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Article

To Assess the Association of Maternal Serum Uric Acid and C- Reactive Protein with Severity of Pre-Eclampsia In A Tertiary Care Hospital, Rajasthan, India

Article History:

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Abstract: ***Background***: Pre-eclampsia is a significant contributor to maternal and perinatal morbidity and mortality, particularly in low-resource settings. Characterized by hypertension and proteinuria after 20 weeks of gestation, it is a complex, multisystem disorder with unclear pathophysiology. Serum uric acid and C-reactive protein (CRP) have been investigated as potential biochemical markers for disease severity. Aim: To evaluate the levels of maternal serum uric acid and CRP in pre-eclamptic versus normotensive pregnant women and assess their association with disease severity. ***Methods***: A hospital-based, observational study was conducted over six months in the Department of Obstetrics and Gynaecology, Sardar Patel Medical College, Bikaner. A total of 252 pregnant women >=32 weeks gestation were enrolled and divided into two groups: 126 with pre-eclampsia/eclampsia (Group B) and 126 normotensive controls (Group A). Serum uric acid and CRP levels were measured and correlated with blood pressure and proteinuria levels. Results : Mean serum uric acid was significantly elevated in pre-eclamptic women (6.20 ± 2.29 mg/dL) compared to controls (4.79 ± 1.65 mg/dL, p = 0.0001). Although CRP levels were higher in the pre-eclamptic group (19.66 ± 18.60 mg/L vs. 17.91 ± 16.94 mg/L), the difference was not statistically significant (p = 0.436). A significant association was observed between elevated uric acid and CRP levels and the severity of pre-eclampsia (p = 0.003). Proteinuria and blood pressure levels also correlated positively with disease severity. ***Conclusion***: Serum uric acid is a reliable, cost-effective biomarker for assessing the severity of pre-eclampsia and can be incorporated into routine prenatal screening. CRP showed limited standalone predictive value but may offer additional insight when combined with uric acid. Early identification using such biomarkers could improve maternal and neonatal outcomes through timely intervention.

Keywords: Pre-eclampsia; uric acid; C-reactive protein; maternal morbidity; pregnancy complications; proteinuria; hypertension in pregnancy; antenatal screening.

INTRODUCTION

Pre-eclampsia is a leading cause of maternal and perinatal morbidity and mortality, especially in low- and middle-income countries [1]. Characterized by new-onset hypertension and proteinuria after 20 weeks of gestation, it is a multisystem disorder that may progress to eclampsia and serious maternal-fetal complications [2]. Despite extensive research, its exact pathophysiology remains unclear, and reliable tools for early prediction and severity assessment are lacking [3]. Biochemical markers like serum uric acid and C-reactive protein (CRP) have gained interest for their potential role in assessing disease severity [4]. Uric acid, traditionally seen as a marker of renal dysfunction, is now recognized for its pro-inflammatory, oxidative, and vasoconstrictive properties, contributing to disease progression and complications such as IUGR and placental abruption [5,6]. Its levels rise abnormally early in pre-eclampsia, possibly due to impaired renal excretion or oxidative stress [7]. Similarly, CRP, an acute-phase protein elevated in response to systemic inflammation, has been found to be significantly raised in pre-eclamptic pregnancies [8]. It reflects the exaggerated maternal immune response to placental ischemia and may correlate with disease severity [9]. Inflammatory mechanisms are now understood to play a central role in

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pre-eclampsia pathogenesis, alongside vascular and renal dysfunction [10].A combined evaluation of uric acid and CRP may offer better insights into both metabolic and inflammatory components of the disease [11]. As affordable and widely available tests, they are especially useful in low-resource settings like India [12]. Hence, this study aims to investigate the association of maternal serum uric acid and CRP levels with the severity of pre-eclampsia in a tertiary care setting.

AIMS:

This study aimed to evaluate whether there is a significant difference in serum uric acid and C-reactive protein (CRP) levels between women with pre-eclampsia and normotensive pregnant women, and to assess the potential of these biomarkers in predicting the severity of pre-eclampsia.

METHODS

This was a hospital-based, observational study conducted in the Department of Obstetrics and Gynaecology at Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, Rajasthan—a tertiary care center catering to a large population in the northwestern region of India**.**The study was carried out over a period of six months following approval from the Institutional Ethics Committee.A total of 252 pregnant women attending the antenatal clinic (ANC), obstetrics wards, or labour room were enrolled and divided into two groups:**Group A (Cases):** 126 women diagnosed with pre-eclampsia or eclampsia & **Group B (Controls):** 126 normotensive pregnant women without any known medical complications .Participants were selected from inpatient and outpatient services based on clinical criteria and relevant investigations. Inclusion Criteria for the case included were: Pregnant women aged 18–40 years with Gestation age ≥ 32 weeks having Singleton live pregnancy, diagnosed with pre-eclampsia or eclampsia (for Group A) And who were Willing to participate and provide informed written consent. None of the patients included were in active labour or had diabetes mellitus, cardiovascular disease, endocrine disorders, Essential hypertension, Seizure disorder, Severe anemia, conditions known to affect serum uric acid or CRP levels, including:Metabolic syndrome or liver disorders, Acute or chronic kidney disease, Gouty arthritis,Multifetal pregnancies or known fetal anomalies. The normal range of parameter taken for these biomarkers are as follows:

URIC ACID (serum) – Normal levels:

Units	Nonpregnant adult	First trimester	Second trimester	Third trimester
mg/dL	2.5-5.6	2.0-4.2	2.4-4.9	3.1-6

Normal CRP levels, with mean of 0.81 mg/l at 5–7 weeks of gestation, 2.85 mg/l at 19–20 weeks of gestation, and 3.89 mg/l at 32 weeks of gestation22. Elevated CRP is defined as higher than 5 mg/l. (Dati et al., 1996).

RESULTS& DISCUSSION

In the present study, the mean age was 25.67 ±4.08 years in normotensive women and 25.64 ±4.90 years in preeclamptic women, showing no significant difference. This is comparable to the findings by Tesfa et al [13]., who also reported a similar mean age of 27.33 ±4.45 years in normotensive women and 27.98 ±5.64years in the preeclampsia group.38 On the other hand, Mosayebi et al [14]. observed a slightly higher mean age (27.79 ± 4.43 years) in preeclampsia than normotensive pregnant women (26.19 4.44 years), suggesting regional or lifestyle differences might influence the age at which pregnancy complications manifest.

Table 1: Distribution of the cases according to age groups

Age Group (Years)	*Group A Normotensive*		*Group B Preeclampsia*	
	No.	*%*	*No.*	*%*
≤19	*7*	*5.56*	*12*	*9.52*
20-24	*46*	*36.51*	*44*	*34.92*
25-29	*52*	*41.27*	*46*	*36.51*
30-35	*17*	*13.49*	*18*	*14.29*
>35	*4*	*3.17*	*6*	*4.76*
Total	*126*	*100.00*	*126*	*100.00*

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Mean ± SD	*25.67 ±4.08*	*25.64 ±4.90*
p value	*7.707*	

Systolic and diastolic pressures were significantly elevated in the preeclampsia group (158.92 ±12.09 mmHg systolic, 94.19 ±7.40 mmHg diastolic) compared to normotensive women (118.64 ±6.92 mmHg systolic, 78.42 ±6.69 mmHg diastolic, p = 0.0001). These results correspond with the findings of Kameshwarama et al.[15], & Tesfa et al.[13] where mean blood pressure in case group is 165.25±26.5/ 103.25±14.52, 155.30±10.85/99.38±7.7 resp. which is much higher than in control group i.e., 119.25±10.24/77.6±7.27, 110.75±8.49/71.25±7.53,p>0.001 indicating a strong correlation between hypertension and biochemical inflammatory markers in preeclampsia.

Table 2: Distribution of the cases according to Systolic Blood pressure

Systolic Blood pressure (mmhg)	*Group A Normotensive*		*Group B Preeclampsia*	
	no.	*%*	*no.*	*%*
< 130	*111*	*88.10*	*0*	*0.00*
130-160	*15*	*11.90*	*100*	*79.37*
>160	*0*	*0.00*	*26*	*20.63*
Total	*126*	*100.00*	*126*	*100.00*
Mean SD	*118.64 6.92*		*158.92 12.09*	
p value	*0.0001*			

Table no. 3: Distribution of the cases according to diastolic Blood pressure

Diastolic Blood pressure (mmhg)	*Group A Normotensive*		*Group B Preeclampsia*	
	no.	*%*	*no.*	*%*
<80	*61*	*48.41*	*0*	*0.00*
80-100	*65*	*51.59*	*112*	*88.89*
>100	*0*	*0.00*	*14*	*11.11*
Total	*126*	*100.00*	*126*	*100.00*
Mean SD	*78.42± 6.69*		*94.19± 7.40*	
p value	*0.0001*			

Table 04: Distribution of cases according to level of proteinuria

Proteinuria Level	***Group A Normotensive***		***Group B Preeclampsia***	
	No.	*%*	*No.*	*%*
No Proteinuria	*118*	*93.65*	*24*	*19.05*
+1 Proteinuria	*6*	*4.76*	*46*	*36.51*
+2 Proteinuria	*2*	*1.59*	*32*	*25.40*
+3 or more Proteinuria	*0*	*0.00*	*24*	*19.05*
Total	*126*	*100.00*	*126*	*100.00*
p value	*0.0001*			

Proteinuria was significantly higher among preeclamptic women in our study: 81% showed +1 or more proteinuria, compared to 6.35% in the normotensive group (p = 0.0001). These findings were similar to that of Kushwaha et al.[16], where maximum number of cases with preeclampsia had +3 proteinuria (55%) and in control group 58% of patients had +1 proteinuria. Similarly, Kameshwaramma et.al[15], in study group A (cases), maximum number of patients had severe proteinuria (+3) i.e. 55%, and in group B(controls), maximum number of patients had proteinuria of +1, i.e., 55.7% (p=0.001), which emphasized proteinuria as a hallmark of preeclampsia and correlated it with disease severity and renal involvement.

