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ORIGINAL RESEARCH

Assessment of serum calcium and serum magnesium amongst Preeclampsia and Normotensive Pregnant Women attending a Tertiary Care centre

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ABSTRACT
Background: One of the most frequent causes of maternal and foetal morbidity and mortality is preeclampsia. The present study was conducted to assess serum calcium and serum magnesium in subjects with gestational hypertension and pre-eclampsia.
Materials and Methods: 80 patients with a singleton pregnancy in the third trimester were divided into two groups of 40 each. Group I were subjects with blood pressure (BP) ≥140/90 mm Hg, and group II had normal, normotensive pregnant subjects (controls). The serum calcium and magnesium levels of the two groups were compared. Using the NM-BAPTA technique, the serum calcium was estimated.
Results: The mean serum calcium in group I was 8.20 mg/dl, and in group II it was 8.96 mg/dl. The mean magnesium level in group I was 1.63 mg/dl in group I and 1.88 mg/dl in group II. The difference was significant (P< 0.05). In subjects with SBP 140–149 mm Hg, the mean serum calcium and magnesium levels were found to be 8.9 mg/dl and 1.8 mg/dl, respectively. In subjects with SBP 150–159 mm Hg, the mean serum calcium and magnesium levels were 8.3 mg/dl and 1.8 mg/dl, respectively, and with >160 mm Hg, they were 8.1 mg/dl and 1.6 mg/dl, respectively. The systolic blood pressure and serum calcium show a negative correlation. The correlation between systolic blood pressure and serum magnesium shows a strong negative correlation and is significant (P = 0.05). In subjects with DBP 90–99 mm Hg, the mean serum calcium and magnesium levels were found to be 8.4 mg/dl and 1.8 mg/dl, respectively. In subjects with DBP 100–109 mm Hg, the mean serum calcium and magnesium levels were 8.7 mg/dl and 1.7 mg/dl, respectively, and with >110 mm Hg, they were 8.0 mg/dl and 1.6 mg/dl, respectively. The diastolic blood pressure and serum calcium show a negative correlation, which is statistically significant. The correlation between diastolic blood pressure and serum magnesium is statistically significant (P< 0.05).
Conclusion: It is not plausible for hypocalcaemia or hypomagnesaemia to be modifiable factors in the development of pregnancy-related hypertension.
Key words: Serum magnesium, Calcium, Hypertension

Introduction

One of the most frequent causes of maternal and foetal morbidity and mortality is preeclampsia. It is estimated that 4–18% of poor countries have preeclampsia.[1] Therefore, it is estimated that hypertensive problems during pregnancy account for 16% of all maternal deaths in affluent nations and 9% of maternal deaths in Asia and Africa. As a result, dietary calcium deficiencies lower serum calcium levels and have been linked in certain research to pre-eclampsia.[2] Reduced serum calcium levels have a vasoconstrictive impact, which helps to explain this notion. In this vasoconstrictive mechanism, 1, 25-dihydroxycholecalciferol stimulation has been linked.[3] Moreover; low serum calcium levels raise the synthesis of parathyroid hormone (PTH), which raises intracellular calcium levels. These physiological mechanisms provide the rationale for the theory that hypocalcaemia might

cause vasoconstriction, which raises blood pressure.[4] This causes the smooth muscle in the blood vessels to contract, which raises blood pressure. Magnesium is known as "nature's physiological calcium blocker," and low serum magnesium levels exacerbate the symptoms of hypocalcaemia. Increased intracellular calcium results from hypomagnesaemia's opening of the L-type Ca2+ channel and blocking of the sarcoplasmic reticulum's Ca2+ ATPase. Vasoconstriction is the direct result of low serum magnesium levels, which also reduce the generation of prostacyclin.[5]

Aims and Objectives: The present study was conducted to assess serum calcium and serum magnesium in gestational hypertension and pre-eclampsia.

Materials and Methods

The present prospective cross-sectional study comprised 80 patients with a singleton pregnancy in the third trimester, conducted at the Department of Biochemistry in collaboration between the Department of Biochemistry and the Department of Obstetrics and Gynaecology, Kanti Devi Medical College, Hospital and Research Centre, Mathura, Uttar Pradesh, India. The study took place from January 2020 to June 2021 after receiving approval from the Institutional Ethics Committee. All gave their written consent to participate in the study. Data such as name, age, etc. was recorded. Keeping power (1-beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required was 60 patients; therefore, we included 80 (more than the minimum required number of cases) patients in the present study.

