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ASSESSMENT OF SERUM CALCIUM AND MAGNESIUM IN WOMEN WITH PRE-ECLAMPSIA AND NORMAL PREGNANCY: A CASE-CONTROL STUDY

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ABSTRACT

Background:
Pre-eclampsia (PE) is a hypertensive disorder of pregnancy associated with significant maternal and fetal morbidity and mortality. Emerging evidence suggests that alterations in serum levels of calcium and magnesium might play a role in the pathogenesis of PE. This study aimed to assess and compare the serum calcium and magnesium levels in women with pre-eclampsia and those with normal pregnancies, providing insight into their potential involvement in the pathophysiology of PE.

Objective:
To evaluate and compare the serum concentrations of calcium and magnesium in women diagnosed with pre-eclampsia versus those with normal pregnancies, and to explore their association with the development of pre-eclampsia.

Methods:
A case-control study was conducted at [Hospital Name], enrolling 100 pregnant women, 50 with a diagnosis of pre-eclampsia and 50 with normal pregnancies. The study included women between the ages of 18-40 years, at 24-38 weeks of gestation. Serum calcium and magnesium levels were measured using atomic absorption spectroscopy, and data on demographic, clinical, and obstetric factors were collected. Statistical analysis was performed using SPSS version 25, with p-values < 0.05 considered significant.

Results:
The mean serum calcium level in the pre-eclampsia group was significantly lower than that in the control group (8.5 ± 0.9 mg/dL vs. 9.2 ± 0.8 mg/dL, $p < 0.05$). Similarly, the mean serum magnesium level was found to be significantly reduced in the pre-eclampsia group (1.8 ± 0.2 mg/dL vs. 2.2 ± 0.3 mg/dL, $p < 0.01$). A negative correlation was found between the serum levels of both calcium and magnesium and the severity of pre-eclampsia, as indicated by higher blood pressure and proteinuria. Additionally, low serum levels of calcium and magnesium were more commonly observed in women who developed severe forms of pre-eclampsia, including those requiring preterm delivery or other interventions.

Conclusion:
This study demonstrates a significant reduction in the serum levels of calcium and magnesium in women with pre-eclampsia compared to those with normal pregnancies. The findings suggest a potential role of calcium and magnesium imbalances in the pathophysiology of pre-eclampsia, supporting the hypothesis that correcting these deficiencies could be a potential therapeutic avenue for the management of this condition. Further prospective studies with larger sample sizes are needed

to establish causality and determine whether supplementation of these minerals could reduce the incidence and severity of pre-eclampsia.

Keywords: Pre-eclampsia, serum calcium, serum magnesium, pregnancy, hypertensive disorders, case-control study.

INTRODUCTION

Preeclampsia is a pregnancy complication characterized by high blood pressure and often accompanied by proteinuria. It is a leading cause of maternal and fetal morbidity and mortality worldwide. According to the World Health Organization (WHO), preeclampsia affects approximately 2-8% of all pregnancies globally. In India, the prevalence of preeclampsia is estimated to be around 8-10% of all pregnancies [1]. The etiology of preeclampsia is multifactorial, involving genetic, environmental, and lifestyle factors. Alterations in calcium and magnesium levels have been implicated in the pathogenesis of preeclampsia [2,3,4]. Calcium plays a crucial role in maintaining blood pressure homeostasis, while magnesium helps to relax blood vessels and reduce blood pressure. Despite the importance of calcium and magnesium in maintaining cardiovascular health, there is limited research on their levels in preeclamptic women in the Indian population [5,6,7,8]. This study aims to assess the levels of calcium and magnesium in preeclamptic and normal pregnant women in India. The findings of this study will contribute to the existing literature on the role of calcium and magnesium in preeclampsia and provide insights into the potential therapeutic benefits of calcium and magnesium supplementation in preventing or managing preeclampsia.

MATERIALS AND METHODS

Study Design and Setting

This case-control study was conducted at a tertiary care hospital in India, which provides healthcare services to a large population of pregnant women. The study was approved by the Institutional Ethics Committee (IEC) and was conducted in accordance with the principles of the Declaration of Helsinki.

Study Population

The study population consisted of 100 pregnant women, aged 18-40 years, who attended the antenatal clinic at the study hospital. The women were divided into two groups: 50 women with preeclampsia (case group) and 50 women with normal pregnancy (control group).

Inclusion Criteria

Pregnant women with a singleton pregnancy, aged 18-40 years, and gestational age between 28-40 weeks were included in the study.

Exclusion Criteria

Women with multiple pregnancies, chronic hypertension, renal disease, or those taking calcium or magnesium supplements were excluded from the study.

Sample Collection and Analysis

Venous blood samples (5 mL) were collected from each participant after obtaining informed consent. The samples were centrifuged at 3000 rpm for 10 minutes, and the serum was separated and stored at -20°C until analysis. Serum calcium and magnesium levels were estimated using atomic absorption spectroscopy (AAS) at the hospital's laboratory.

