



Effect of calcium and magnesium levels in Pregnancy induced Hypertension

Dilutpal Sharma^{1*}, Debapriya Bandyopadhyay²

1*. Associate Professor, Department of Biochemistry, School of Medical Sciences and Research, Greater Noida, U.P.

2. Assistant Professor, Department of Biochemistry, All India Institute of Medical Sciences, Bhubaneswar, Orissa.

*Corresponding Author Email- dilutpal@gmail.com

Abstract

Background – preeclampsia, a systemic illness of late pregnancy seen in approximately 6% of primigravid women and it is an important cause of maternal and fetal morbidity. Changes in intracellular calcium and magnesium concentrations seem to be involved in the pathogenesis of pregnancy induced hypertension or pre eclampsia. So the study was undertaken to find out the role of calcium and magnesium in preeclampsia.

Material and Methods – the study was performed on 200 pregnant women of the age group 20-35 years. All the subjects were categorized under two groups – Control group and Study group. Their serum calcium and magnesium levels were estimated.

Results – Both the serum calcium and magnesium levels were lower in preeclamptic groups as compared to normotensive group.

Conclusion – It can be concluded that a disturbance in calcium and magnesium levels can play a significant role in the pathogenesis of preeclampsia.

Keywords - Calcium, Magnesium, Preeclampsia.

Received on 22-03-14

Accepted on 30-03-14

Introduction

Preeclampsia, a systemic illness of late pregnancy seen in approximately 6% of primigravid women and it is an important cause of maternal and fetal morbidity. A role for altered calcium (Ca) metabolism in the pathogenesis of this disorder as suggested by epidemiologic evidence linking low dietary level of Ca with increased incidence of pregnancy induced hypertension or pre eclampsia¹. Changes in intracellular Ca and Magnesium (Mg) concentrations seem to be involved in the pathogenesis of preeclampsia. On the basis of the therapeutic effects of Mg salts and the known vasodilating properties of Mg, it was suggested that a deficiency in Mg contributed to the development of vasoconstriction in the preeclampsia². Physiologic Mg stores cannot be assessed adequately by measurements of the plasma Mg concentration, as plasma contains <1% of total body Mg. Therefore, the intracellular or membrane Mg concentrations in pre eclampsia are of more interest³. Ca metabolism is altered in preeclampsia and is associated with reduced ionized serum Ca, hypocalciuria and raised parathyroid hormone (PTH)⁴. Lower ionised serum Ca levels may reflect impaired intestinal absorption or reduced bone break down, but the hypocalciuria appears to be independent of PTH, Calcitonin or Ca intake⁵⁻⁷. Furthermore intestinal absorption of Ca in women who develop preeclampsia does not appear to differ from normal pregnant women⁸. The fetoplacental demand for Ca is probably reduced in preeclampsia. This would not be expected to result in reduced maternal Ca levels in blood or urine. The lower maternal ionised serum Ca is presumably responsible for raised PTH levels. Of great interest are Ca and Mg because of their potential importance in etiology and management of preeclampsia. The ionised fractions of these elements are most significant because they represent the bioactive portions. Ionised Ca has been well described in relation to pregnancy^{9,10}.

Therefore the overall objective of the present study was to determine the levels of serum Ca and Mg in normotensive and preeclamptic pregnant women in their third trimester pregnancy.

Material and Methods

The present study was undertaken in the Department of Biochemistry in School of Medical Sciences and Research, Greater Noida, U.P. After obtaining ethical clearance from the institutional ethical committee, the study was performed on 200 pregnant women between age group of 20-35 years. All the subjects were categorized under 2 groups viz, control group (Normotensive pregnant women) and study group (preeclamptic pregnant women).

For the biochemical parameters to be analysed, blood samples were collected after an overnight fast. Plain vials were used for the estimation of Ca & Mg levels in sera by using kit based method on semiauto analyzer.

Statistical analysis – Values are expressed as mean \pm SD. The significant mean differences between the groups were assessed by student t test.

Results

In our study we have found that the mean serum calcium levels were significantly lower in preeclamptic group as compared to normotensive group the percentage decrease in study group is 7.52% (p value < 0.05) (Table 1).

