CHANGES IN SERUM CALCIUM AND SERUM MAGNESIUM LEVEL IN PREECLAMPTIC VS NORMAL PREGNANCY

Pallavi P Chaurasia*1, Pranay A Jadav2, Jasmin H. Jasani3

*1 Resident, Department of Biochemistry, Smt. Bhikhiben K. Shah Medical Institute & Research Center, Piparia, Gujarat.
2 Resident, Department of Community Medicine, Smt. Bhikhiben K. Shah Medical Institute & Research Center, Piparia, Gujarat.
3 Associate Professor, Department of pathology, Smt. Bhikhiben K. Shah Medical Institute & Research Center, Piparia, Gujarat.

E-mail of Corresponding Author: drlucky2008@yahoo.com

Abstract

Objective: To compare serum calcium and magnesium in preeclamptic women and normal pregnant women.

Materials and methods: A cross sectional study was done between August 2010 to April 2011 on 30 normal pregnant women and 30 preeclamptic women in Dhiraj Hospital attended Gynecology and Obstetrics’ department. The blood samples were collected and analyzed for calcium and magnesium by semi-automatic analyzer ERBA CHEM 5 in central laboratory. The data was analyzed using SPSS version 15. The p-value <0.05 was considered to be statistically significant.

Results: The serum calcium and magnesium in preeclamptic women were (8.9±0.4 mg/dl vs. 9.7±0.7 mg/dl, p<0.0001) and (0.75±0.08 mmol/l vs.0.85±0.09 mmol/l, p=0.001) respectively, significantly lower than that in normal pregnant women.

Conclusion: These findings support the hypothesis that hypocalcaemia and hypomagnesaemia are possible etiologies of preeclampsia.

Keywords: Serum calcium, Serum magnesium, Preeclampsia, Normal pregnancy

1. Introduction: -

Preeclampsia is defined as the triad of hypertension, proteinuria and edema occurring after 20 weeks gestation in a previously normotensive woman1. It is specific to human pregnancy and complicate 6 – 8 % of gestation after week 20'. Preeclampsia is still one of the leading causes of maternal and fetal morbidity and mortality2. The pathophysiological mechanism is characterized by a failure of the trophoblastic invasion of the spiral arteries which may be associated with an increased vascular resistance of the uterine artery and a decreased perfusion of the placenta3. Despite active research for many years, the etiology of this disorder remains unknown, although contributory factors include obesity, diabetes, calcium deficiency, older maternal age and job stress4,5,6. Previous clinical studies show contradictory results in levels of serum calcium and magnesium in preeclamptic pregnancies7,8. Therefore, the altered calcium and magnesium metabolism during pregnancy could be one of the potential causes of preeclampsia. On the physiological basis, calcium plays an important role in muscle contraction and regulation of water balance in cells. Modification of plasma calcium concentration leads to the alteration of blood pressure. The lowering of serum calcium and the increase of intracellular calcium can cause an elevation of blood pressure in preeclamptic mothers. The serum magnesium also decreases in women with preeclampsia9. Generally, magnesium has been known as an essential cofactor for many enzyme systems. It also plays an important role in neurochemical transmission and peripheral vasodilatation10.

On the basis of some studies’ claim that blood calcium and magnesium have a relaxant effect on the blood vessels of pregnant women,11 we tried to find out whether there is a correlation between pre-eclampsia and the serum levels of calcium and magnesium in pregnant women. Limited data are available on the role and status of serum levels of magnesium and calcium among pregnant women from the rural community of Vadodara district. The present study was done to measure serum levels of calcium and magnesium in preeclamptic pregnancy and to compare with those in normal pregnancy.
2. Materials and Methods
This cross sectional study was conducted on total 60 women (30 pregnant women with diagnosis of preeclampsia, and 30 normal pregnant women) who were in their third trimester, primi or multigravida, without any history of chronic or transient hypertension, renal disease or cardiovascular disease, thyrotoxicosis, hemophilia, diabetes mellitus and attended the Department of Obstetrics and Gynecology, Dhiraj Hospital, Pipariya from August 2010- April 2011. A written informed consent was obtained from the participants in the study. Study was approved by the Institutional Human Ethics Committee.