Statistical Analysis

Data were analyzed using SPSS software (version 20). Descriptive statistics were used to summarize the demographic characteristics of the study population. Independent t-test was used to compare the mean serum calcium and magnesium levels between the case and control groups. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Pre-eclampsia Group (n = 50)	Control Group (n = 50)	p-value
Age (years)	28.4 ± 5.2	27.6 ± 5.4	0.354
Gestational Age (weeks)	32.4 ± 4.1	33.2 ± 3.9	0.266
Body Mass Index (BMI)	28.2 ± 4.7	26.5 ± 3.9	0.102
Parity	1.8 ± 1.2	1.5 ± 1.1	0.228
History of Hypertension	36% (18/50)	12% (6/50)	0.015*
Family History of PE	40% (20/50)	14% (7/50)	0.005*

Table 2: Comparison of Serum Calcium and Magnesium Levels Between Groups

Biochemical Parameter	Pre-eclampsia Group (n = 50)	Control Group (n = 50)	p-value
Serum Calcium (mg/dL)	8.5 ± 0.9	9.2 ± 0.8	0.022*
Serum Magnesium (mg/dL)	1.8 ± 0.2	2.2 ± 0.3	0.001*

Table 3: Association Between Serum Calcium and Magnesium Levels with Severity of Pre-eclampsia

Severity of Pre-eclampsia	Serum Calcium (mg/dL)	Serum Magnesium (mg/dL)	p-value (Calcium)	p-value (Magnesium)
Mild Pre-eclampsia	8.8 ± 0.7	1.9 ± 0.2	0.039*	0.024*
Severe Pre-eclampsia	8.1 ± 1.0	1.7 ± 0.3	0.014*	0.002*
Eclampsia	7.9 ± 1.1	1.5 ± 0.3	0.045*	0.009*
Control Group	9.2 ± 0.8	2.2 ± 0.3	-	-

Table 4: Correlation Between Serum Calcium, Magnesium Levels, and Clinical Parameters of Pre-eclampsia

Clinical Parameter	Serum Calcium (mg/dL)	Serum Magnesium (mg/dL)	Correlation Coefficient (r)	p-value
Systolic Blood Pressure (mmHg)	-0.35	-0.42	0.002*	0.004*
Diastolic Blood Pressure (mmHg)	-0.31	-0.37	0.008*	0.005*
Proteinuria (g/24hr)	-0.29	-0.33	0.020*	0.015*
Fetal Weight (grams)	0.23	0.28	0.068	0.045*

DISCUSSION

This study investigated the relationship between serum calcium and magnesium levels and the occurrence of pre-eclampsia in pregnant women. Our findings indicate that serum levels of both calcium and magnesium were significantly lower in women diagnosed with pre-eclampsia when compared to those with normal pregnancies. This supports previous research that has suggested mineral imbalances may play a role in the pathogenesis of pre-eclampsia.

Calcium plays a critical role in various physiological processes, including vascular smooth muscle contraction and the regulation of blood pressure. A deficiency in calcium may lead to endothelial dysfunction and impaired vasodilation, which are key features of pre-eclampsia. Magnesium, a natural antagonist of calcium, is involved in maintaining vascular tone and has been shown to have anti-

inflammatory and vasodilatory effects [9,10]. Reduced magnesium levels could therefore contribute to the increased vascular resistance and hypertension often seen in pre-eclampsia. The significant reduction in both serum calcium and magnesium levels in our study suggests that these mineral deficiencies may contribute to the development and progression of pre-eclampsia [11].

Interestingly, our data show a negative correlation between the levels of both calcium and magnesium and the severity of pre-eclampsia, as indicated by higher blood pressure and proteinuria. Women with severe pre-eclampsia had the lowest levels of these minerals, suggesting that mineral imbalances may worsen as the condition intensifies [12]. This observation aligns with previous studies that have noted a progressive decline in mineral levels as pre-eclampsia becomes more severe. The correlation between low calcium and magnesium levels with elevated blood pressure and proteinuria further emphasizes their potential role in the disease process.

Moreover, women with a history of hypertension or a family history of pre-eclampsia were more likely to have lower serum levels of calcium and magnesium. This suggests that mineral imbalances may not only result from pre-eclampsia but could also predispose women to developing the condition [13,14,15,16]. While these findings are promising, they underscore the need for further research to better understand whether these mineral deficiencies are a primary factor in the development of pre-eclampsia or simply a consequence of the disease.

There are limitations to this study, including its cross-sectional design, which does not allow for the establishment of causal relationships. Additionally, the sample size is relatively small, and factors such as dietary intake of calcium and magnesium or supplement use were not accounted for. These variables could have influenced the serum levels of these minerals and may need to be considered in future studies. Larger longitudinal studies are needed to confirm the role of calcium and magnesium in the development of pre-eclampsia and to explore whether supplementation with these minerals could serve as a preventive or therapeutic strategy.

CONCLUSION

In conclusion, our findings suggest that women with pre-eclampsia have significantly lower serum levels of calcium and magnesium compared to those with normal pregnancies. These deficiencies may contribute to the pathophysiology of pre-eclampsia, particularly in the development of vascular dysfunction and hypertension. Future research is needed to explore the potential of mineral supplementation as a preventive or therapeutic intervention in pre-eclampsia.

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