Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 12, 2023

Original research article

Assessing perinatal risks associated with elevated uric acid in pre-eclampsia: An observational study

[1]Dr. Maitri Kulkarni, [2]Dr. Ramani Anishetty, [3]Dr. Sailaja Kanakamedala, [4]Dr. Nibedita Maharana

[1]Associate Professor, Department of Obstetrics and Gynecology, Mamata Academy of Medical Science, Bachupally, Hyderabad, Telangana, India

[2,3,4]Assistant Professor Department of Obstetrics and Gynecology, Mamata Academy of Medical Science, Bachupally, Hyderabad, Telangana, India

Corresponding Author: Dr. Ramani Anishetty

Abstract

Introduction: The relationship between elevated uric acid levels and pre-eclampsia has been a subject of considerable research, highlighting its potential role as a biomarker for the disease and its complications. This observational study aimed to assess perinatal risks associated with elevated uric acid levels in pregnant women diagnosed with pre-eclampsia.

Material and Methods: Seventy-five pregnant women with pre-eclampsia were included in the study. Baseline demographics, clinical parameters (including blood pressure, proteinuria, and uric acid levels), and perinatal outcomes (such as gestational age at delivery, birth weight, Apgar scores, preterm birth incidence, NICU admissions, and fetal distress) were collected. Statistical analysis included means, standard deviations, and p-values to assess differences and associations.

Results: Maternal age (28.5 ± 4.2 years), parity (1.8 ± 1.2), and gestational age at pre-eclampsia diagnosis (30.4 ± 2.5 weeks) showed significant variations ($p < 0.05$). Perinatal outcomes demonstrated lower gestational age at delivery (36.2 weeks ± 2.1), reduced birth weight (2750 grams ± 350), and Apgar scores at 1 and 5 minutes (7.8 ± 1.2 and 8.5 ± 1.0, respectively), indicating the impact of pre-eclampsia on neonatal health. The study revealed a high incidence of preterm birth (32%), NICU admissions (25%), and fetal distress (15%).

Conclusion: Elevated uric acid levels in pre-eclampsia are associated with adverse perinatal outcomes, including preterm birth, low birth weight, and increased neonatal care requirements. Early detection, vigilant monitoring, and appropriate interventions are essential in managing pre-eclampsia and improving neonatal outcomes.

Keywords: Pre-eclampsia, uric acid, perinatal outcomes, gestational age, birth weight, Apgar scores, preterm birth, NICU admission, fetal distress

Introduction

Pre-eclampsia is a complex and potentially life-threatening hypertensive disorder of pregnancy that affects approximately 5-8% of pregnancies worldwide [1]. It is characterized by new-onset hypertension, proteinuria, and often significant end-organ dysfunction, typically arising after 20 weeks of gestation (American College of Obstetricians and Gynecologists, 2019). While the precise etiology of pre-eclampsia remains elusive, it is believed to result from placental dysfunction and maternal endothelial dysfunction, leading to systemic inflammation, oxidative stress and vascular dysfunction [2].

One of the hallmarks of pre-eclampsia is the elevation of uric acid levels in the maternal bloodstream, a phenomenon that has been recognized for more than a century [4]. Elevated uric acid in pre-eclampsia is thought to be a consequence of impaired renal perfusion and decreased glomerular filtration rate, reflecting the extent of endothelial damage and renal dysfunction [5]. While the association between elevated uric acid levels and pre-eclampsia is well-established, the clinical significance and perinatal risks associated with this elevation remain a topic of active investigation. This observational study aims to provide a comprehensive assessment of perinatal risks linked to elevated uric acid in pre-eclampsia.

The significance of this study lies in the potential for uric acid to serve as a biomarker for assessing the severity of pre-eclampsia and predicting adverse maternal and fetal outcomes. Elevated uric acid levels have been correlated with a higher incidence of complications such as preterm birth, low birth weight, fetal distress and neonatal intensive care unit (NICU) admissions [6]. The pathophysiological link between elevated uric acid and pre-eclampsia is multifaceted. It is believed that reduced renal perfusion and impaired glomerular filtration rate, secondary to endothelial dysfunction and vasoconstriction, lead to decreased clearance of uric acid, resulting in its accumulation in the bloodstream. Elevated uric acid levels may reflect the extent of maternal endothelial damage and renal dysfunction, making it a valuable marker for assessing disease severity.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 12, 2023

Importantly, studies have shown that elevated uric acid levels in pre-eclampsia are associated with a higher risk of adverse perinatal outcomes. These include preterm birth, low birth weight, intrauterine growth restriction, fetal distress, and an increased likelihood of neonatal intensive care unit (NICU) admissions [7]. The exact mechanisms by which elevated uric acid contributes to these adverse outcomes are not fully understood, but it is hypothesized that systemic inflammation and oxidative stress, which are often present in pre-eclampsia, may play a role.

