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MATERNAL SERUM URIC ACID AS A PREDICTOR OF DISEASE SEVERITY AND PERINATAL OUTCOME IN WOMEN WITH ECLAMPSIA

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ABSTRACT

Background: Preeclampsia and eclampsia are major causes of maternal and perinatal morbidity and mortality. Maternal serum uric acid has been proposed as a simple biochemical marker for assessing disease severity and predicting adverse pregnancy outcomes.

Objective: To evaluate maternal serum uric acid as a predictor of disease severity and perinatal outcome in women with preeclampsia and eclampsia.

Methods: This prospective observational study was conducted at the Department of Obstetrics & Gynecology, Arif Memorial Teaching Hospital/ Rashid Latif Medical College Lahore from December 2024 to June 2025 included 120 pregnant women with preeclampsia or eclampsia. Maternal serum uric acid, blood pressure, renal and hematological parameters, maternal complications, and perinatal outcomes were recorded. Serum uric acid levels were compared according to disease severity and adverse outcomes.

Results: Mean serum uric acid increased significantly from 5.1±1.0 mg/dL in non-severe preeclampsia to 6.8±1.2 mg/dL in severe preeclampsia and 7.6±1.4 mg/dL in eclampsia ($p<0.001$). Women with uric acid ≥6.2 mg/dL had higher rates of severe preeclampsia/eclampsia (86.8% vs. 40.4%), HELLP syndrome (20.6% vs. 5.8%), ICU admission (23.5% vs. 7.7%), preterm delivery (61.8% vs. 34.6%), low birth weight (57.4% vs. 30.8%), NICU admission (48.5% vs. 23.1%), and perinatal mortality (17.6% vs. 3.8%). A cutoff of 6.2 mg/dL predicted severe preeclampsia/eclampsia with an AUC of 0.82, sensitivity of 78.8%, specificity of 73.1%, and adjusted OR of 4.62.

Conclusion: Higher maternal serum uric acid levels were associated with increasing disease severity and adverse maternal and perinatal outcomes. Serum uric acid may serve as a simple and inexpensive adjunct for risk stratification in women with preeclampsia and eclampsia.

KEYWORDS: Preeclampsia; Eclampsia; Serum uric acid; Disease severity; Perinatal outcome; Maternal outcome; Preterm birth

INTRODUCTION

Thus, hypertensive disorders of pregnancy continue to be a significant contributor to maternal and perinatal morbidity and mortality globally, especially in low- and middle-income countries [1]. Preeclampsia is a multisystem disorder of pregnancy associated with new onset of hypertension (after the 20th week of gestation), proteinuria and/or the presence of maternal organ dysfunction and eclampsia is a severe neurological complication associated with generalized seizures [2][3]. Growth of the disease can be fast and can result in serious maternal complications such as cerebral hemorrhage, renal dysfunction, pulmonary edema, hepatic injury, disseminated intravascular coagulation, placental abruption, and maternal death [4]. Intrauterine growth restriction, preterm delivery, low birth weight, intrauterine fetal death, neonatal intensive care admission and low Apgar score are fetal and neonatal outcomes [5][6]. It is, therefore, important to identify women who may be at risk of severe disease and adverse pregnancy outcomes as early as possible to enable appropriate surveillance and timely obstetric intervention. Blood pressure, proteinuria, platelet count, liver enzymes, serum creatinine, lactate dehydrogenase and serum uric acid have been studied for their potential as markers

for preeclampsia risk stratification [7][8]. In particular, uric acid is easy to measure, broadly available and low cost, and is so attractive as a measurement in resource-limited settings.

The end product of purine metabolism is uric acid which is excreted mainly by kidneys. In normal pregnancy, uric acid levels are reduced at the beginning due to its increased urinary excretion levels and then gradually increase later in pregnancy [9]. The serum uric acid level may rise substantially in preeclampsia resulting from decreased renal clearance, increased tubular reabsorption, tissue ischemia, increased oxidative stress, endothelial dysfunction, and increased production by the placenta [10][11]. There is a correlation between elevated uric acid level and the severity of hypertension, proteinuria, renal insufficiency, severe preeclampsia, and eclampsia [12]. Previous studies also showed increased serum uric acid levels in women with more severe hypertensive disorders of pregnancy [13]. Hyperuricemia in mothers has also been linked to poor fetal and neonatal outcomes. High uric acid levels in the blood have been associated with low birth weight, low Apgar scores, fetal growth restriction, preterm delivery, and neonatal mortality [14][15]. The predictive value of serum uric acid is, however, controversial, as different proposed cut-off points, different populations and varying disease severity have resulted in conflicting data in different studies [16]. Given the low cost and the fact that maternal serum uric acid is commonly available, the need to consider its usefulness as a reliable measure of disease severity and risk in the perinate may prove to be a useful aid in making clinical decisions.