Preeclampsia is defined as a blood pressure of at least 140/90 mmHg measured on two occasions each 6 hours apart, accompanied by proteinuria of at least 300 mg per 24 h, or at least 1+ on dipstick testing. Severe pre-eclampsia is defined as having one or more of the following criteria: blood pressure of at least 160 /110 mmHg measured on two occasions each 6 h apart, proteinuria of at least 5 g per 24 h, or at least 3+ on dipstick testing, oliguria of less than 500 ml per 24 h, cerebral or visual disturbances, pulmonary edema or cyanosis, epigastric or right upper quadrant pain, impaired liver function, thrombocytopenia, fetal growth restriction 12.

2.1 Data collection: The venous blood was aspirated from the participant’s antecubital vein, collected in a plain, EDTA and citrate vacuumtainer tube before the initiation of intravenous therapy. Blood samples were allowed to clot at room temperature and then centrifuged at 3,000 rpm for 5 mins and stored at -20°C until analysis. Serum calcium was measured by monovial Accucare kit using arsezeno-111 method and for magnesium using xylidil blue method in semiautoanalyzer ERBAchem.5 spectrophotometer. Normal value of serum magnesium is 0.65-1.11 mmol/l and serum calcium level is 9-11 mg/dl 13.

Midstream random urine sample is collected in sterile container. Urine protein was measured by dipstick and was graded on a scale of 0 to 4+ (0, none; 1+, 30 mg/ dl; 2+, 100 mg/ dl; 3+, 300–1,999 mg/dl; 4+, at least 2,000 mg/dl) 13. Pedal and pretibial edema were assessed by palpation and related on a scale of 0 to 4+ (0, none; 1+, generalized puffiness; 2+, indentation depth up to 1 cm with immediate recovery; 3+, indentation depth 1–1.5 cm with slow recovery; 4+, indentation depth greater than 1.5cm) 14. Body mass index (BMI) was calculated as ratio of weight in kilogram to height in meter square.

Blood pressure was measured by mercury sphygmomanometer on left arm of participants in lying down position and classified according to Joint national committee VII. Korotkoff sound 1 and 5 will be considered as systolic and diastolic blood pressure respectively 15.

2.2 Data analysis: - The data were analyzed with the SPSS software package version 15. Continuous variables were expressed as mean ± SD. The p-value <0.05 was considered to be statistically significance.

3. Results
A total of 60 pregnant women in their third trimester of pregnancy enrolled in the study. The mean of ages and parity of the two groups were not significantly different. In preeclamptic women gestational age was significantly lesser than that of normal pregnant women (p<0.05), while total weight gain, body mass index, systolic and diastolic blood pressure were higher in preeclamptic group with statistical significance (Table 1) than normal pregnancy.

| Table 1: Clinical characteristics of participants (n=60) |
|---------------------------------------------------------|
| Variables | Normal pregnant women (n=30) | Preeclamptic pregnant women (n=30) |
|------------|-------------------------------|-----------------------------------|
| Age (yrs) | 25.0±4.8 | 27.4±4.7 |
| Parity | Primiparous 19 | 16 |
| | Multiparous 11 | 14 |
| Gestational age (wk) | 38.2±2.0* | 37.1±3.0* |
| Total weight gain(kg) | 13.7±5.4* | 16.9±5.7* |
| BMI (KG/M2) | 27.3±3.7* | 30.2±4.3* |
| Blood pressure Systolic (mmHg) | 111.5±7.0* | 156.4±13.1* |
| Diastolic (mmHg) | 71.3±6.0* | 98.3±16.3* |

| Table 2: Serum levels of calcium and magnesium according to participants: |
|-----------------------------------------------|
| Normal pregnancy (n=26) | Preeclampsia (n=26) |
| Serum Calcium (mg/dl) | 9.7±0.7* | 8.9±0.4* |
| S. Magnesium (mmol/l) | 0.85±0.09* | 0.75±0.08* |

Table 1 & 2:-p value: <0.05 * Significant, NS Not significant
4. Discussion
The objective of present study was to compare serum level of calcium and magnesium in normal pregnant and preeclamptic women. We found a decrease in both serum calcium and magnesium in preeclamptic pregnant women as compared to normal pregnant women. These findings confirmed the hypothesis that hypocalcaemia and hypomagnesaemia may be the etiologies of preeclampsia. The mean serum calcium levels in these normal pregnant women (9.7±0.7 mg/dl) were within the range (9.5–11.1 mg/dl) given by previous reports. The serum magnesium concentration in preeclamptic pregnant women was significantly lower than that of normal pregnant women (Table 2). The data supported the hypothesis that calcium might be a cause in the development of preeclampsia.

