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Serum Magnesium concentration in normal and preeclamptic pregnancy: A tertiary center experience

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Abstract

Preeclampsia and maternal mortality are more prevalent in underdeveloped nations. Preeclampsia has an estimated 16% incidence rate in Bangladesh, which is extremely high. One of the body's major macronutrients is magnesium. It also serves a multitude of enzymes as a cofactor. This cross-sectional study was done in the department of Biochemistry of Mymensingh Medical College, Mymensingh, from July 2016 to June 2017. This study involved a total of 100 individuals, where 50 preeclamptic patients and 50 healthy pregnant women served as the case and control groups, respectively. The results were shown as mean ±SD. For both the case and control groups, the mean ±SD of serum magnesium levels were 1.75 ±0.22 mg/dl and 1.63 ±0.21, respectively. Comparison of the mean ±SD of serum magnesium in the case and control groups revealed a highly significant difference (P<0.001). Students' unpaired 't' test was used to compute the statistical difference.

Keywords: Preeclampsia, Serum Magnesium.

Introduction

One of the main causes of morbidity and mortality among mothers and perinatal is preeclampsia.[1] Preeclampsia and eclampsia are thought to account for 14% of maternal deaths worldwide annually (50,000-75,000).[2] Preeclampsia is still rather common in underdeveloped nations.[3] This illness complicates 2-8% of pregnancies worldwide.[4] Preeclampsia is thought to be directly responsible for 10% of direct maternal mortality in Asia, according to estimates from the World Health Organization (WHO).[5] In Bangladesh, preeclampsia and eclampsia account for roughly 16% of maternal fatalities.[6] About 10% of primigravida cases and 5% of multigravida cases are reported.[7] When a pregnant woman's blood pressure increases to ≥140 mmHg systolic or ≥90 mmHg diastolic on two different readings taken at least four to six hours apart after 20 weeks gestation in a person whose blood pressure was previously normal, preeclampsia is diagnosed. A 24-hour urine sample containing 300 mg or more of protein; a spot urine protein to creatinine ratio of 0.3 or more; or a urine dipstick reading of 1(+) or higher (dipstick readings should only be used in the absence of other quantitative methods).[8] One of the vital microminerals in our bodies is magnesium. The extracellular magnesium content in the human body must be normal.[9] Due to its significant involvement in peripheral vasodilatation and neurochemical transmission.[10] Moreover, it serves as an enzyme cofactor for over 300. Because magnesium competitively reduces the entry of calcium into neurons, lowering the blood magnesium concentration increases neuromuscular excitability.[11] Reduced serum magnesium levels are hypothesized to enhance the vascular smooth muscle's contractile responsiveness to vasopressor.[12] The decrease in serum magnesium levels can be attributed to inadequate food intake, hemodilution, or extracellular space expansion. Calcium is shifted intracellularly when the amount of extracellular magnesium is reduced. This results in partial membrane depolarization and a decrease in repolarization as well as the opening of membrane calcium channels. This phenomenon causes blood pressure to rise and vasoconstriction.[13]

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Furthermore, it has been suggested that low serum magnesium inhibits the release of prostacyclins from the endothelial cells of umbilical arteries, which again results in an increase in blood pressure, and increases endothelin-1- mediated smooth muscle contraction.[14] Because magnesium affects both the health of the fetus and the mother, magnesium plays a part in obstetrics as well.

Preeclampsia is one of the pregnancy issues that the individual is at risk for due to the low concentration of magnesium in their serum.[15] Additionally, it has been proposed that a newborn's magnesium shortage may be linked to sudden infant death syndrome (SIDS). Preterm labor, low birth weight kids, leg cramps, preeclampsia, hypertension, and intrauterine growth retardation can all result from magnesium insufficiency during pregnancy.[16] Though magnesium has a significant effect on peripheral vasodilatation, it may also have a significant effect on blood pressure by modulating the tone and structure of the arteries through its effects on several biochemical events that regulate vascular growth/apoptosis, differentiation, and inflammation.[17] Furthermore, oxidative stress, proinflammatory states, endothelial dysfunction, platelet aggregation, insulin resistance, and hyperglycemia have all been linked to this mineral's deficit. As a result, while variations in magnesium levels may contribute to the etiopathology of hypertension, magnesium may be physiologically significant in the regulation of blood pressure. Therefore, a deficit in magnesium or a drop in serum magnesium concentration may be a contributing element to the pathophysiology or predisposing factor for the development of preeclampsia.[18]

Materials and methods

It was a cross-sectional study. From July 2016 to June 2017, it was conducted at the Department of Biochemistry at Mymensingh Medical College in Mymensingh, Bangladesh. There was a total of 100 subjects in this investigation. Of these, fifty preeclamptic patients were designated as cases, and fifty additional pregnant women were designated as controls. The analytical process was completed as quickly as feasible. The method used to express biochemical values was mean ± SD (standard deviation). Using the Student's unpaired 't' test, the statistical significance of the difference between the two groups was assessed, and a P-value of less than 0.05 ($p<0.05$) was deemed significant. The statistical analysis was conducted using the SPSS software, version 21 for Windows. The presence of inclusion and exclusion criteria were used to select the study participants, and their informed written consent was obtained. All pertinent information was gathered. Using a sterile disposable syringe, venous blood was drawn from each subject's median antecubital vein while taking all necessary aseptic measures. Using the test kit, serum magnesium was measured using a colorimetric technique.[19]

Results

Clinical parameters of the study subjects such as maternal age, gestational age, Body Mass Index, Systolic Blood Pressure and Diastolic Blood Pressure are represented in Table 01.