Objective

To evaluate maternal serum uric acid as a predictor of disease severity and perinatal outcome in women with preeclampsia and eclampsia.

METHODOLOGY

This prospective observational study was conducted at the Department of Obstetrics & Gynecology, Arif Memorial Teaching Hospital/ Rashid Latif Medical College Lahore from December 2024 to June 2025. A total of 120 pregnant women diagnosed with preeclampsia or eclampsia were included. Preeclampsia was diagnosed by new-onset hypertension after 20 weeks of gestation with proteinuria and/or evidence of maternal organ dysfunction, while eclampsia was defined as the occurrence of generalized seizures in a woman with preeclampsia without another identifiable neurological cause. Women with singleton pregnancies beyond 20 weeks of gestation were included. Patients with chronic kidney disease, chronic hypertension, diabetes mellitus, gout, liver disease, multiple pregnancy, or use of medications known to alter serum uric acid levels were excluded. Disease severity was assessed according to blood pressure, neurological symptoms, renal or hepatic dysfunction, thrombocytopenia, and occurrence of eclamptic seizures.

Data Collection

Demographic and obstetric information including maternal age, gestational age, parity, gravidity, booking status, body mass index, and previous history of hypertensive disorders of pregnancy was recorded. Clinical variables included systolic and diastolic blood pressure, presence of headache, visual disturbance, epigastric pain, edema, proteinuria, and seizures. Venous blood samples were collected at admission for measurement of serum uric acid, hemoglobin, platelet count, serum creatinine, alanine aminotransferase, aspartate aminotransferase, and lactate dehydrogenase. Maternal outcomes included severe preeclampsia, eclampsia, HELLP syndrome, placental abruption, intensive care admission, mode of delivery, and maternal complications. Perinatal outcomes included gestational age at delivery, birth weight, preterm birth, fetal growth restriction, Apgar score at 1 and 5 minutes, neonatal intensive care unit admission, stillbirth, and early neonatal death.

Statistical Analysis

Data were entered and analyzed using SPSS version 26.0. Continuous variables such as maternal age, gestational age, blood pressure, serum uric acid, and birth weight were expressed as mean±SD or median with interquartile range according to data distribution. Categorical variables were presented as frequency and percentage. Serum uric acid levels were compared according to disease severity and adverse perinatal outcomes using the independent-samples t-test or Mann–Whitney U test. Chi-square or Fisher's exact test was used for categorical comparisons. Correlation analysis was performed to assess the relationship of serum uric acid with blood pressure, gestational age, and birth weight. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Maternal age was similar across non-severe preeclampsia, severe preeclampsia, and eclampsia groups (27.1±4.9, 28.0±5.3, and 27.6±5.0 years; p=0.710). With increasing disease severity, gestational age decreased from 36.9±2.1 to 34.8±2.7 and 33.9±3.0 weeks, while systolic BP rose from 146.2±8.4 to 166.5±12.1 and 174.3±15.2 mmHg, diastolic BP from 94.3±6.1 to 108.4±8.2 and 114.1±9.6 mmHg, uric acid from 5.1±1.0 to 6.8±1.2 and 7.6±1.4 mg/dL, and

creatinine from 0.79±0.18 to 0.96±0.27 and 1.08±0.31 mg/dL. Platelet count declined from 214.6±54.2 to 168.8±61.5 and 149.7±58.9×10³/μL (all p<0.001).

Table 1. Clinical Characteristics According to Disease Severity

Variable	Non-severe Preeclampsia (n=40)	Severe Preeclampsia (n=50)	Eclampsia (n=30)	p-value
Maternal age, years, mean±SD	27.1±4.9	28.0±5.3	27.6±5.0	0.710
Gestational age, weeks, mean±SD	36.9±2.1	34.8±2.7	33.9±3.0	<0.001
Systolic BP, mmHg, mean±SD	146.2±8.4	166.5±12.1	174.3±15.2	<0.001
Diastolic BP, mmHg, mean±SD	94.3±6.1	108.4±8.2	114.1±9.6	<0.001
Serum uric acid, mg/dL, mean±SD	5.1±1.0	6.8±1.2	7.6±1.4	<0.001
Serum creatinine, mg/dL, mean±SD	0.79±0.18	0.96±0.27	1.08±0.31	<0.001
Platelet count, ×10³/μL, mean±SD	214.6±54.2	168.8±61.5	149.7±58.9	<0.001

Women with uric acid ≥6.2 mg/dL had higher rates of severe preeclampsia/eclampsia (86.8% vs. 40.4%, p<0.001), HELLP syndrome (20.6% vs. 5.8%, p=0.021), placental abruption (14.7% vs. 3.8%, p=0.049), ICU admission (23.5% vs. 7.7%, p=0.021), cesarean delivery (67.6% vs. 48.1%, p=0.031), and renal dysfunction (19.1% vs. 5.8%, p=0.032).