Inclusion criteria:

The study group included all normal pregnant and preeclamptic women, ages 18 to 35, who were willing to participate in the study and had live singleton pregnancies in the third trimester (beyond 30 weeks). The women had been diagnosed with preeclampsia based on the guidelines given by the ACOG task force on hypertension in pregnancy.[6]

Pregnant women with normotensive status who were willing to participate in the study and were in the same age group, parity, and gestational period were included in the comparison group.

Exclusion criteria:

Patients receiving magnesium and/or calcium therapy, patients refusing to participate in the study, pre gnant women with kidney disorders, chronic hypertension, gestational diabetes mellitus, or any combi nation of these conditions. A random urine sample with proteinuria ≥1+ on the dipstick plus a systolic blood pressure of ≥140 mmHg and a diastolic blood pressure of ≥90 mmHg was used to diagnose preeclampsia.[7]

Patients were divided into two groups of 40 each. Group I (cases) were patients with blood pressure (BP) ≥140/90 mm Hg, and group II(control) had normal, normotensive pregnant subjects (controls). The serum calcium and magnesium levels of the two groups were compared.

Statistical analysis

The data thus obtained were subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS) version 22.0. Categorical data were presented as mean ± standard deviation (SD). The significance of the difference between the groups was compared using the Student t-test. The chi-square test was used to compare the socioeconomic status and clinical characteristics between the groups. Using the NM-BAPTA technique, the serum calcium was estimated. A P value less than 0.05 were considered significant.

Results

The present study revealed that in the majority of the cases (group I) of preeclamptic patients, the majority were from the poor economic class, whereas in the normotensive group II, they belonged to

the middle class. The comparison of gestational age between the cases and the control group showed a statistically significant difference. There was also a significant difference in age between both groups.

Table 1: Comparison of characteristics in the control and case groups

Parameters	**Group I (cases)**, n=40	**Group II (control)**, n=40	**P value**
Mean gestational age (in years)	33.85±2.93	32.05±2.60	0.001
Mean age (in years)	27.05±4.79	24.65±4.05	0.001

Table 2: Comparative analysis of demographic and biochemical parameters of study participants

Parameters	**Group I,** n=40 (Mean± SD)	**Group II,** n=40 (Mean± SD)	**P value**
BMI (kg/m2)	27.85±3.60	26.32±4.51	0.01
SBP (mmHg)	156.95±12.51	110.80±10.75	0.001
DBP (mmHg)	98.02±9.50	75.08±5.92	0.001
Serum calcium (mg/dL)	8.20±0.50	8.96±0.60	0.001
Serum magnesium (mg/dL)	1.63±0.20	1.88±0.25	0.01

SBP=Systolic blood pressure DBP=Diastolic blood pressure

Table 2 shows that the mean BMI (kg/m2) in group I was 27.85 and in group II was 26.32. The mean SBP and DBP in group I were 156.95 mmHg and 98.02 mmHg, whereas in group II they were 110.80 mmHg and 75.08 mmHg, respectively. The mean serum calcium in group I was 8.20 mg/dl and in group II was 8.96 mg/dl. The mean magnesium level in group I was 1.63 mg/dl in group I and 1.88 mg/dl in group II. The difference was significant (P< 0.05).