Table 1 – serum calcium levels in normotensive and pre eclamptic group.

| Particulars | Normotensive | Preeclamptic |
|---------------|-----------------------|-----------------------|
| Mean \pm SD | 8.27 \pm 1.46 mg/dl | 7.96 \pm 1.22 mg/dl |
| % decrease | | 3.75% |
| p value | | < 0.05 |

Mean serum magnesium levels were slightly lower in preeclamptic group when compared to normotensive group. Levels were statistically significant, the percentage decrease in preeclamptic group was 3.4% (Table 2).

Table 2 – serum magnesium levels in normotensive and preeclamptic group

| Particulars | Normotensive | Preeclamptic |
|-------------|-------------------|-------------------|
| Mean ± SD | 1.47 ± 0.22 mg/dl | 1.42 ± 0.19 mg/dl |
| % decrease | | 3.4% |
| p value | | <0.05 |

Discussion

Preeclampsia is a frequent complication of pregnancy. Kisters et al 3 in their study found decreased intra erythrocytic Mg in preeclamptic patients as compared to controls, while total magnesium levels did not differ. Our results were also consistent with the findings of Handworker et al¹¹ where the study group has lower serum Mg than control group and in a study by Seydouse et al¹² where mean serum Mg was slightly rise in study group as compared to control. The results of present study also compared to the studies by Frenkel Y et al 6 and Zhao F et al¹³ where mean serum Mg was slightly lower in study group as compared to control group. Hence difference between two groups was statistically insignificant.

Thus, the decreased intra cellular Mg concentrations in preeclampsia may reflect an intra cellular Mg deficiency and possibly a defect in intracellular Mg membrane transport, which could play a role in the pathogenesis of vasoconstriction. However, besides the reported disturbances in calcium concentrations, additional may significantly contribute to the pathogenesis of hypertension in pregnancy¹⁴⁻¹⁸.

During pregnancy, there is a great demand for Ca intake to respond to the higher demands for calcium caused by the process of fetal bone formation. Further more, there is a dilution of cation due to the expanded cellular fluid volume, and to the normal hypercalciuria of pregnancy consequent to increase glomerular filtration. Thus, serum ionized Ca concentrations depend on an adequate Ca intake¹⁹.

It was reported that preeclamptic women present a reduction in extracellular Ca concentration with low levels of the serum ionized Ca and abnormal calcitropic hormones levels²⁰. More over, it was proposed that the beneficial effects of calcium supplementation in the prevention of pregnancy induced hypertension could be related with the maintenance of the plasma ionized calcium levels within the narrow physiologic range²¹. The concentration of extracellular ionized Ca is crucial for the synthesis in the endothelium of vasoactive substances, such as prostacyclin and nitric oxide²².

Conclusion

In the light of above observations, it can be concluded that preeclamptic pregnant women have decreased level of serum Ca & Mg as compared to normotensive pregnant women in their third trimester. Lowered plasma or serum Mg concentrations in pre eclampsia may contribute to the development in hypertension and pregnancy. In addition, a disturbed Ca homeostasis is observed in pre eclampsia. On the basis of our above findings it can be concluded that a disturbance in serum Ca and Mg levels plays a significant role in the pathogenesis of pre eclampsia. This complicated condition of pregnancy occurs not only due to mineral deficiency but also due to an associated effect of physiologically induced oxidative stress. There fore, serum Ca and Mg may be used as an effective marker of PIH or preeclampsia.

