

Brief Research Communication

## Mineral levels in Women with Pre-Eclampsia in Third Trimester of Pregnancy

Shweta Dwivedi<sup>1\*</sup>, Urvashi Singh Berman<sup>2</sup>, Dharmveer Sharma<sup>3</sup>

1. Assistant Professor 3. Associate Professor, Department of Biochemistry 2. Associate Professor, Department of Obstetrics and Gynaecology, Motilal Nehru Medical College, Allahabad, U.P, India.

### Abstract

**Background:** Preeclampsia, a systemic illness of late pregnancy seen in approximately 6% of primigravid women, is an important cause of maternal and fetal morbidity. The levels of calcium and magnesium in pregnancy may implicate in the possible role in pregnancy induced hypertension (PIH). This study assessed serum  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$  and  $\text{K}^+$  levels in women with PIH. **Materials and Methods:** We evaluated serum potassium, sodium, magnesium and calcium levels in 100 normal pregnant women and 100 women with pre-eclampsia. **Result:** We found elevated serum potassium levels and reduced calcium, sodium and magnesium levels in pregnant mothers with preeclampsia. **Conclusion:** Lowered plasma or serum magnesium concentrations in pre-eclampsia may contribute to the development in hypertension in pregnancy. In addition, a disturbed Calcium homeostasis is observed in pre-eclampsia.

**Keywords:** Pre-eclampsia, PIH, calcium, magnesium, sodium, potassium

### Introduction

Pre-eclampsia is a disorder that occurs only during pregnancy and affects both the mother and the fetus. According to the World health Organization, preeclampsia is a major cause of both maternal and fetal neonatal morbidity and mortality.<sup>[1-5]</sup>

The incidence rate of pre-eclampsia stands at 3-10% globally.<sup>[6-8]</sup> Taking into account of the numerous studies conducted, the aetiology of this condition remain unknown. Although factors such as obesity, diabetes, calcium ( $\text{Ca}^{2+}$ ) deficiency advanced maternal age, oxidative stress, placental ischaemia, genetic factors and immune maladaptation have been implicated.<sup>[9-11]</sup> A role for altered calcium metabolism in the pathogenesis of this disorder is suggested by epidemiologic evidence linking

low dietary level of calcium with increased incidence of pre-eclampsia.<sup>[12]</sup> Changes in intracellular calcium and magnesium concentrations seem to be involved in the pathogenesis of preeclampsia. On the basis of the vasodilating therapeutic effects of magnesium salts, it is suggested that a deficiency in magnesium contributes to the development of vasoconstriction in pre-eclampsia.<sup>[13]</sup> Therefore the objective of the study is to determine the of electrolyte imbalance by estimating the levels of serum  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{++}$  and  $\text{Ca}^{2+}$  in pre-eclamptic pregnant women in their third trimester of pregnancy.

### Material and Methods

This study was performed in 200 pregnant women in their third trimester and who were aged between 20-35 years. Hundred women each were categorized into two groups of control and study group. For the biochemical parameters to be analyzed, blood sample were collected after an overnight fast from the antecubital vein avoiding venostasis in all subjects. Plain vials were used for the estimating of serum minerals ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{++}$  and

#### \*Corresponding Author

Dr. Shweta Dwivedi  
Assistant Professor, Department of Biochemistry  
Motilal Nehru Medical College,  
Allahabad, U.P, India.  
E-mail: shwetamishra\_30@rediffmail.com  
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Ca<sup>2+</sup>). Serum sodium, potassium and calcium were measured by electrolyte analyzer. Magnesium was estimated by Neil and Nelly method (expressed as mg/dl). Biochemistry analyzer was used for the measurement of absorbance.

### Statistical analysis

Values are expressed as mean  $\pm$  SD. The significant mean differences between the groups is assessed by student-t test.

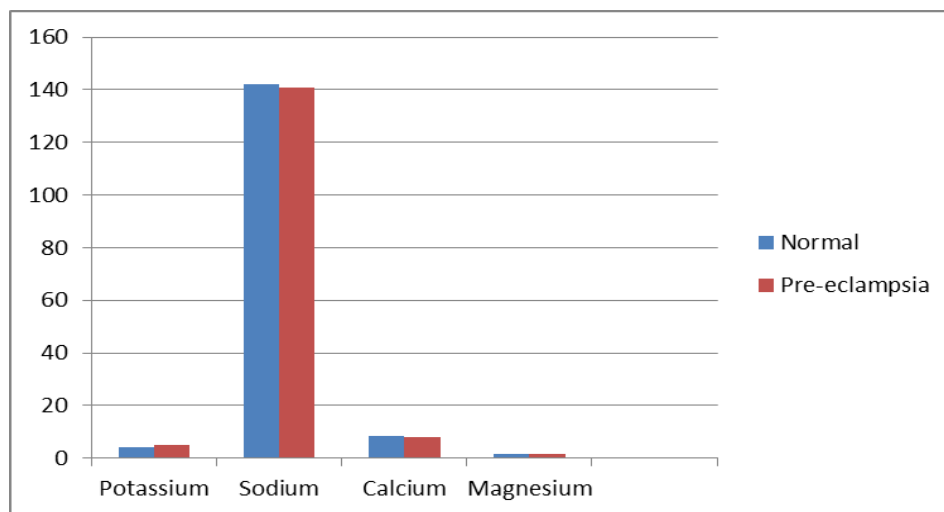
### Results

Table 1 shows that the mean serum K<sup>+</sup> levels were elevated in study group as com-

pared to control group  $4.95 \pm 0.99$  vs  $4.38 \pm 0.80$  mEq/L. Levels were significantly higher in pre-eclamptic group as compared to normotensive ( $p < 0.001$ ). Mean serum Ca<sup>2+</sup> levels were significantly lower in preeclamptic group as compared to normotensive group. The percentage decrease in study group in 7.52% ( $p < 0.05$ ). Mean serum Na<sup>+</sup> levels were almost same in both group. This difference was not statistically significant ( $p < 0.1$ ). Mean serum Mg<sup>2+</sup> levels were slightly lower in pre-eclamptic group when compared to normotensive group levels and were statistically significant ( $p < 0.05$ ). The percentage decrease in pre-eclamptic group was 3.4%.

