



Serum calcium and magnesium in preeclampsia and normal pregnancy

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Abstract

Preeclampsia affects 3–5% of pregnancies. Along with preeclampsia, other diseases which are included in the group of hypertensive disorders of pregnancy are eclampsia, gestational hypertension and chronic hypertension. The Normal serum calcium is 9 -11 mg/dl. The Normal serum Magnesium is 1.8 – 2.4 mg/dl.

This study was done in Department of Biochemistry and patients were selected from Department of Obstetrics & Gynaecology in DMCH Darbhanga. Total 50 women had been included in the study, there were divided in two groups as 25 females in Preeclampsia group and 25 females in Control study group. Estimation of Serum Calcium was done by Ortho cresol thale in complex one method. Estimation of Serum Magnesium was done by Calmagite method.

Hence from the above generated data it can be concluded that Preeclampsia is related with hypocalcaemia and hypomagnesaemia. Hypocalcaemia may have a starring role in the etiology of pre eclampsia. Hence calcium supplementation is beneficial in lowering blood pressure and reducing incidence of preeclampsia.

Keywords: preeclampsia, calcium, magnesium levels etc

Introduction

Preeclampsia is one of the hypertensive (high blood pressure) disorders of pregnancy. It is a major cause of maternal and perinatal mortality (number of stillbirths and deaths of newborn in the first week of life) and morbidity. Hypertensive disorders of pregnancy occur in about 10% of all pregnant women around the world. Preeclampsia affects 3–5% of pregnancies. Along with preeclampsia, other diseases which are included in the group of hypertensive disorders of pregnancy are eclampsia, gestational hypertension and chronic hypertension.

In Asia and Africa, nearly one tenth of all maternal deaths are associated with hypertensive disorders of pregnancy. In India, the incidence of preeclampsia is reported to be 8-10% among the pregnant women. According to a study, the prevalence of hypertensive disorders of pregnancy was 7.8% with preeclampsia in 5.4% of the study population in India. Preeclampsia is a pregnancy specific hypertensive disease with multisystem involvement. It is a disorder of widespread vascular endothelial malfunction and vasospasm that occurs after 20 weeks of gestation and can present as late as 4-6 weeks postpartum (after child birth) ^[1].

According to the new guidelines given by American Congress of Obstetricians and Gynaecologists (ACOG) in 2013, the diagnosis of preeclampsia does not require the detection of high levels of protein in the urine (proteinuria) along with hypertension. Evidence shows that changes in kidney and liver can occur without signs of proteinuria, and the amount of protein in the urine does not predict how severely the disease will progress.

Preeclampsia is now to be diagnosed by persistent high blood

pressure that develops during pregnancy or during the postpartum period and is associated with a lot of protein in the urine or the new development of decreased blood platelets, changes in the kidney or liver function, fluid in the lungs, or signs of brain disorder such as seizures and/or visual disturbances.

Preeclampsia is a pregnancy complication characterized by high blood pressure and signs of damage to another organ system, most often the liver and kidneys. Preeclampsia usually begins after 20 weeks of pregnancy in women whose blood pressure had been normal. Even a slight rise in blood pressure may be a sign of preeclampsia.

Risk factors for pre-eclampsia include obesity, prior hypertension, older age, and diabetes mellitus. It is also more frequent in a woman's first pregnancy and if she is carrying twins. The underlying mechanism involves abnormal formation of blood vessels in the placenta amongst other factors ^[2]. Most cases are diagnosed before delivery. Rarely, pre-eclampsia may begin in the period after delivery. While historically both high blood pressure and protein in the urine were required to make the diagnosis, some definitions also include those with hypertension and any associated organ dysfunction. Blood pressure is defined as high when it is greater than 140 mmHg systolic or 90 mmHg diastolic at two separate times, more than four hours apart in a woman after twenty weeks of pregnancy ^[3]. Pre-eclampsia is routinely screened for during prenatal care ^[4].

Recommendations for prevention include: aspirin in those at high risk, calcium supplementation in areas with low intake, and treatment of prior hypertension with medications. In those with pre-eclampsia delivery of the baby and placenta is an

effective treatment. When delivery becomes recommended depends on how severe the pre-eclampsia and how far along in pregnancy a woman is [5]. Blood pressure medication, such as labetalol and methyldopa, may be used to improve the mother's condition before delivery [6]. Magnesium sulfate may be used to prevent eclampsia in those with severe disease. Bedrest and salt intake have not been found to be useful for either treatment or prevention [5].

