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Serum Calcium Levels in Pre-eclamptic and Normal Pregnancies

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Abstract

Background: Pre-eclampsia presents significant management problems for every obstetrician. While the cause remains unknown, dietary deficiency has been suggested. The study aimed to compare serum calcium levels in pre-eclamptic and normotensive pregnant women.

Methodology: It was a comparative cross-sectional study of pre-eclamptics and normotensive pregnant women. A total of 50 pre-eclamptic and 50 normal pregnant women attending the antenatal clinic were enrolled for the study. Blood samples of the women were collected and analysed for serum calcium. The laboratory estimation of calcium was done using the spectrophotometer method. The mean serum calcium of women in the two groups were compared using the student's t-test. A p-value < 0.05 was considered significant.

Results: The mean age of the pre-eclamptic group was 27.4 $\pm$ 2.7 years. The mean age of the control group was 28.3 $\pm$ 2.9 years. The mean serum calcium level of the pre-eclamptic group was 2.30 $\pm$ 0.14 mmol/l while that of the normotensive control group was 2.34 $\pm$ 0.21 mmol/l. This difference was not statistically significant. (P=0.2652: t=1.1207, df=98,).

Conclusion: There is no significant difference between the mean serum calcium levels between pre-eclamptic women and healthy normotensive controls.

Keywords: Normal Pregnancies; Pre-Eclamptic; Serum Calcium

Introduction

Pre-eclampsia is a leading cause of maternal and perinatal morbidity and mortality, especially in low- and middle-income countries.[1] It is a pregnancy-specific, multisystem disorder characterized by placental malperfusion with release of circulating factors causing maternal vascular endothelial injury, intravascular volume contraction, hypertension and multi-organ damage.[1] It complicates 5-7% of pregnancies.[2]

Despite numerous researches, the aetiology remains unknown. The epidemiology of the disorder, being more common in women of low socioeconomic status, suggests dietary deficiency [3]. The nutrients that have been suggested include calcium, magnesium, sodium, zinc, copper, selenium,

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iron, magnesium and manganese. Serum levels of copper, selenium and magnesium have been found to be lower in pre-eclamptic women.[4]

Calcium is an intracellular bivalent cati on that is vital for regulation of a number of cellular activities. Reduced calcium intake has been associated with the occurrence of pre-eclampsia[5,6]. This has led to the hypothesis that the incidence of pre-eclampsia can be reduced in populations of low calcium intake by calcium supplementation[7]. Calcium is essential in the synthesis of nitric oxide, a potent vasodilator produced by the endothelial cells and believed to contribute to the maintenance of reduced vascular tone in pregnancy [8]. Also there is a strong relationship between extra cellular calcium concentration and vascular endothelial synthesis of prostacyclin (PGI_2) - a potent vasodilator as well as inhibitor of platelet aggregation [9].

Various clinical, biophysical, and biochemical tests have been proposed for screening, prediction and early detection of preeclampsia.[10] A decrease in 24-hour urinary calcium and increase in protein between 20-28 weeks geastation was associated with increased risk of pre-eclampsia.[11] Hence, biochemical tests like calcium estimation have the prospect of being easy, cheap and non-invasive screening tests for identifying patients at risk of the disease who may therefore benefit from early therapeutic interventions such as calcium supplementation for the prevention of this disorder. It is therefore imperative to investigate the possible role of serum calcium in the occurrence of pre-eclampsia in our environment. The study was carried out to compare the mean serum calcium level in pre-eclamptic women with that of normotensive pregnant women.

Methodology

Study Area: The study was carried out in a tertiary hospital in North-Central Nigeria.

Study Population: The study population comprised pregnant women with diagnosis of pre-eclampsia and normotensive pregnant women as controls.

Study Design: It was a comparative cross-sectional study.

Inclusion Criteria: Women with singleton pregnancies with diagnosis of pre-eclampsia and normotensive women with singleton pregnancies were included.

Exclusion Criteria: Women with multiple pregnancy, eclampsia and those on magnesium sulphate and calcium supplements were all excluded from the study.

Ethical Consideration: Ethical approval was obtained from the Research and Ethical Committee of the Hospital.

Sampling Techniques: Consecutive, eligible, consenting pre-eclamptic women were enrolled from among ante-natal clinic attendees by convenient sampling. Each eligible normotensive woman following a pre-eclamptic was enrolled from the same antenatal population as a control. Pre-eclampsia was defined as occurrence of blood pressure of 140/90 mmHg or more taken twice at least four hours apart with proteinuria of 2+ or more after 20 weeks of gestation in a previously normotensive and non-proteinuric woman [12].

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Data Collection: Data was collected using a researcher-administered questionnaire and entered into the proforma. Clinical characteristics obtained included age, gestational age, weight measurement, systolic and diastolic blood pressure measurements. Urine protein estimation was carried out using the dipstick. Two milliliters (ml) of blood sample for calcium estimation was drawn from the cubital vein using syringe and needle but without applying tourniquet. The blood samples were sent to the laboratory for analysis of calcium.

