg/dl) compared to those without GDM (220.1$\pm$7.6 μg/dl and 234.9$\pm$4.6 μg/dl). There was significant ($p<0.001$) increase of serum Cu levels in 3rd trimester compared to 2nd trimester in both GDM and non GDM cases.

Conclusion: There was distinct alteration of serum Mg and Cu levels in GDM compared to normal pregnancy.

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Introduction

Gestational diabetes mellitus is defined as carbohydrate intolerance resulting in hyperglycemia, with first onset or detection during pregnancy [1,2]. Usually initiation of GDM is in middle and late gestational period and continues to term [3]. Glucose intolerance usually returns to normal range within six weeks after delivery [4]. Approximately 1-14 % of all pregnancies are complicated by GDM [4]. The prevalence of GDM among Bangladeshi pregnant mothers has been reported as 9.7% [5]. Pregnancy is associated with physiological changes that result in increased plasma volume and decreased concentrations of plasma proteins and micronutrients [6]. It is a time

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of increased nutritional needs, both to support the rapidly growing fetus and the changes occurring in mother during pregnancy. Different researchers have demonstrated that macro and micro nutrients are essential for the optimum development of fetus. Among the micronutrients, Cu is important, especially early in the life for the development and maintenance of fetal organs and tissues. Deficiencies of Cu have been implicated in infertility, pregnancy wastage, congenital abnormalities, still birth and low birth weight [7,8]. Serum Cu values in healthy pregnant women increases with gestational period [9]. Serum Cu has been found to be significantly higher in GDM cases as compared to euglycemic healthy pregnant women [10]. Earlier studies reported higher level of serum Cu in full term healthy Bangladeshi pregnant women compared to non pregnant women [11,12]. Likewise, Mg has been found to be linked to fetal and maternal wellbeing. Mg deficiency during pregnancy is associated with intrauterine growth retardation and metabolic syndrome in later life of the offspring [13,14]. There is report of low and variable serum Mg level during second and third trimester of normal pregnancy [15]. It has been found that serum Mg is depleted at a greater extent in women with GDM [16]. However, there is no systematic study regarding the serum levels of Cu and Mg in Bangladeshi pregnant women with GDM. Therefore, the present study was undertaken to determine the serum Cu and Mg levels in second and third trimester of pregnancy in Bangladeshi women with GDM.

Materials and Methods

The study was conducted at Mymensingh Medical College Hospital from July 2013 to June 2014 to evaluate the serum level of magnesium and copper in pregnant women with GDM. The study protocol was approved by the institutional review committee and written informed consent was obtained from all the participants prior to their enrolment into this study.

Study population and collection of samples: Pregnant women, in their second and third trimester, attending the outpatient department of Obstetrics and Gynecology and the Department of Endocrinology of Mymensingh Medical College Hospital were enrolled by purposive sampling technique. Pregnant women with the previous history of diabetes, hypertension and other endocrine disorders were excluded from the study. Data were collected in a predesigned data collection sheet. The variables included were - age, height, weight, duration of gestation, family history of diabetes, previous history of pregnancy and gestational diabetes mellitus. About 5 ml of blood was collected aseptically with venipuncture from all participants for OGTT and estimation of serum Cu and Mg levels.

Estimation serum glucose, Cu and Mg: Blood glucose was estimated by enzymatic GOD-PAP colorimetric method [17]. GDM was diagnosed on the basis of OGTT as defined in WHO criteria 2013 [1,18]. The cut off value for fasting plasma glucose level was $\geq$6.1 mmol/L or $\geq$7.8 mmol/L 2 hours after glucose load. Serum Cu and Mg were determined by commercial colorimetric assay kits obtained from Japan Institute for the Control of Aging (JaICA), Nikken Seal Co., Ltd, Japan. Serum Cu was estimated by 3, 5-DiBr-PAESA method and Mg by Xylidyl Blue-I Method as per manufacturer's instruction.

The results were analyzed and values were expressed as mean $\pm$SD. The level of significance was determined by employing Student's t test.

Result

A total of 172 pregnant women in their second and third trimester were enrolled in the study of which 86 had GDM and 86 were normoglycemic by OGTT test. Pregnant women without GDM (normoglycemic)

Table-1: *Age and BMI of study population*

Group	Age in yrs	BMI (m/kg^2)
GDM	28.6$\pm$3.2	26.4$\pm$1.5
Control	27.3$\pm$3.1	26.3$\pm$1.3
p value	0.778	0.774

GDM- Gestational diabetes mellitus; Control- Pregnant women without GDM (Euglycemic)

Table-2: *Serum concentration of Mg and Cu in GDM and euglycemic pregnant women*

Group	Mean±SD concentration of Mg (mg/dl) in			Mean±SD concentration of Cu (μg/dl) in		
	2nd Trimester	3rd Trimester	Total	2nd Trimester	3rd Trimester	Total
GDM	1.4 ±0.3	0.9 ±0.2	1.2 ±0.3	224.3±3.8	243.9±6.9	237.0±10.0
Control	1.7 ±0.3	1.7 ±0.3	1.7 ±0.3	220.1±7.6	234.9 ±4.6	234.6±4.2
p value	0.001	0.001	0.001	0.002	0.001	0.042

were considered as control group. The mean age of GDM and control groups were 28.6±3.2 years and 27.3±3.1 years while the mean BMI was 26.4±1.5 m/kg^2 and 26.3±1.3 m/kg^2 respectively (Table-1). Serum Mg level was significantly low ($p<0.001$) in 2nd and 3rd trimesters in GDM cases (1.4±0.3 mg/dl and 0.9±0.2 mg/dl) compared to control group (1.7±0.3 mg/dl and 1.7±0.3 mg/dl). The serum Mg level declined in 3rd trimester compared to 2nd trimester in GDM cases while there was no such change in cases without GDM. On the contrary, serum Cu levels in GDM cases were significantly ($p<0.002$) higher in both trimesters (224±3.8 μg/dl and 243.9±6.9 μg/dl) compared to those without GDM (220.1±7.6 μg/dl and 234.9±4.6 μg/dl). There was significant ($p<0.01$) rise of serum Cu levels in 3rd trimester compared to 2nd trimester in both GDM and non GDM cases (Table-2).

Discussion

In this study, we have estimated serum Mg and Cu levels in pregnant women with GDM and in healthy pregnant women (euglycemic control). Serum Mg concentration in women with GDM was significantly low compared to that of control. The decrease in serum Mg might be caused by osmotic diuresis and by indirect hormonal effects. The low serum Mg levels seen in the diabetic population could be a consequence of insulin resistance and low dietary Mg intake and decreased intestinal absorption [16].

In the present study, the serum concentration of Cu in women with GDM were significantly higher ($p<0.001$) compared to the controls. The possible causes of high serum Cu concentration in GDM cases could be due to the hormonal, metabolic and enzymatic changes in pregnancy. Increased Cu level in GDM cases could be due to decreased insulin sensitivity in GDM [10]. Though studies have found increased level of copper in GDM, others have found no statistically significant difference of serum Cu concentrations between healthy pregnant women and women with GDM [19]. However, pregnant women with GDM should be carefully monitored for adverse effects of increased copper.

The present study has revealed that there is pronounced alteration of serum Mg and Cu levels in GDM cases compared to normal pregnancy. Therefore, further study should be done to find out the underlying mechanism of alteration of serum Mg and Cu levels in DGM.

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