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Original Research Article

Study of Serum Calcium, Uric Acid, Magnesium and Adenosine Deaminase Activity and Their Correlation in Toxemia of Pregnancy

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Abstract: The objective is to compare serum calcium, magnesium, uric acid and ADA levels in pre eclamptic, eclamptic women and normal pregnant women. A Prospective Observational Study was conducted in 35 normal pregnant women, 25 preeclamptic Women & 10 eclamptic women who were admitted in the Department of OBG at Gandhi Hospital, Secunderabad. The blood samples were collected and analyzed for Ca, Mg, uric acid and ADA . In our study, it can be concluded that preeclamptic and eclamptic pregnant women have decreased levels of serum Ca & Mg and increased levels of serum uric acid and adenosine deaminase as compared to control group as normal pregnant women.
Keywords: Toxemia, Pregnancy, calcium, magnesium, uric acid, ADA

INTRODUCTION:

Toxaemia of pregnancy is a common complication of pregnancy. Preeclampsia and eclampsia are the two major categories of toxaemias of pregnancy. Preeclampsia is characterized by hypertension, edema and proteinuria. Eclampsia is characterized by convulsions in addition to hypertension, edema and proteinuria [1].

Preeclampsia is a common medical complication of pregnancy affecting 5% to 10% of all pregnancies. It is best described as a pregnancy specific syndrome of reduced organ perfusion secondary to vasospasm and endothelial activation, characterized by hypertension and proteinuria that may lead to multi system involvement including renal, hematological, hepatic and cerebral impairment. It usually occurs after 20 weeks of gestation, most often near term, and can be superimposed on another hypertensive disorder [1, 2].

Pathophysiology:
1. Changes in intracellular Calcium and Magnesium (Mg) concentrations seem to be involved in the pathogenesis of preeclampsia [3].
2. The association between raised serum UA and preeclampsia pregnancies was first reported almost a century ago. Reduced UA clearance secondary to reduced glomerular filtration rate, increased reabsorption, and decreased secretion may be at the origin of elevated serum levels in women with preeclampsia [4].
3. There is a correlation between ADA activity and T-cell cytokine production in preeclampsia. Several studies have shown that serum ADA activity is significantly increased in women with recurrent spontaneous abortions, preeclampsia, and hyperemesis gravidarum where enhanced cell-mediated immunity is thought to be an important pathogenesis. Pathogenesis of preeclampsia depicted in Figure 1

On the contrary, in pregnancies complicated by preeclampsia which is characterized by enhanced cell-mediated immunity, ADA activities of both the maternal serum and fetal cord blood were increased. An increase in ADA activity in preeclampsia may indirectly contribute to the maintenance of immune response in preeclampsia by controlling adenosine levels[5].