Preeclampsia sometimes develops without any symptoms. High blood pressure may develop slowly, or it may have a sudden onset. Monitoring your blood pressure is an important part of prenatal care because the first sign of preeclampsia is commonly a rise in blood pressure. Blood pressure that exceeds 140/90 millimeters of mercury (mm Hg) or greater — documented on two occasions, at least four hours apart — is abnormal.

Other signs and symptoms of preeclampsia may include

- Excess protein in your urine (proteinuria) or additional signs of kidney problems
- Severe headaches
- Changes in vision, including temporary loss of vision, blurred vision or light sensitivity
- Upper abdominal pain, usually under your ribs on the right side
- Nausea or vomiting
- Decreased urine output
- Decreased levels of platelets in your blood (thrombocytopenia)
- Impaired liver function
- Shortness of breath, caused by fluid in your lungs

In the current preceding nutritional deficit is attaining prominence in the pathogenesis of preeclampsia. The role of macronutrients like calcium and magnesium in maintaining the normal vasculature is very important in the pregnancy condition. The previous studies also reported the increased frequency of their deficiency during pregnancy. Hence present study was planned to measure the serum calcium and magnesium in preeclamptic patients and compared with normal pregnant women. This will be helpful to know their role in the pathogenesis and prevention of preeclampsia.

Materials & Methodology

This study was conducted in patients admitted in DMCH Darbhanga. Total 50 patients were enrolled into the study. All the patients were informed consent. The aim and the objective of the study are conveyed to all patients.

Following was the inclusion and exclusion criteria of the study.

Inclusion Criteria: All pregnant women are at or beyond 28 weeks of gestation, with singleton pregnancy and in the age group between 25-40 years are included.

Exclusion Criteria: Women with chronic hypertension, renal disease, cardio vascular disease, thyroid disease, liver disease, diabetes mellitus, twin pregnancy and molar pregnancy are excluded. Blood samples were collected with the consent of the patient and centrifuged and analysed immediately for serum calcium and magnesium levels.

Estimation of Serum Calcium was done by Orthocresolphthale

in complex one method. The Normal serum calcium is 9 -11 mg/dl. Estimation of Serum Magnesium was done by Calmagite method. The Normal serum Magnesium is 1.8 – 2.4 mg/dl.

Results & Discussion

The data from total 25 pregnant women's diagnosed with of preeclampsia and 25 pregnant women with normal pregnancy in the third trimester were collected and presented as below. Table 1 indicates age of the patients and number of patients, Blood pressure, Serum Calcium and Magnesium Levels.

Table 1: Age & No. of cases

Age	No. of cases	
	Preeclamptics	Control
25-30 yrs	16	18
31-35 yrs	4	3
36-40 yrs	5	4
Total	25	25
Blood Pressure	Preeclamptics	Control
Mean systolic blood pressure (mm Hg)	142.5 ± 5.3	119.8 ± 6.5
Mean diastolic blood pressure (mm Hg)	97.8 ± 4.6	80.2 ± 3.8
Serum calcium (mg/dL)	7.9 ± 0.5	10.2 ± 0.3
Serum magnesium (mg/dL)	1.7 ± 0.2	2.06 ± 0.1

In our study, we found a significantly lower serum calcium levels among the cases and there was a strong association between hypocalcemia (<9 mg/dl) and preeclampsia. Our findings are consistent with the results of a study conducted by Selina Akhtar *et al* who showed that reduced serum calcium may be one of the risk factor for preeclampsia. Further they showed that serum calcium is strongly and negatively correlating with systolic and diastolic blood pressure in preeclamptic patients [7]. Indumathi V *et al* also confirmed that there was a linear fall in the serum total and ionised calcium in preeclampsia group than compared to normal pregnancy [8].

We also found that there was a significant decrease in serum magnesium levels in preeclamptic group than compared to the controls. This was supported by K Nahar *et al*, who concluded that by estimating serum magnesium during antenatal period, pre-eclampsia can be predicted and eclampsia can be prevented early [9]. According to Sukonpan K *et al*, serum magnesium concentration in preeclamptic women is significantly lower than that in normal pregnant women [10].