Table 01: Clinical characteristics of the study subjects

Variables	Control Mean ± SD	Case Mean ± SD	P-value
Maternal age(years)	25.82 ± 4.45	26.56 ± 4.67	0.419^{ns}
Gestational age (weeks)	34 ± 4.74	32.28 ± 4.11	0.292^{ns}
BMI (Kg/m^2)	23.74 ± 1.43	25.09 ± 1.37	P<0.001**
SBP (mm of Hg)	107.40 ± 7.77	165.60 ± 16.06	P<0.001**
DBP (mm of Hg)	68.20 ± 7.19	110.60 ± 14.0	P<0.001**

In this study, it was observed that the mean values of serum magnesium levels were 1.63 ±0.21 and 1.75 ±0.22 mg/dl in Group-II (case) and Group-I (control) respectively. A highly significant (P<0.001) decrease in serum magnesium levels was observed in preeclamptic patients (case) when compared to that of the normal healthy pregnant women. Analysis of mean serum magnesium levels of the study population are presented in Table 02 and Figure 01 below.

Table 02: Comparison of mean serum magnesium levels in the study population

Variable	Group-I (control) Mean ±SD	Group-II (case) Mean ±SD	P value
Serum magnesium (mg/dl)	1.75 ±0.22	1.63 ±0.21	< 0.001**

P less than 0.05 is taken as the level of significance.
P<0.001 considered a highly significant result.
SD= Standard deviation

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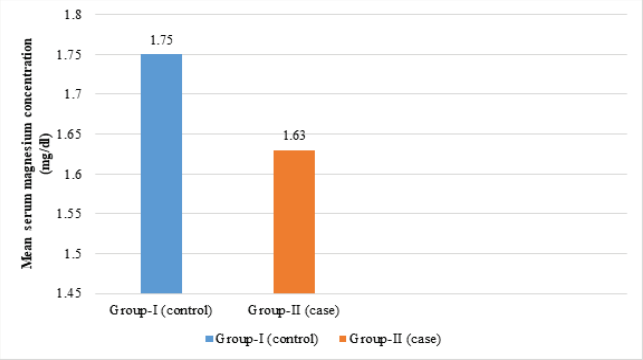

Figure 01: Comparison of mean serum magnesium levels in the study population

Discussion

Magnesium is necessary throughout pregnancy for the baby's healthy growth and development. It is necessary for a developing fetus's cell division and is a vital component of life chemistry that maintains a healthy neuromuscular system. A severe magnesium deficit may result in low fetal growth, hypertension, or even fetal mortality. Appropriate magnesium levels may also aid in the baby's placental absorption of additional nutrients and support the growth and restoration of the mother's tissue during pregnancy.[20] The current investigation revealed that the mean ±SD of serum magnesium levels in Group-I (control) and Group-II (case) were 1.75 ±0.22 mg/dl and 1.63 ±0.21 mg/dl, respectively. The results showed that preeclamptic patients had significantly lower serum magnesium levels (P<0.001) than the control group. This finding was well correlated and corroborated by Purohit et al.[17], Kumar & Keerthana[21], Bansode et al.[22], Tavana & Hosseinmirzaei[23], and Al-Rubaye.[24] According to a study by Purohit et al.[17], the hemodilution effect of estrogen and the fetus's increased demand lower serum magnesium levels throughout pregnancy, and urine magnesium excretion increases in preeclampsia. Preeclamptic women may have lower levels of magnesium because of decreased food intake, higher kidney clearance, hemodilution from extracellular space expansion, or increased mineral consumption by the developing fetus.[21] Given that the kidneys are the primary regulators of the body's magnesium levels, an increase in renal clearance during pregnancy could be a factor in the drop in serum magnesium levels.[24] Thus, hypomagnesemia is linked to hemodilution, altered renal clearance, and mineral uptake by developing fetuses.[10] In preeclampsia, magnesium enhances endothelial function. This could be because magnesium has direct vasodilatory effects or because it can trigger the production of prostacyclin, an endothelial vasodilator that both causes vasodilation and inhibits platelet adhesion and aggregation[25]. Additionally, low serum magnesium inhibits the release of prostacyclin from the endothelial cells of the umbilical arteries, increasing blood pressure[14], and enhances endothelin-1-mediated smooth muscle contraction. A drop in extracellular magnesium results in partial depolarization and decreased repolarization of the membrane, as well as the opening of membrane channels, which produces an intracellular calcium shift. Moreover, the current rise in the fetal calcium demand may concurrently cause an intracellular pull and prevent calcium from being reabsorbed into the bone. Vasoconstriction and elevated blood pressure are the results of this mechanism, as demonstrated by pregnancy-induced hypertension and preeclampsia.[26] Nevertheless, conflicting research by Vafaei, Dalili & Hashemi[27], Lou et al.[28], and Bringman et al.[29] revealed that preeclamptic patients' serum magnesium levels did not significantly differ from those of normal pregnant women. Magnesium may function by counteracting the rise in intracellular calcium concentration as well as calcium-dependent artery constriction by Richard, Nelson, & Zuspan.[30]

Conclusion

A sufficient amount of magnesium is essential during pregnancy because it has been proposed that a magnesium deficit is a significant contributing factor to the development of preeclampsia. In this investigation, the preeclamptic patients' serum magnesium levels considerably (p<0.001) lower than those of the normal pregnant women. Therefore, if a pregnant woman exhibits further preeclamptic symptoms at her antenatal checkup, her serum magnesium level may be investigated. It may therefore lower the chance of preeclampsia as well as other problems for the mother and fetus.

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