Figure 1:comparative analysis of parameters

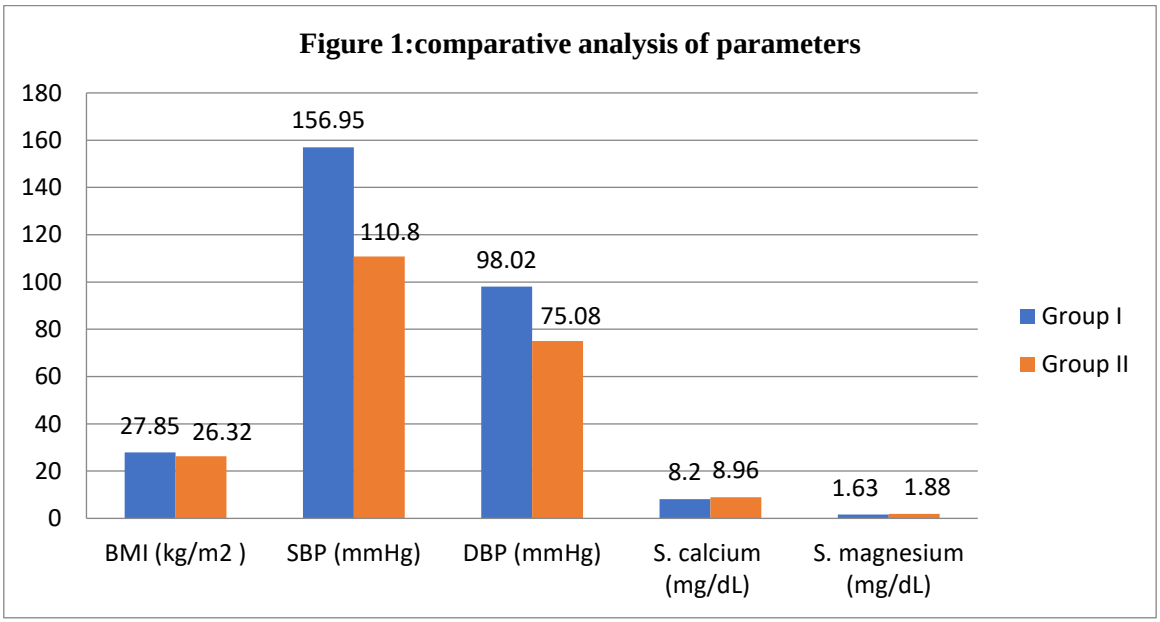

Table 3: Assessment of serum calcium and magnesium based on systolic blood pressure

Systolic blood pressure (mm Hg)	**Serum calcium**	**Serum magnesium**
140-149	8.9	1.8
150-159	8.3	1.8
>160	8.1	1.6
P value	0.76	0.05

Table 3 shows that in subjects with SBP (140–149 mm Hg), the mean serum calcium and magnesium levels were found to be 8.9 mg/dl and 1.8 mg/dl, respectively. In subjects with SBP (150–159 mm Hg), the mean serum calcium and magnesium levels were 8.3 mg/dl and 1.8 mg/dl, respectively, and with >160 mm Hg, they were 8.1 mg/dl and 1.6 mg/dl, respectively. The systolic blood pressure and serum calcium show a negative correlation. The correlation between systolic blood pressure and serum magnesium shows a strong negative correlation and is significant (P = 0.05).

Table 4: Assessment of serum calcium and magnesium based on diastolic blood pressure

Diastolic blood pressure (mm Hg)	Serum calcium	Serum magnesium
90-99	8.4	1.8
100-109	8.7	1.7
>110	8.0	1.6
P value	0.05	0.02

Table 4 shows that in subjects with DBP (90–99 mm Hg), the mean serum calcium and magnesium levels were found to be 8.4 mg/dl and 1.8 mg/dl, respectively. In subjects with DBP (100–109 mm Hg), the mean serum calcium and magnesium levels were 8.7 mg/dl and 1.7 mg/dl, respectively, and with >110 mm Hg, they were 8.0 mg/dl and 1.6 mg/dl, respectively. The diastolic blood pressure and serum calcium show a negative correlation, which is statistically significant. The correlation between diastolic blood pressure and serum magnesium is statistically significant (P< 0.05).

Discussion

The endothelial dysfunction seen in preeclamptic pregnant women may persist years after the episode, and therefore, preeclamptic women may be at high risk of cardiovascular diseases later in life.[8-10] Though the aetiology of preeclampsia remains unclear, many theories suggest abnormal placental implantation and abnormal trophoblastic invasion as possible causes. The molecular basis of this condition is unresolved in the literature.[11] It has been postulated that fluctuations in maternal serum ions may be the precipitating cause of elevated blood pressure in preeclampsia.[12] Dietary deficiency of mineral ions has been shown to have a harmful effect on the pregnant mother and growing foetus and possibly complicate preeclampsia.[13] Dietary deficiency of magnesium has been established to play a role in blood pressure regulation and hence the development of preeclampsia.[11] Evidence supporting routine magnesium supplementation for all pregnant women has not been substantiated by research, though most studies have reported reduced magnesium levels in pregnancy and worse levels in preeclampsia.[14,15]

The present study was conducted to assess the association between serum calcium and serum magnesium in gestational hypertension and pre-eclampsia.