Table 2. Maternal Outcomes According to Serum Uric Acid Level

Maternal Outcome	Uric Acid ≥6.2 mg/dL (n=68), n (%)	Uric Acid <6.2 mg/dL (n=52), n (%)	p-value
Severe preeclampsia/eclampsia	59 (86.8)	21 (40.4)	<0.001
HELLP syndrome	14 (20.6)	3 (5.8)	0.021
Placental abruption	10 (14.7)	2 (3.8)	0.049
ICU admission	16 (23.5)	4 (7.7)	0.021
Cesarean delivery	46 (67.6)	25 (48.1)	0.031
Maternal renal dysfunction	13 (19.1)	3 (5.8)	0.032

Higher uric acid was associated with more preterm delivery (61.8% vs. 34.6%, p=0.003), low birth weight (57.4% vs. 30.8%, p=0.004), fetal growth restriction (36.8% vs. 15.4%, p=0.009), low 5-minute Apgar score (32.4% vs. 13.5%, p=0.017), NICU admission (48.5% vs. 23.1%, p=0.004), and perinatal mortality (17.6% vs. 3.8%, p=0.020). Mean birth weight was lower at 2.18±0.54 versus 2.71±0.48 kg (p<0.001), while stillbirth was 13.2% versus 3.8% (p=0.077).

Table 3. Perinatal Outcomes According to Maternal Serum Uric Acid

Perinatal Outcome	Uric Acid ≥6.2 mg/dL (n=68), n (%)	Uric Acid <6.2 mg/dL (n=52), n (%)	p-value
Preterm delivery	42 (61.8)	18 (34.6)	0.003
Low birth weight	39 (57.4)	16 (30.8)	0.004
Fetal growth restriction	25 (36.8)	8 (15.4)	0.009
Apgar score <7 at 5 minutes	22 (32.4)	7 (13.5)	0.017
NICU admission	33 (48.5)	12 (23.1)	0.004
Stillbirth	9 (13.2)	2 (3.8)	0.077
Perinatal mortality	12 (17.6)	2 (3.8)	0.020
Birth weight, kg, mean±SD	2.18±0.54	2.71±0.48	<0.001

A uric acid cutoff of 6.2 mg/dL predicted severe preeclampsia/eclampsia with AUC 0.82, 78.8% sensitivity, 73.1% specificity, and adjusted OR 4.62 (p<0.001). It also predicted preterm delivery (AUC 0.76; OR 2.81, p=0.009), low birth weight (AUC 0.78; OR 2.94, p=0.007), NICU admission (AUC 0.75; OR 2.56, p=0.021), and composite adverse perinatal outcome (AUC 0.80; OR 3.38, p=0.004).

Table 4. Predictive Performance of Maternal Serum Uric Acid

Outcome	Optimal Cutoff (mg/dL)	AUC (95% CI)	Sensitivity (%)	Specificity (%)	Adjusted OR (95% CI)	p-value
Severe preeclampsia/eclampsia	6.2	0.82 (0.74–0.89)	78.8	73.1	4.62 (2.01–10.64)	<0.001
Preterm delivery	6.2	0.76 (0.67–0.84)	70.0	68.3	2.81 (1.29–6.14)	0.009
Low birth weight	6.3	0.78 (0.69–0.86)	72.7	69.2	2.94 (1.34–6.45)	0.007
NICU admission	6.4	0.75 (0.66–0.84)	73.3	66.7	2.56 (1.15–5.69)	0.021
Adverse composite perinatal outcome	6.2	0.80 (0.72–0.87)	76.1	71.4	3.38 (1.49–7.67)	0.004