Furthermore, the use of uric acid as a predictive tool for adverse perinatal outcomes in pre-eclampsia is of clinical significance. Early identification of women with elevated uric acid levels can help healthcare providers stratify risk and tailor management strategies accordingly [7]. Timely interventions may include closer monitoring, blood pressure control, and consideration of early delivery in cases of severe pre-eclampsia to mitigate potential harm to both mother and baby. The aim of this observational study is to assess the perinatal risks associated with elevated uric acid levels in pregnant women diagnosed with pre-eclampsia.

Materials and Methods

Study Design: This observational study was conducted with a cohort of 75 pregnant women diagnosed with pre-eclampsia. The study was conducted in accordance with ethical guidelines and written informed consent was obtained from all participants.

Inclusion Criteria

1. Pregnant women diagnosed with pre-eclampsia according to established clinical criteria (American College of Obstetricians and Gynecologists, 2019).
2. Gestational age greater than 20 weeks.
3. Ability to provide informed consent.

Exclusion Criteria

1. Women with pre-existing medical conditions (e.g., chronic hypertension, renal disease, diabetes) other than pre-eclampsia.
2. Multiple pregnancies (e.g., twins or triplets).
3. Patients unwilling or unable to provide informed consent.

Data Collection

1. **Baseline Demographics:** Information including maternal age, race/ethnicity, parity, and gestational age at pre-eclampsia diagnosis was collected.
2. **Clinical Parameters:** Clinical data were collected at the time of pre-eclampsia diagnosis, including blood pressure, proteinuria levels, and uric acid levels. Blood pressure was measured using a standardized method, and proteinuria was assessed via 24-hour urine collection.
3. **Uric Acid Measurement:** Serum uric acid levels were measured using standard laboratory method.
4. **Perinatal Outcomes:** Perinatal outcomes were recorded, including:

- Gestational age at delivery.
- Birth weight of the neonate.
- Apgar scores at 1 and 5 minutes after birth.
- Incidence of preterm birth (defined as <37 weeks of gestation).
- Neonatal intensive care unit (NICU) admission.
- Incidence of fetal distress.

Statistical Analysis: Data were analyzed using SPSS. Descriptive statistics, including means, medians, standard deviations, and percentages, were calculated as appropriate. Comparative analysis was performed to assess the association between elevated uric acid levels and perinatal outcomes. Statistical significance was set at $p<0.05$.

Results

Table 1: Baseline Demographics and Clinical Characteristics of the Study Cohort in Pre-eclampsia

Parameter	Mean (±SD)	p-value
Maternal Age (years)	28.5 (±4.2)	<0.001
Parity (number of previous pregnancies)	1.8 (±1.2)	<0.05
Gestational Age at Pre-eclampsia Diagnosis (weeks)	30.4 (±2.5)	<0.001

Table 1 show, maternal age has a mean of 28.5 years with a standard deviation of 4.2 years. The p-value indicates a statistically significant difference among age groups. Parity has a mean of 1.8 with a standard deviation of 1.2. The p-value suggests a statistically significant difference in parity among subjects. Gestational age at pre-eclampsia diagnosis has a mean of 30.4 weeks with a standard deviation of 2.5

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 12, 2023

weeks. The p-value indicates a statistically significant difference in gestational age at diagnosis.

Table 2: Maternal Serum Uric Acid Trends across Trimesters in Pre-eclampsia

Uric Acid Level (mg/dL)	Mean (±SD)
First Trimester	5.0 (±1.0)
Second Trimester	5.5 (±1.2)
Third Trimester	6.8 (±1.5)

This table 2 illustrates the changing trends in maternal serum uric acid levels (measured in mg/dL) during pregnancy among women diagnosed with pre-eclampsia. Uric acid levels tend to increase progressively from the first trimester (5.0 mg/dL ± 1.0) to the second trimester (5.5 mg/dL ± 1.2). However, the most significant rise is observed in the third trimester (6.8 mg/dL ± 1.5). These trends indicate that uric acid levels correlate with pregnancy progression, with a notable increase in the third trimester, potentially reflecting the severity of pre-eclampsia. Monitoring uric acid levels offers insights into disease progression and informs clinical management decisions.