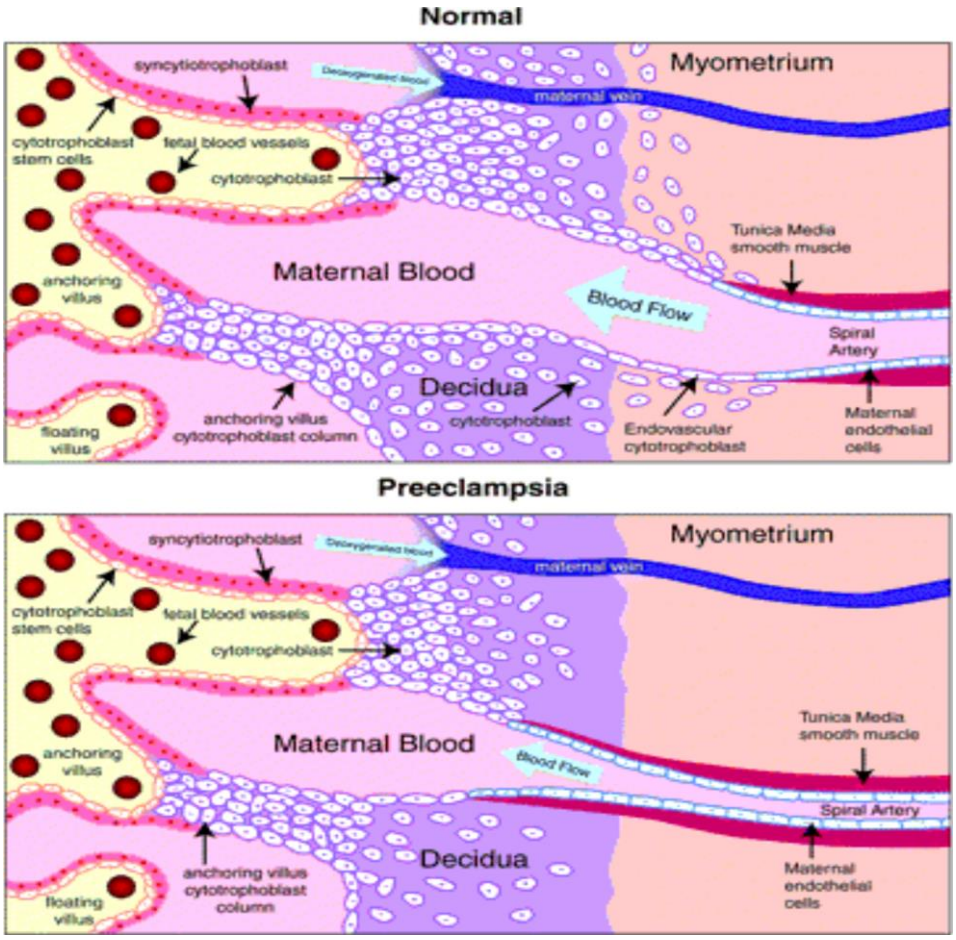

Fig 1: In normal placental development, invasive cytotrophoblasts of fetal origin invade the maternal spiral arteries, transforming them from small caliber resistance vessels to high caliber capacitance vessels capable of providing placental perfusion adequate to sustain the growing fetus. In preeclampsia, cytotrophoblasts fail to adopt an invasive endothelial phenotype. Instead, invasion of the spiral arteries is shallow, and they remain small-caliber resistance vessels

AIM OF OUR STUDY:

To establish the relationship of Serum levels of Calcium, Magnesium, Uric acid and ADA in diagnosing hypertensive disorders of pregnancy.

MATERIALS AND METHODS:

The present study has been done in the Department of Biochemistry in Gandhi Medical College, Secunderabad. The study was performed on 70 pregnant women between age group of 18-35 years during the period from 2013- 2014. All the subjects were categorized under 3 groups viz, control group (Normotensive pregnant women) and study groups (preeclampsia and eclampsia patients).

Inclusion criteria: Age >18 yrs, Single term pregnancy beyond 28th weeks,

Systolic B.P.>140 mmHg, Diastolic >90 mmHg

Exclusion criteria: Known heart disease, Nephropathy, Hypertension preceding pregnancy

Methods for estimation of these parameters by

1. **Serum Calcium**: O. Cresol phthalein complexion method by Agapee- Mispa excels chemistry analyzer (Figure No.3).

2. **Serum Uric acid**: Uricax-POD method by Transasia ERBA MANIHAM XL 640 autoanalyser (Figure No.2).

3. **Serum Magnesium:** Calmagite method by Agapee-Mispa excels chemistry semi auto analyzer (Figure No. 3).

4. **Serum Adenosine Deaminase**: Galante &Giusti method by Agapee- Mispa excel chemistry semi auto analyser (Figure No. 3).

Fig 2: Auto analyser: Trasasia Erba Mannheim XL-640

Fig-3: Semi auto analyser: Agapee Mispa Excel Chemistry

RESULTS:

The results obtained in this study were from a total number of 70 patients were divided into 3 groups, 35 cases controls (normal pregnant), 35 cases - 25 cases of preeclampsia and 10 cases of eclampsia..

Table 1: Comparison of mean age in different groups

	Mean	S.D
Control	22.6	± 2.9
Preeclampsia	26.8	±2.7
Eclampsia	27.9	±2.6

It is evident from the table 1, the mean age was increased in preeclampsia and eclampsia group compared to control group. The increase is highly significant statistically. ($p < 0.001$), no significant difference between the preeclampsia and eclampsia, p value is 0.34.