**Table 1.** Serum electrolyte levels in pregnant women with pre-eclampsia and normotension

Serum electrolyte	Normotensive women (mean $\pm$ SD)	Pre-eclamptic women (mean $\pm$ SD)	Significance
Potassium	4.38 $\pm$ 0.80	4.95 $\pm$ 0.99	( $p < 0.001$ )
Sodium	142 $\pm$ 1.12	141 $\pm$ 1.95	( $p < 0.01$ )
Calcium	8.27 $\pm$ 1.46	7.96 $\pm$ 0.22	( $p < 0.05$ )
Magnesium	1.47 $\pm$ 0.22	1.42 $\pm$ 0.19	( $p < 0.05$ )



**Fig 1.** Electrolyte levels in pregnancy with preeclampsia compared with normal pregnancy

## Discussion

Hypertensive disorders of pregnancy are associated with increased morbidity and mortality, especially during delivery. Our study was conducted to assess the levels of serum  $K^+$ ,  $Na^+$ ,  $Ca^{2+}$  and  $Mg^{2+}$  in pregnant women with preeclampsia compared to that in normal pregnancy.

Serum calcium and magnesium are very important for metabolism at the cellular level and are vital for muscle contraction and cell death and neuronal activity making it very essential in pregnancy.<sup>[14]</sup> The observation of low  $Ca^{2+}$  and  $Mg^{2+}$  levels is in agreement with other studies conducted in hypertensive disorders in pregnancy.<sup>[14-17]</sup> A probable theory to this observation may be that when serum calcium levels decreased, the levels of intracellular calcium increased, leading to constriction of smooth muscles in blood vessels and therefore increased vascular resistance culminating in a raised systolic and diastolic blood pressure.<sup>[18-21]</sup>

The present study showed that serum magnesium level was significantly reduced in mothers with pre-eclampsia compared to healthy control group. The level in pre-eclampsia women was not only significantly low when the diagnosis was confirmed, but also the initial level from early on in the pregnancy was lower than the control group. These findings confirmed that hypomagnesimemia may be one of the etiologies of preeclampsia. A study by Seydoux<sup>[20]</sup> revealed that serum magnesium decrease with progress in pregnancy.<sup>[21]</sup> These results were consistent with earlier study by Handwerker et al, where the study group has lower serum magnesium than control group and in study by Seydoux et al, where mean serum magnesium was slightly rise in study also correspond to the studies by Zhao F and Frankel Y et al, where mean serum magnesium was slightly lower in study group as compared to control group.<sup>[21-24]</sup>

During pregnancy, there is a great demand for calcium intake to respond to the higher demands for calcium caused by the process of fetal bone formation. Furthermore, there is dilution of the cation due to the expand

extracellular fluid volume, and to the normal hypercalciuria of pregnancy consequent to increase glomerular filtration. Thus, serum ionized calcium concentrations depends on an adequate calcium intake.<sup>[25]</sup>

It was reported that preeclamptic women present a reduction in extracellular calcium concentration with low levels of the serum ionized calcium and abnormal calcitropic hormone levels.<sup>[26]</sup> Our study further indicated no change in serum sodium levels in pre-eclamptic as compared to normotensive pregnancies. Serum Potassium levels however showed a highly significant increase in pre-eclamptic pregnant women. These findings are in close conformity with the findings of Agyei-Frampong et al who demonstrated that there was only slight correlation between the plasma sodium levels and diastolic blood pressure with no significant difference between normotensive and pre-eclamptic subjects.<sup>[27]</sup> Serum potassium levels however, showed a highly significant increase in pre-eclamptic women. These results were consistent with earlier study by Handwerker et al where the study group had significantly higher levels of serum potassium than control group.<sup>[28]</sup> Normal pregnancy has been associated with a decrease in mean serum potassium possibly related to a physiologic increase in  $Na^+$ /  $K^+$  adenosine triphosphatase activity in the cell membranes, causing a shift of  $K^+$  into cells with extrusion of  $Na^+$ . Thus our findings of higher extracellular  $K^+$  levels in toxemia may be of interest.

## Conclusion

In the light of the above observations it can be concluded that pre-eclamptic pregnant women have higher levels of serum potassium, decreased level of serum calcium and magnesium and no significant difference in sodium levels as compared to normotensive pregnant women in their pregnancy during third trimester. Lowered plasma or serum magnesium concentrations in pre-eclampsia may contribute to the development in hypertension in pregnancy. In addition, a disturbed calcium homeostasis is observed in pre-eclampsia. In pre-eclamptic pregnant women undergoing magnesium sulfate therapy, before magnesium

therapy, ionized calcium levels were lower in pre-eclamptic women than in normotensive pregnancy. In the presence of elevated magnesium levels ionized calcium appears to be tightly regulated. On the basis of above findings it can be concluded that a disturbance in electrolyte imbalance plays a significant role in the pathogenesis of preeclampsia. This complicated condition of pregnancy occurs not only due to mineral deficiency but also due to an associated effect of physiologically induced oxidative stress. Therefore, serum mineral levels of sodium, potassium, calcium and magnesium may not only be used as effective markers of PIH or preeclampsia but their imbalance may be regarded as a status of oxidative stress as well.

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