A COMPARATIVE STUDY OF SERUM CALCIUM, MAGNESIUM AND URIC ACID LEVEL IN NORMAL PREGNANT AND PRE-ECLAMPTIC WOMEN - OUR EXPERIENCE

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ABSTRACT

BACKGROUND
Pre-eclampsia is one of the major causes of maternal and foetal morbidity and mortality. Though the aetiology is obscure, recent studies indicate that serum level of calcium, magnesium and uric acid play a role in pre-eclampsia.

OBJECTIVE OF THE STUDY
This study had been undertaken to differentiate the biochemical basis of pre-eclampsia from normal pregnancy.

MATERIALS AND METHODS
60 cases were taken into study. 20 were healthy pregnant women with 28 weeks of gestation with normal blood pressure. 20 cases of pre-eclamptic women with blood pressure >140/90 mmHg with proteinuria, 20 cases of severe pre-eclamptic pregnant women with blood pressure >160/110 mmHg with proteinuria were included in the study. The blood samples were analysed for calcium, magnesium and uric acid. The data was analysed by ANOVA through SPSS version 17.

RESULTS
Serum calcium was decreased significantly in mild-to-severe pre-eclamptic pregnant women compared to normal pregnant women. There was significant increase in uric acid level in mild-to-severe pre-eclamptic gestation compared to normal gestation. The change in magnesium level was not statistically significant in all the subjects.

CONCLUSIONS
Hypocalcaemia and hyperuricemia was observed in mild-to-severe pre-eclampsia. Not many studies have been done on these parameters in India so far.

KEYWORDS
Pre-eclampsia, Normal Pregnancy, Serum Calcium, Serum Magnesium, Serum Uric Acid.


INTRODUCTION
Pre-eclampsia is transient but potentially dangerous complication of pregnancy that affects 3-5% of all pregnancies.1 It is an idiopathic multisystem disorder specific to pregnancy and the puerperium. It is one of the most common causes of maternal and foetal mortality and morbidity.2

Pre-eclampsia is defined as a triad of hypertension, proteinuria and oedema occurring after 20 weeks of gestation in previously normotensive women. It is characterised by abnormal vascular response to placentation that is associated with increased systemic vascular resistance, enhanced platelet aggregation, activation of coagulation system and endothelial cell dysfunction.3

It most commonly occurs during the last trimester of pregnancy and may also arise in the 2nd trimester (14-20 weeks). It is twice as common in primigravidae as in women having second/later pregnancies.4 Changes in vision, headache and sudden weight gain are important symptoms. Clinically, pre-eclampsia present with elevated blood pressure >140/90 mmHg, proteinuria and oedema. Sometimes, it is associated with oliguria, eclampsia, visual disturbances, elevated liver enzymes and restricted foetal growth.5 Early detection and appropriate treatment may reduce the complications of pre-eclampsia. But the pathophysiological mechanism of pre-eclampsia is not clearly understood still. Environmental factors and nutritional supplementation may play a role in causation of pre-eclampsia. Proper nutritional supplementation is important for the maintenance of mother’s health and growth of the foetus during pregnancy. Pregnant women in developing countries are undernourished due to various reasons leading to deficiency of minerals and vitamins.6 Micronutrients like calcium and magnesium are important for many biochemical mechanisms. Calcium plays a role in muscle contraction and water balance in cells. Alterations in calcium level leads to change in blood pressure i.e. decreased serum calcium and increased intracellular...
calcium levels leads to increased blood pressure in pre-eclamptic women. Magnesium is a cofactor to many enzyme systems in the body. It plays a role in neurochemical transmission and peripheral vasodilatation. Magnesium sulphate is the drug of choice in controlling the seizures in pre-eclampsia. Hyperuricaemia is observed in pre-eclampsia as a result of abnormal renal function, decreased renal excretion and increased production secondary to tissue ischaemia and oxidative stress. It also induces endothelial dysfunction which may induce hypertension and vascular damage. The changes in calcium, magnesium and uric acid metabolism during pregnancy may be one of the causes of pre-eclampsia. The aim of the present study was to measure serum concentrations of calcium, magnesium and uric acid in mild and severe pre-eclamptic gestation subjects in comparison with normal pregnant women.

**MATERIALS AND METHODS**

The present study was carried out in the Department of Biochemistry in collaboration with the Department of Obstetrics and Gynaecology at Prathima Institute of Medical Sciences situated in Nagunur village of Karimnagar district of Telangana state. Institutional Ethics Committee approval was obtained prior to the study. The study population consisted a total of 90 participants and divided into 3 groups. Group-I consisted of 30 normal pregnant women with normal blood pressure, Group-II consisted of 30 pregnant women with the diagnosis of mild pre-eclampsia and Group-III consisted of 30 pregnant women with severe pre-eclampsia. All participants were ≥28 weeks of gestation. Mild pre-eclampsia is defined as a blood pressure of 140/90 mmHg measured on 2 occasions each 6 hours apart with mild proteinuria of at least 300 mg/24 hours or at least 1+ on dipstick testing. Severe pre-eclampsia is defined as having one or more of the following criteria: blood pressure at least 160/110 mmHg measured on 2 occasions each 6 hours apart with severe proteinuria of at least 5 g/24 hours or at least 3+ on dipstick testing, oliguria of less than 500 mL/24 hours, cerebral and visual disturbances, impaired liver function, thrombocytopenia, pulmonary oedema or cyanosis, epigastric or right upper quadrant pain and foetal growth restriction. Foetal growth restriction is defined as the condition in which the newborn has a birth weight lesser than 10% for gestational age. Patients with history of renal disease, liver disease, CVS diseases, thyrotoxicosis, haemophilia, diabetes mellitus, chronic or transient hypertension were excluded from this study.