Table 2: Comparison of mean SBP in different groups

	Mean	S.D
Control	110.2	± 9.5
Preeclampsia	144.0	±7.6
Eclampsia	146.0	± 9.0

It is evident from the table 2, that mean SBP was increased in preeclampsia and eclampsia cases compared to control the increase is highly significant statistically. ($p < 0.001$). From the table the mean SBP was slightly increased in eclampsia cases compared to preeclampsia but it is not significant statistically. (p value o.54) .

Table 3 : Comparison of mean DBP in different groups

	Mean	S.D
Control	68.2	± 7.8
Preeclampsia	94.4	± 7.1
Eclampsia	100.0	± 8.1

It is evident from the table 3 that mean DBP was increased in preeclampsia and eclampsia cases compared to controls the increase is highly significant statistically. ($p < 0.001$), no significant difference between the cases, p value is 0.548.

Table 4: Comparison of mean values of calcium in different groups

	Mean	S.D
Control	9.0	± 0.21
Preeclampsia	8.36	±0.53
Eclampsia	7.06	± 0.53

It is evident from the table 4, that levels of mean serum calcium was decrease in preeclamsia compared to controls and further decreased in eclampsia cases compared to preeclampsia. The decrease is highly significant statistically, p value is 0.001.

Table 5 : Comparison of mean values of magnesium in different groups

	Mean	S.D
Control	1.934	± 0.160
Preeclampsia	1.835	±0.100
Eclampia	1.707	±0.815

It is evident from the table 5 , that levels of mean serum mg was decrease in preeclampsia compared to controls, and further magnesium level was decrease in eclampsia cases compared to preeclampsia cases. The decrease is highly significant statistically. ($p < 0.001$).

Table 6: Comparison of mean values of serum uric acid in different groups

	Mean	S.D
Control	4.642	±0.469
Preeclampsia	5.752	± 0.376
Eclampsia	6.410	±0.334

It is evident from the table 6 that levels of mean serum uric acid was increased in preeclampsia

compared to controls and further more increased in eclampsia cases compared to preeclampsia cases. The increase is highly significant statistically. ($p< 0.001$) .

Table 7: Comparison of mean values of serum ADA levels in different groups

	Mean	S.D
Control	18.885	±3.428
Preeclampsia	27.920	±5.187
Eclampsia	33.500	± 4.377

It is evident from the table 7 that levels of mean serum ADA was increased in preeclampsia and eclampsia groups compared to controls. The mean value of serum ADA was increased in eclampsia cases compared to preeclampsia cases. The increased levels was highly significant statistically. ($p < 0.001$).

STATISTICAL ANALYSIS:

The data was analyzed with the SPSS software package version 15.0 and expressed in terms of mean, standard deviation (SD). Continuous variables of serum calcium, magnesium, uric acid adenosine deaminase concentrations of the three groups were compared by F-test from Analysis of Variances (ANOVA). Then Scheffe was used for post hoc comparisons if F-test had statistical significance. A p-value < 0.05 was considered to be statistically significant.

DISCUSSION

The present study was designed to assess the association of different biochemical parameters like calcium, magnesium, uric acid and adenosine deaminase in PIH.

In this study 3 groups were selected, these are Group 1- control (normal pregnant), Group 2 – preeclampsia, and Group 3 – eclampsia.

In our study (Table 4) -a significant decrease in serum calcium levels was seen in the preeclampsia cases as compared to the controls, with a further highly significant decrease in the eclampsia cases as compared to the preeclampsia cases.

Chanvitya Punthumapol *et al.;* in 2008 [13] found significant hypocalcemia in both mild and severe forms of preeclampsia when compared to normal pregnancy. Seely EW *et al.;* [14] confirmed that preeclamptic women had lower serum ionized calcium levels than normotensive, third trimester, pregnant women (1.20 +/- 0.01vs. 1.26 +/- 0.01 mmol/L, P less than 0.02).

Some researchers [15] have also shown an increased, intracellular, ionized calcium concentration and an increased sensitivity of these cells to angiotensin II in women with preeclampsia. Talat J. Hassan *et al.;* [16] Serum calcium, urea and uric acid levels were determined in 100 normal pregnant women and 50 patients with preeclampsia. Serum calcium levels were significantly lower and urea and uric acid levels higher in preeclampsia. Low levels of calcium were found as early as 28 weeks and can therefore be used for early diagnosis of preeclampsia.