References

1. Belizan JM, Villar J. The relationship between Calcium intake and edema, proteinuria, and hypertension-getosis : an hypothesis. *Am J clin Nutr.* 1980; 33(10) : 2202-2210
2. Altura BM, Altura BT, Carella A. Magnesium deficiency- induced spasm of umbilical vessels:relation to preeclampsia, hypertension, growth retardation. *Science.*1983; 221 (4608): 376-378.
3. 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(7) 765-769.
4. Seely EW, Wood RJ, Brown EM, Graves SW. Lower serum ionized Calcium and abnormal calcitrophic hormone levels in pre-eclampsia. *J Clin Endocrinol Metab.* 1992; 74(6):1436-1440.
5. Pedersen EB, Johannesen P, Kristensen S, Rasmussen AB, Emmertsen K, Moller J, et al. Calcium, parathyroid hormone and calcitonin in normal pregnancy and pre-eclampsia. *Gynecol obstet Invest.* 1984; 18(3) : 156-164.
6. Frenkel Y, Barkai G, Mashiach S, Dolev E, Zimlichman R, Weiss M. Hypocalciuria of preeclampsia is independent of parathyroid hormone levels. *Obstet Gynecol.* 1991; 77(5) : 689-691.
7. August P, Marcaccio B, Gertner JM, Druzin ML, Resnick LM, Laragh JH. Abnormal 1, 25 dihydroxyvitamin D metabolism in preeclampsia. *Am J obstet Gynecol.* 1992; 166(4) : 1295-1299.
8. Tolaymat A, Sanchez-Ramos L, Yergey AL, vieira NE, Abrams SA, Edelstein P. Pathophysiology of hypocalciuria in preeclampsia: measurement of intestinal Calcium absorption. *Obstet Gynecol.* 1994; 83(2):239-243.
9. Pitkin RM, Gebhardt MP. Serum Calcium concentrations in human pregnancy. *Am J obstet Gynecol.* 1977; 127(7) : 775-778.
10. Schauburger CW, pitkin RM. Maternal-perinatal Calcium relationships. *Obstet Gynecol.* 1979; 53(1) : 74-76.
11. Handwerker SM, Altura BT, Chi DS, Altura BM. Serum ionized Magnesium levels during intravenous Mg SO₄, therapy of preeclamptic women. *Acta Obstet Gynecol Scand.*1995; 74(7) : 517-519.
12. Seydoux J, Girardin E, Paunier L, Beguin F. Serum and intracellular magnesium during normal pregnancy and in patients with pre-eclampsia. *Br J Obstet Gynaecol.* 1992; 99(3) : 207-11.
13. Zhao F. Ca, Mg, Cu and Zn contents of the maternal and umbilical cord serum in pregnancy induced hypertension: pregnancy induced hypertension. *Zhonghua Fu Chan Ke Za Zhi.* 1989 ;24(4):212-4, 252.
14. White RE, Hartzell HC. Effects of intracellular free Magnesium on Calcium current in isolated cardiac myocytes. *Science.* 1988; 239 (4841 Pt 1) : 778-780.
15. Resnick LM, Gupta RK, Laragh JH. Intracellular free Magnesium in erythrocytes of essential hypertension : relation to blood pressure and serum divalent cations. *Proc Natl Acad Sci USA.* 1984; 81(20) : 6511-6515.
16. Resnick LM, Bardicof O, Altura BT, Alderman MH, Altura BM. Serum ionized magnesium : relation to blood pressure and racial factors. *Am J Hypertens.* 1997; 10 : (12pt1):1420-1424.
17. Schobel HP, Fischer T, Heuszer K, Geiger H, Schmieder RE. Preeclampsia - a state of sympathetic overactivity. *N Engl J Med.* 1996; 335(20) : 1480-1485.
18. Arbogast BW, Leeper SC, Merrick RD, Olive KE, Taylor RN . Which plasma factors bring about disturbance of endothelial function in pre-eclampsia?. *Lancet.* 1994; 343(8893):340-341.

19. Lopez-Jaramillo P, Narvaez M, Weigel RM, Yopez R. Calcium Supplementation reduces the risk of pregnancy-induced hypertension in an Andes population. *Br J Obstet Gynaecol.* 1989; 96(6) : 648-655.
20. Villar J, Belizan JM. Same nutrient, different hypothesis : disparities in trials of Calcium supplementation during pregnancy. *Am J Clin Nutr.* 2000; 71(5suppl) : 1375S-1379S.
21. Seely EW, Wood RJ, Brown EM, Graves SW. Lower serum ionized Calcium and abnormal calciotropic hormone levels in pre-eclampsia. *J Clin Endocrinol Metab.* 1992;74(6):1436-1440.
22. Lopez-Jaramillo P, Guarner F, Moncada S. Effects of Calcium and parathyroid hormone on prostacyclin synthesis by vascular tissue. *Life Sci.* 1987;40(10): 983-986