Maternal venous samples were obtained after admission from antecubital vein before the start of treatment. The venous blood was collected in sterile plain vacutainer. Urine protein, oedema and deep tendon reflexes were assessed at the time of blood sample collection. Urine protein was measured by dipstick and was graded on a scale of 0 to 4+ (0 = none; 1+ is 30 mg/dL, 2+ is 100 mg/dL, 3+ is 300-1999 mg/dL, 4+ is at least 2000 mg/dL). Deep tendon reflexes were assessed by striking patellar tendon and grading the response on a scale of 1+ to 4+ (1+, slight movement of the foot; 2+, mild leg withdrawal; 3+, marked leg and foot movement; 4+, abrupt leg jerk and extension).

The venous blood sample was collected in plain tube and was allowed to clot for 30 minutes and centrifuged at 3000 RPM for 10 minutes to obtain clear serum and calcium, magnesium and uric acid levels were analysed by Erba chem 7 semi-autoanalyser. Serum calcium was estimated by Arsenazo III method, uric acid by enzymatic photometric method and magnesium by Xylidyl blue method.

Statistical analysis: The numerical data was presented as Mean±SD. ANOVA was applied to analyse the significance in more than two groups’ means and ‘p’-value was elicited. A ‘p’-value of <0.05 was considered as statistically significant. This analysis performed through SPSS version 17.

**RESULTS**

The study included 90 subjects, Group-I= 30 normal healthy pregnant women, Group-II=30 pregnant women with mild pre-eclampsia and Group-III=30 pregnant women with severe pre-eclampsia. The demographic details of the participants were presented in Table-I: The age of the participants of all the three groups were not significantly different. The mean gestational age in normal pregnant women was more than both mild and severe pre-eclamptic pregnant women.

Table-II showed the comparison between the biochemical parameters between all the three groups. The mean±SD of serum calcium in group-I was 9.25±0.37, in group-II was 8.31±0.13 and in group-III was 7.81±0.37. There was significant decrease in serum calcium level in group-II and group-III compared with group-I with ‘p’-value of <0.001.

The mean±SD of serum uric acid level in group-I was 4.91±0.92, group-II was 6.49±0.48 and group-III was 7.93±0.53 respectively. The patients with severe pre-eclampsia showed hyperuricemia with ‘p’-value of <0.001 compared with that of normal pregnant women and pregnant women with mild pre-eclampsia.

The serum magnesium in severe pre-eclampsia was decreased when compared with normal pregnant women and mild pre-eclamptic women with ‘p’-value of <0.001.

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<tr>
<td>Serum calcium (mg/dL)</td>
<td>9.25±0.37</td>
<td>8.31±0.13</td>
<td>7.81±0.37</td>
<td>&lt;0.0001</td>
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<td>Serum magnesium (mg/dL)</td>
<td>2.22±0.13</td>
<td>2.19±0.12</td>
<td>2.08±0.33</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
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<tr>
<td>Serum uric acid (mg/dL)</td>
<td>4.19±0.92</td>
<td>6.49±0.48</td>
<td>7.93±0.53</td>
<td>&lt;0.0001</td>
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**Table II: Comparison of Biochemical Parameters for the Three Groups of Participants**

**Table I: Comparison of Some Clinical Parameters for the Three Groups of Participants**

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<tr>
<td>Age in Years</td>
<td>22.6±4.82</td>
<td>25.5±5.24</td>
<td>23.6±4.58</td>
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<tr>
<td>Gestational age in weeks</td>
<td>36.3±1.86</td>
<td>34.5±1.68</td>
<td>34.6±1.64</td>
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DISCUSSION

The serum calcium level did not change throughout pregnancy in some of the previous studies. But Malas et al showed decreased serum calcium level in pre-eclamptic women compared with normal pregnant women. In the present study, we also observed hypocalcaemia in severe pre-eclamptic women compared with normal pregnant women and mild pre-eclamptic women. Our data support the hypothesis that calcium level might be a cause in the development of pre-eclampsia. Decreased serum calcium level in turn increases intracellular calcium level which led to constriction in the smooth muscle of blood vessels and increased vascular resistance culminating in increase in systolic and diastolic blood pressure.

The mean serum magnesium levels in severe pre-eclamptic women decreased when compared with mild pre-eclamptic women and normal pregnancy in the present study. This result was in collaboration with few workers where decreased serum magnesium levels were observed in pre-eclamptic women compared to normal pregnant women. Decreased magnesium in pregnant women is associated with renal clearance during pregnancy, haemodilution and consumption of magnesium by growing foetus. Few studies showed increased serum magnesium levels in pre-eclampsia. This difference may be due to dietary intake and variations of the studied population.

In normal pregnancy, serum uric acid concentration was decreased as a result of pregnancy induced expansion of blood volume, increased renal blood flow and glomerular filtration rate and uricosuric action of oestrogen by mid pregnancy, then slowly increases and reaches to normal level by term. Increased serum uric acid level in pre-eclampsia was due to reduction in renal excretion of urate which is probably mediated by the systemic vasoconstriction, reduction in renal blood flow and decreased glomerular filtration rate that accompany this disease. There is also evidence for increased generation of uric acid from the ischaemic placenta. Thus, many authors had suggested that the increased serum uric acid is an excellent marker for tissue ischaemia, endothelial dysfunction and oxidative stress. Our study was also in favour of the above workers.

CONCLUSIONS

The present study showed that serum calcium and serum magnesium in severe pre-eclamptic women were lower and serum uric acid was higher compared with that from normal pregnant women and mild pre-eclamptic women. Thus, hypocalcaemia, hypomagnesaemia and hyperuricaemia was observed in severe pre-eclampsia.

REFERENCES