Magna Manjareeka *et al.;* [17] Serum calcium level in the preeclamptic group was significantly lower (-22.6%) than the normal pregnant group. It was further observed that hypertensive women in the later part of the third trimester (34 –40w) showed further decline in serum calcium level (-24.2 %), with a mean value of 7.221 mg / dL, when compared to women in the early third trimester (28 -33w) who had a mean serum calcium level of 7.595mg / dL (-20.2 %); the additional decrease was statistically significant with a p value of < 0.05. In our study (Table 5), there was a significant decrease in the serum magnesium levels in the preeclampsia cases as compared to those in the controls and this significantly decreased further in eclampsia.

Condradt [19] demonstrated that a probable correlation of the level of serum magnesium plays an important role in the etiology of preeclampsia and reduced levels of serum magnesium may be because of excessive excretion of magnesium in urine in such patients.

Standley *et al.;* [18] studied the magnesium levels at different gestational ages. They found that magnesium decreases in both preclamptic and uncomplicated pregnancies, but that the magnesium concentration was lowered earlier in women with preeclampsia. This difference has been proposed as a marker of severity of the condition.

In our study (Table 6) - a significant increase in serum uric acid levels was seen in the preeclampsia cases as compared to the controls, with a further highly significant increase in the eclampsia cases as compared to the preeclampsia cases.

H. Pasoaglu *et al.;* [20] studied Nitric acid (NO) and Uric Acid (UA) levels along with lipid peroxides in 40 preeclamptic women and 25 eclamptic women and noted significant in all three parameters indicating them to be directly related to the severity of disease and thus may have diagnostic significance.

S.V. Kashinakunti *et al.;* [21] studied Lipid Peroxidation and Antioxidant Status in Preeclampsia taken case control study consisting of 30 preeclamptic and 30 healthy pregnant women where he found Uric Acid level in serum increased significantly($p<0.001$).

Chanvitya Punthumapol *et al.;* [13] showed

that serum calcium in severe preeclamptic women was lower and serum uric acid was higher than normal pregnant women and mild preeclamptic women respectively but there was no difference between normal pregnant women and mild preeclamptic women.

In our study (Table 7) - levels of mean serum ADA was increased in preeclampsia and eclampsia groups compared to controls. The mean value of serum ADA was increased in eclampsia cases compared to preeclampsia cases .The increased levels was highly significant statistically. ($P < 0.001$).

Yoneyama *et al.;* [9] have measured serum activities of total ADA, ADA1, and ADA2 in normal pregnant women in the third trimester and age-matched healthy non pregnant women. In normal pregnant women, serum total ADA and ADA2 activities were lower than those of the non pregnant women, while there was no difference in ADA1 activity.

These results suggest that reduced serum total ADA activity reflects decreased ADA2 activity, which may be in part associated with depressed cell-mediated immunity during normal pregnancy [23]. One possible explanation for decreased ADA activity in normal pregnancy is due to the increase in pregnancy-related hormones such as estradiol and cortisol which tends to inhibit ADA activity [22]. In our study, we observed a significant increase in plasma ADA activity in pregnant women with preeclampsia and eclampsia. Similar to that described by Yoneyama *et al.;* [24].

CONCLUSION AND SUMMARY

To establish the correlation between severities of toxaemias of pregnancy, a study was taken in the following parameters. Levels of serum calcium, serum magnesium, serum uric acid and serum adenosine deaminase were studied in toxaemias of pregnancy with normal pregnant women as control group. In the present study, it can be concluded that preeclamptic and eclamptic pregnant women have decreased levels of serum Ca & Mg and increased levels of serum uricacid and adenosine deaminase as compared to control group as normal pregnant women.

On the basis of our above findings it can be concluded that a disturbance in serum Ca, Mg, Uric acid and Adenosine deaminase levels plays a significant role in the pathogenesis of preeclampsia. There is further future research scope to find out a single parameter which can quantitatively, predict toxaemia and useful in prognosticating the patients so that early decision is taken to decrease the morbidity & mortality of both mother and infant.

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