DISCUSSION

The present analysis revealed that levels of maternal serum uric acid rose with the severity of hypertensive diseases. The mean uric acid level was found to be 5.1 ± 1.0 mg/dL in non-severe PPE, 6.8 ± 1.2 mg/dL in severe PPE and 7.6 ± 1.4 mg/dL in eclampsia ($p<0.001$). Blood pressure and creatinine level also rose with increasing severity of the disease and platelet count decreased with severity of the disease. In a study that was conducted earlier, the researchers also found that the serum uric acid was significantly correlated with the severity of preeclampsia, blood pressure, serum creatinine and proteinuria [17].The maternal morbidity was significantly higher in women who had uric acid levels ≥6.2 mg/dL. Wives with high uric acid level experienced severe preeclampsia/eclampsia in 86.8% of the cases, while women with lower uric acid level experienced 40.4% ($p<0.001$). HELLP syndrome (20.6% vs. 5.8%), placental abruption (14.7% vs. 3.8%), ICU admission (23.5% vs. 7.7%), cesarean delivery (67.6% vs. 48.1%), and renal dysfunction (19.1% vs. 5.8%) were also significantly more frequent. Previous studies have also correlated maternal hyperuricemia with greater biochemical abnormalities and more complications during pregnancy, which are indicators of more severe disease [18]. Maternal uric acid was also found to be related to poorer perinatal outcomes. Women with uric acid ≥6.2 mg/dL had higher frequencies of preterm delivery (61.8% vs. 34.6%), low birth weight (57.4% vs. 30.8%), fetal growth restriction (36.8% vs. 15.4%), low 5-minute Apgar score (32.4% vs. 13.5%), NICU admission (48.5% vs. 23.1%), and perinatal mortality (17.6% vs. 3.8%). Mean birth weight was also significantly lower in this group (2.18±0.54 vs. 2.71±0.48 kg, $p<0.001$). Elevated serum uric acid was previously reported to be related to preterm delivery, low birth weight, fetal growth restriction and neonatal mortality, indicating a potential as an indicator of fetal compromise [19]. The link between hyperuricemia and negative fetal outcomes could be due to the placental and endothelial dysfunction seen in preeclampsia. Higher uric acid levels are correlated with poor renal clearance, oxidative stress and higher overall disease burden. Therefore, elevated uric acid levels can be useful to recognize pregnancies with more placental dysfunction and decreased fetal growth. Previous studies have also shown an association between hyperuricemia, premonaturity, low birth weight and small-for-gestational age infants [20].

Serum uric acid was also found to be useful in predicting in the present analysis. The cutoff at 6.2 mg/dL was identified as the value with the highest AUC (0.82), sensitivity (78.8%) and specificity (73.1%) and an adjusted OR of 4.62 which predicted severe preeclampsia/eclampsia. It was also found to predict preterm delivery (AUC 0.76), low birth weight (AUC 0.78), admission to the NICU (AUC 0.75), and composite adverse perinatal outcome (AUC 0.80). Previous studies have reported AUC value of 0.752 for fetal/neonatal complications detection and elevated uric acid significantly increased the risk of preterm birth, growth restriction, low Apgar scores and neonatal death [21]. Although associated, serum uric acid should not be viewed as a single, independent diagnosis or prognosis. Moderate, not perfect predictive accuracy has been reported in previous studies and large evidence syntheses have reported variability in sensitivity and specificity in populations [22]. Thus, the uric acid level in the serum should be used in combination with the blood pressure, clinical severity, renal and hepatic parameters, platelet count and fetal assessment. However, with its low cost and availability it is a possible tool for risk stratification, especially in low resource areas of obstetrics. There were a number of limitations to this study. It was done in a single centre and the sample size of 120 patients may not allow for the results to be generalised. The changes of serum uric acid level were not assessed at intervals throughout the course of the disease. Other factors that potentially could impact uric acid levels, such as diet, hydration, renal function and gestational age, may also play a role in its predictive value. It is

recommended that larger multicenter studies with serial uric acid measurements are done to confirm the optimal cut-off for predicting maternal and perinatal outcomes.

CONCLUSION

It is concluded that maternal serum uric acid increases with the severity of preeclampsia and eclampsia and is associated with adverse maternal and perinatal outcomes. Higher uric acid levels were linked with severe disease, HELLP syndrome, renal dysfunction, preterm delivery, low birth weight, fetal growth restriction, NICU admission, and perinatal mortality. A serum uric acid cutoff around 6.2 mg/dL showed good predictive ability for severe disease and adverse perinatal outcomes. Serum uric acid may therefore serve as a simple, inexpensive, and readily available adjunct for risk stratification in women with preeclampsia and eclampsia.

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Dr Yibala Akpama Edimek contributed equally and should be considered co-first joint author.

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