The effect of serum calcium on changes in blood pressure could be explained by the level of cellular concentration of calcium. The increase of cellular calcium concentration level when serum calcium went lower lead to constriction of smooth muscles in blood vessels and increase of vascular resistance.

Serum magnesium concentration in preeclamptic women was significantly lower than that of normal pregnant women (Table 2). The mean serum magnesium levels in these normal pregnant women (0.85±0.09 mmol/l) was within the range (0.65 –1.11 mmol/l) given by previous reports. The serum magnesium level decreased significantly during pregnancy. Generally, it is associated with hemodilution, altered renal clearance and consumption of minerals by the growing fetus. Magnesium is essential cofactor for enzymes and plays an important role in neurochemical transmission and peripheral vasodilatation.

5. Limitations:
The dietary pattern of both the groups related to consumption of calcium and magnesium in their diet is unavailable.

Conclusion
Our study shows that both serum calcium and serum magnesium in preeclamptic pregnant women were lower than in normal pregnant women. These findings support the hypothesis that hypocalcaemia and hypomagnesaemia are possible etiologies of preeclampsia. However, calcium and magnesium supplement in pregnant women for the prevention of preeclampsia requires further study.

Acknowledgement
The authors are grateful to central laboratory Sumandeep Vidyapeeth for support and make this study successful.

References
1. Redman CWG, Jefferis M. Revised definition of preeclampsia. Lancet 1988; 1:809 – 812.
2. Pridjian G. Puschet JB. Preeclampsia. Part 1 clinical and pathophysiological considerations. Obstet Gynecol Surv 2002; 57: 598 – 618.
3. Phupong V, Dejthevaporn T, Tanawattanachat S, Mano-taya S, Tannirandorn Y, Charoenvithiya D (2003) Predicting the risk of preeclampsia and small for gestational age infants by uterine artery Doppler in low-risk women. Arch Gynecol Obstet 268:158–161
4. Silab B. Prevention of preeclampsia: a big disappointment. Am J Obstet Gynecol 1998;179:1275-1278.
5. Hojo M, August P. Calcium Metabolism in Preeclampsia: Supplementation may help. Medscape Womens Health 1997;2:5.
6. Marcoux S, Berube S, Brisson C, Mondor M. Job strain and pregnancy-induced hypertension. Epidemiology 1999; 10: 376-382.
7. Malas NO, Shurideh ZM (2001) Does serum calcium in pre-eclampsia and normal pregnancy differ? Saudi Med J 22:868–871
8. Kisters K, Barenbrock M, Louwen F, Hausberg M, Rahn KH, Kosch M. Membrane, intracellular, and plasma magnesium and calcium concentrations in preeclampsia. Am J Hypertens 2000; 13: 765-769.
9. Ray J, Vasishta K, Kaur S, Majumdar S, Sawhney H. Calcium metabolism in pre-eclampsia. Int J Gynaecol Obstet 1999; 66: 245-250.
10. Kisters K, Barenbrock M, Louwen F, Hausberg M, Rahn KH, Kosch M. Membrane, intracellular, and plasma magnesium and calcium concentrations in preeclampsia. Am J Hypertens 2000; 13: 765-769.
11. Skjaerven R, Wilcox A, Lie RT. The interval between pregnancies and the risk of preeclampsia. N Engl J Med 2002; 346:33-8.
12. Sukonpan K, Phupong V. Serum calcium and serum magnesium in normal and preeclamptic pregnancy. Arch Gynecol Obstet 2005; 273: 12-16.
13. Chanvitya P, Boomsri K Serum Calcium, Magnesium and Uric Acid in Preeclampsia and Normal Pregnancy J Med Assoc Thai 2008; 91 (7): 968-73
14. ACOG Diagnosis and management of preeclampsia and eclampsia. ACOG practical bulletin. Clinical management guidelines for obstetrician gynecologists Number 33, January 2002. Obstet Gynecol 2002; 99:159–166.
15. Wilkins K, Norman R, Joffers R, McAllister F, Nichol M, Quach S et al. Blood pressure in Canadian adults statistics Canada, catalogue no. 82-003-XPE, Health Reports, march 2010; 211(1): 1-10
16. Kosch M, Hausberg M, Louwen F, Barenbrock M, Rahn KH, Kisters K. Alterations of plasma calcium and intracellular and membrane calcium in erythrocytes of patients with pre-eclampsia. J Hum Hypertens 2000; 14:333–336