Serum Calcium Estimation: The laboratory estimation of ionized calcium was done by spectro photometry using the Fotress^{R} diagnostic kit. The test principle is the formation of a red-violet complex when calcium ion is combined with o-cresolpthalein – a chromogen. The reagent was prepared by mixing equal volumes of the AMP buffer and o-cresolpthalein. The samples were placed in a calibrated spectrophotometer at an ambient temperature of 20-25^{o}c. The absorbances of the sample and the standard solution were read against that of the reagent blank after 5-50 minutes at a wavelength of 570nm. The concentration of serum calcium was calculated from the formula:

$$\text{Calcium concentration (mmol/l)} = \frac{\text{absorbance of sample solution}}{\text{absorbance of standard}} \times \text{concentration of standard}$$

Statistical Methods: The data was entered and analysed using the E pi info statistical software (CDC, Atlanta, Georgia). The mean and standard deviation of age, parity, gestational age, weight, and serum calcium levels of subjects from both groups were compared using the students t-test. A p-value of <0.05 was considered significant.

Limitations: Dating of pregnancy was by the last normal menstrual period rather than first trimester ultrasound scan. Also, there could be observer variation with the spectrophotometric method of serum calcium estimation.

Results

The results of 50 pre-eclamptic women were compared with those of 50 normotensive controls. The mean age of the pre-eclamptic group was 27.4 $\pm$ 2.7 years. The mean age of the control group was 28.3 $\pm$ 2.9 years. The mean parity of the pre-eclamptic group was 1.3 $\pm$ 0.9. The mean parity of the control group was 1.4 $\pm$ 1.1. The mean gestational age (at recruitment) of the pre-eclamptic group was 33.6 $\pm$ 2.2 weeks. The mean gestational age of the control group was 30.1 $\pm$ 6.8 weeks. The mean weight of the pre-eclamptic group was 73.9 $\pm$ 6.5 Kg. The mean weight of the control group was 69.9 $\pm$ 8.5 Kg. The mean serum calcium level of pre-eclamptic women was 2.30 $\pm$ 0.14 mmol/l while that of the normotensive controls was 2.34 $\pm$ 0.21 mmol/l. This difference was not statistically significant (P=0.2652: t=1.1207, df=98, SED=0.036). See table 1.

Table 1 Serum calcium levels (P=0.2652: t=1.1207, df=98, SED=0.036)

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Group	Pre-eclamptic	Normotensive
Mean	2.3000	2.3400
SD	0.1400	0.2100
SEM	0.0198	0.0297
N	50	50

Discussion

This study was undertaken to compare the mean serum calcium level of pre-eclamptic women with that of normotensive controls. There was no statistically significant difference in the levels of serum calcium between the pre-eclamptic group and the healthy normotensive group, although the pre-eclamptic group had a lower mean serum calcium.

The above finding shows that serum calcium concentration in isolation may not have a significant role to play in the pathophysiology of pre-eclampsia. Other factors may be acting in concert with calcium metabolism. Also, since serum calcium is a function of dietary calcium, it is possible that majority of the subjects in both groups did not have calcium deficiency. Moreover, it was the ionized extracellular calcium that was analysed and what is needed for the cellular functions is the intracellular calcium. It is therefore possible that in pre-eclampsia, there is problem with the transmembrane transport of ionized calcium.

The finding from this study is consistent with that of a case-controlled study in Iran comparing serum calcium levels among 50 pre-eclamptic and 50 normal pregnant women. The study did not show any significant difference in the serum calcium between the two groups. A significant reduction in serum magnesium levels among pre-eclamptics compared to the controls was however demonstrated in that study [13].

The finding from this study is also consistent with those of other studies that showed that there were no significant differences in the serum calcium levels of pre-eclamptic and normotensive controls [14,15,16]. One of the studies demonstrated reduced urinary excretion of calcium in pre-eclamptics compared to normotensive controls [15].

The finding from our study differs from that from a similar one in Benin-City, Nigeria, which showed significantly lower mean serum calcium in pre-eclamptics compared to controls. The study did not show any significant difference in magnesium levels between the two groups [17]. Other studies also demonstrated reduced serum calcium among pre-eclamptics and eclamptics suggestimg that calcium might have a causal role in the development of pre-eclampsia and eclampsia [18,19,20].

The implication of the finding from our study for clinical practice is that dietary calcium supplementation alone may not be beneficial for the prevention of pre-eclampsia. This view is strengthened by the findings from a large, randomized trial of calcium supplementation in populations with low dietary calcium in which the authors noted that calcium supplementation did not significantly reduce incidence of pre-eclampsia although it significantly decreased the

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risk of its serious complications such as maternal and neonatal morbidity and death and preterm delivery[21]. Several other studies have however demonstrated benefits of calcium supplementation [7,22,23,24]. In some of the studies, the benefits were most evident in populations with low dietary calcium [7,22].

In conclusion, there is no significant difference in the serum calcium levels between pre-eclamptic women and healthy normotensive women.

Conflict of Interests: None declared.

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