The mean uric acid levels were significantly higher in preeclamptic women (6.20 ±2.29 mg/dL) versus normotensive group (4.79 ±1.65 mg/dL, p= 0.0001). Comparable findings were reported by Mandal et al. [17] (5.46±1.84 mg/dL in cases vs. 3.65±1.09 mg/dL in

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control) and Singh et al.[18] (6.26±1.31 mg/dL in cases vs. 3.99±0.89 mg/dL in controls). Similar observations were drawn by Kaur P et al. [19], where the mean uric acid levels in cases was 5.8±1.8 mg/dL which is quite higher than that of control group, i.e., 4.1±1.05 mg/dL, where the difference is statistically significant(p=0.0001), reinforcing the use of uric acid as a potential predictive biomarker for severity of preeclampsia

Table no. 05 Distribution of cases according to Uric Acid level

Uric Acid (mg/dL)	*Group A Normotensive*		*Group B Preeclampsia*	
	No.	*%*	*No.*	*%*
< 2.4	*5*	*3.97*	*3*	*2.38*
2.4-5.7	*89*	*70.63*	*58*	*46.03*
>5.7	*32*	*25.39*	*65*	*51.59*
Total	*126*	*100.0*	*126*	*100.0*
Mean ± SD	*4.79±1.65*		*6.20±2.29*	
p value	*0.0001*			

Although our study showed slightly elevated CRP levels in preeclamptic women (19.66 ±18.60 mg/L) than normotensive women (17.91 ±16.94 mg/L), the difference was not statistically significant(p = 0.436). These findings were similar to Mandal et al.[17] and Kushwaha et al.[16], where mean CRP levels in cases were 8.14±6.3 mg/L and 8.26±6.9 mg/L and in controls were 6.28±4.66 mg/L and 6.22±4.29 mg/L respectively, which showed non-significant differences. However, Kaur P et al.[19] observed a statistically significant elevation (6.8 ±3.4 mg/L in cases v/s 5.4 ±2.8 mg/L in controls) (p = 0.02), suggesting the variability in CRP's predictive reliability across different populations and gestational timings.

Table no. 06: Distribution of cases according to CRP level

CRP	*Group A Normotensive*		*Group B Preeclampsia*	
	No.	*%*	*No.*	*%*
<6	*36*	*28.57*	*28*	*22.22*
≥ 6	*90*	*71.43*	*98*	*77.78*
Total	*126*	*100.00*	*126*	*100.00*
Mean SD	*17.91±16.94*		*19.66±18.60*	
p value	*0.436*			

Table no. 07: Association of Uric Acid and CRP levels

Uric Acid	*Group A Normotensive*				*Group B Preeclampsia*				*P value*
	CRP <6		*CRP ≥6*		*CRP <6*		*CRP ≥6*		
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	
< 2.4	*2*	*5.56*	*3*	*3.37*	*1*	*3.57*	*3*	*2.04*	*0.003**
2.4-5.7	*26*	*72.22*	*63*	*70.79*	*13*	*46.43*	*45*	*45.92*	
>5.7	*8*	*22.22*	*23*	*25.84*	*14*	*50.00*	*51*	*52.04*	
Total	*36*	*100.00*	*89*	*100.00*	*28*	*100.00*	*99*	*100.00*	

In Group A (Normotensive), maximum, 23 cases (74.19%) were in >5.7mg/dL uric acid level whereas in group B (Preeclampsia), maximum, 51 cases (78.46%) in >5.7mg/dL uric acid level. The association between Uric acid and CRP is found to be statistically significant in both groups (p=0.003). Similarly, Suliman et al .[20] revealed significantly elevated levels of CRP and UA in both mild (15.17±0.78 mg/L and 6.44±0.293 mg/dL) and

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severe (31.5±1.709 mg/L and 7.37±0.27 mg/dL) preeclamptic groups compared to controls (4.79±0.178 mg/L and 4.0±0.061 mg/dL) respectively ($p < 0.001$). CRP and UA also increased with severity and positively correlated with mean arterial pressure ($r > 0.7$; $p < 0.001$). Also, Rekha etal. [21] found that elevated CRP and uric acid levels are closely associated with the severity and progression of preeclampsia and may aid in its early detection and management.

CONCLUSION:

Preeclampsia is a complex multifactorial disease. Our study set the importance of biochemical markers like serum uric acid and CRP. Uric acid showed a statistically significant elevation in preeclamptic women while CRP levels were elevated, but nonsignificant. Proteinuria remained a robust clinical marker for disease presence and severity. Our study suggest the incorporation of uric acid testing in routine prenatal screening protocols, especially in primigravida women presenting with borderline hypertension or proteinuria. This study was conducted with the aim of promptly identifying and managing patients of preeclampsia. Enhanced antenatal surveillance, particularly in booked urban women, may aid in timely diagnosis and intervention, thereby improving maternal and neonatal outcomes

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