The effects of hypocalcemia on vascular smooth muscle cells are further augmented by decreased serum magnesium levels, as they are the "nature's physiologic calcium blocker". Hypomagnesemia opens the L type Ca²⁺ channel and blocks the Ca²⁺ - ATPase present in sarcoplasmic reticulum and leads to increased intracellular calcium [11]. They also cause vasoconstriction by decreasing prostacyclin production and by increasing the vasoconstriction effect of angiotensin II and noradrenaline in the vessel wall.

Magnesium has been known as an essential cofactor for many enzyme systems. It plays an important role in neurochemical transmission and peripheral vasodilatation [12]. There may be a causal relationship since magnesium is involved in blood pressure regulation through an intracellular inhibition of Nitric Oxide Synthase in endothelial cells. The extra cellular

magnesium concentration influences calcium metabolism of vascular smooth muscle cells by changing the calcium influx through the plasma membrane. Consequent to hypomagnesaemia, serum calcium also falls which further aggravates the neuromuscular irritability and convulsions. Magnesium sulfate has been used as the drug of choice in severe pre-eclampsia and eclampsia treatment.

Conclusion

Hence from the above generated data it can be concluded that Preeclampsia is related with hypocalcaemia and hypomagnesaemia. Hypocalcaemia may have a starring role in the etiology of preeclampsia. Hence calcium supplementation is beneficial in lowering blood pressure and reducing incidence of preeclampsia.

References

1. Preeclampsia | National Health Portal of India, <https://nhp.gov.in/disease/gynaecology-and-obstetrics/preeclampsia>.
2. Al-Jameil N, Aziz Khan F, Fareed Khan M, Tabassum H. A brief overview of preeclampsia". *Journal of clinical medicine research*. 2014; 6(1):1-7. doi: 10.4021/jocmr1682w. PMC 3881982 . PMID 24400024.
3. Hypertension in pregnancy. Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy (PDF). *Obstet. Gynecol.* 2013; 122(5):1122-31. doi:10.1097/01.AOG.0000437382.03963.88. PMID 24150027.
4. Steegers Eric AP, von Dadelszen, Peter; Duvekot, Johannes J; Pijnenborg, Robert Pre-eclampsia. *The Lancet*. 2010; 376(9741):631-644. doi: 10.1016/S0140-6736(10)60279-6. PMID 20598363.
5. WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia (PDF). ISBN 978-92-4-154833-5. Archived (PDF) from the original on 2014-2015.
6. Arulkumaran N, Lightstone L. Severe pre-eclampsia and hypertensive crises. *Best Practice & Research Clinical Obstetrics & Gynaecology*. 2013; 27(6):877-884. doi:10.1016/j.bpobgyn.2013.07.003. PMID 23962474.
7. Akhtar S, Begum S, Ferdousi S. Calcium and Zinc Deficiency In Preeclamptic Women, *JBSP*. 2011; 6(2):94-99.
8. Indumati K, Kodliwadmath MV, Sheela MK. The Role of serum Electrolytes in Pregnancy induced hypertension, *Journal of Clinical and Diagnostic Research*. 2011; 5(1):66- 69.
9. Nahar K, Yasmin H, Shamsuzzaman L, Serum Magnesium in Pre-eclampsia and Eclampsia, *Bangladesh journal of obstetrics and gynaecology*. 2010; 25(1):15-19.
10. Sukonpan K, Phupong V. Serum calcium and serum magnesium in normal and preeclamptic pregnancy, *Arch Gynecol Obstet*. 2005; 273(1):6-12.
11. LT Iseri, Magnesium: nature's physiologic calcium blocker, *Am Heart J*. Sayyed AK, Sonttake AN, Electrolyte Status in Preeclampsia, *Online International Interdisciplinary Research Journal*, ISSN2249-9598, Volume-III, Issue-III, May-June 2013 {BiMonthly}.

1984; 108(1):188-93.

12. Punthumapol C, Kittichotpanich B. Serum Calcium, Magnesium and Uric Acid in Pre-eclampsia and Normal Pregnancy. *J Med Assoc Thai*. 2008; 91(7):968-72.