Lower socioeconomic status may be a risk factor for preeclampsia, according to the socioeconomic pr ofiles, which is consistent with a study by Mostafa HM.[16]

Women with preeclampsia had a significantly higher BMI than the normotensive group when the BM Is of the study participants were analysed, which is consistent with the study's findings by Motedayen M.[17]

We found that the mean serum calcium in group I was 8.20 mg/dl and in group II was 8.96 mg/dl. The mean magnesium level in group I was 1.63 mg/dl in group I and 1.88 mg/dl in group II.

Roy et al.[18] compared the serum levels of calcium, magnesium, and zinc in women with preeclampsia and normotensive pregnant women. The study included primigravida women aged between 18 and 35 years, in their third trimester of pregnancy, with a singleton pregnancy. Sixty preeclampsia patients

and 60 normotensive pregnant women were enrolled, and various biochemical parameters like serum calcium, magnesium, zinc, uric acid, urea, creatinine, Alanine Transaminase (ALT), and Aspartate Transaminase (AST) were analysed. The mean age (in years), gestational age (in weeks), and body mass index (BMI) (kg/m2) of the study subjects and control group were 26.02 ± 4.69 and 23.4 ± 3.81, 34.78 ± 2.41 and 33.51 ± 2.79, and 27.97 ± 3.82 and 26.03 ± 4.26, respectively. The authors observed that the levels of biochemical parameters like serum creatinine, AST, ALT, and uric acid were increased in preeclampsia. Furthermore, the serum concentrations of calcium, magnesium, and zinc were significantly decreased in preeclampsia. We observed that in subjects with SBP 140–149 mm Hg, the mean serum calcium and magnesium levels were found to be 8.9 mg/dl and 1.8 mg/dl, respectively. In subjects with SBP 150–159 mm Hg, the mean serum calcium and magnesium levels were 8.3 mg/dl and 1.8 mg/dl, respectively, and with >160 mm Hg, they were 8.1 mg/dl and 1.6 mg/dl, respectively. The systolic blood pressure and serum calcium show a negative correlation. The correlation between systolic blood pressure and serum magnesium shows a strong negative correlation and is significant (P< 0.05). The serum magnesium and total calcium levels of preeclamptic and healthy pregnant women were compared by Darkwaet al.[19]

In preeclamptic women, the mean serum magnesium and total calcium levels were 0.70±0.15 and 2.13±0.30 mmol/L, respectively. In normal pregnant women, the mean serum magnesium and total calcium levels were 0.76±0.14 and 2.13±0.35 mmol/L, respectively. With p-values of 0.092 and 0.972, respectively, there was a statistically insignificant difference between preeclamptic and normal pregnant women's serum magnesium and total calcium. We found that in subjects with DBP 90–99 mm Hg, the mean serum calcium and magnesium levels were found to be 8.4 mg/dl and 1.8 mg/dl, respectively. In subjects with DBP 100–109 mm Hg, the mean serum calcium and magnesium levels were 8.7 mg/dl and 1.7 mg/dl, respectively, and with >110 mm Hg, they were 8.0 mg/dl and 1.6 mg/dl, respectively. The diastolic blood pressure and serum calcium show a negative correlation, which is statistically significant. The correlation between diastolic blood pressure and serum magnesium is statistically significant (P< 0.05). In the study conducted by Naiket al.[20], sixty individuals aged between eighteen and thirty-five who were singleton pregnant in the third trimester were included. When compared to the control group, they discovered that there was a significant drop in serum magnesium and calcium levels among the patients.

Limitation of the study: The limitation of the study is the small sample size and short duration of the study.

Conclusion

The authors found that it is not plausible for hypocalcaemia or hypomagnesaemia to be modifiable factors in the development of pregnancy-related hypertension.

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