Table 3: Clinical Parameters at Pre-eclampsia Diagnosis

Parameter	Mean (±SD)	p-value
Systolic Blood Pressure	145.2 mm Hg (±10.3)	<0.001
Diastolic Blood Pressure	92.6 mm Hg (±8.7)	<0.001
Proteinuria (g/24h)	2.5 g (±0.9)	<0.01
Uric Acid (mg/dL)	6.8 mg/dL (±1.2)	<0.05

Systolic Blood Pressure has a mean of 145.2 mm Hg with a standard deviation of 10.3 mm Hg. The p-value indicates a statistically significant difference in systolic blood pressure among subjects. Diastolic Blood Pressure has a mean of 92.6 mm Hg with a standard deviation of 8.7 mm Hg. The p-value suggests a statistically significant difference in diastolic blood pressure among subjects. Proteinuria levels have a mean of 2.5 grams in 24 hours with a standard deviation of 0.9 grams. The p-value indicates a statistically significant difference in proteinuria levels among subjects. Uric Acid levels have a mean of 6.8 mg/dL with a standard deviation of 1.2 mg/dL. The p-value suggests a statistically significant difference in uric acid levels among subjects.

Table 4: Perinatal Outcomes and Neonatal Parameters in Pre-eclampsia Cohort

Perinatal Outcome	Mean (±SD)	p-value
Gestational Age at Delivery (weeks)	36.2 weeks (±2.1)	<0.001
Birth Weight of the Neonate (grams)	2750 grams (±350)	<0.05
Apgar Score at 1 Minute	7.8 (±1.2)	<0.01
Apgar Score at 5 Minutes	8.5 (±1.0)	<0.001
Incidence of Preterm Birth (%)	32%	<0.05
Neonatal Intensive Care Unit (NICU) Admission (%)	25%	<0.05
Incidence of Fetal Distress (%)	15%	<0.01

Gestational Age at Delivery has a mean of 36.2 weeks with a standard deviation of 2.1 weeks. The p-value suggests a statistically significant difference in gestational age at delivery among the subjects. Birth Weight of the Neonate has a mean of 2750 grams with a standard deviation of 350 grams. The p-value indicates a statistically significant difference in birth weights among neonates. Apgar score at 1 Minute has a mean of 7.8 with a standard deviation of 1.2. The p-value suggests a statistically significant difference in Apgar scores at 1 minute.

Apgar score at 5 Minutes has a mean of 8.5 with a standard deviation of 1.0. The p-value indicates a statistically significant difference in Apgar scores at 5 minutes. Incidence of Preterm Birth is reported as a percentage, and the p-value suggests a statistically significant difference in the incidence of preterm birth. Neonatal Intensive Care Unit (NICU) Admission is reported as a percentage, and the p-value indicates a statistically significant difference in NICU admissions. Incidence of Fetal Distress is reported as a percentage, and the p-value suggests a statistically significant difference in the incidence of fetal distress.

Discussion

Pre-eclampsia is a complex and potentially life-threatening condition that poses significant risks to both maternal and fetal health. Understanding the perinatal outcomes associated with pre-eclampsia are crucial for optimizing clinical management and improving the well-being of both mothers and neonates. In this study, we explored perinatal outcomes in 75 pregnant women diagnosed with pre-eclampsia, focusing on key parameters such as gestational age at delivery, birth weight of neonates, Apgar scores at 1 and 5 minutes, incidence of preterm birth, NICU admissions, and the incidence of fetal distress.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 12, 2023

Gestational age at delivery is a critical determinant of neonatal outcomes in pre-eclampsia. Our results showed that the mean gestational age at delivery in the study cohort was 36.2 weeks (±2.1), which is significantly lower than the expected term gestation of 40 weeks. This finding aligns with previous research demonstrating that pre-eclampsia often leads to preterm births [8]. Preterm birth is associated with increased risks of neonatal morbidity and mortality, including respiratory distress syndrome and developmental delays [9]. Therefore, the early identification and management of pre-eclampsia are critical for extending gestational age and improving neonatal outcomes.

Birth weight is another crucial parameter reflecting fetal well-being and the severity of pre-eclampsia. In our study, neonates born to mothers with pre-eclampsia had a mean birth weight of 2750 grams (±350), which is lower than the average birth weight of healthy neonates. Low birth weight is a well-established consequence of pre-eclampsia [10]. It can lead to a range of health issues, including an increased risk of neonatal mortality, growth restriction and long-term developmental problems [11]. Our findings underscore the importance of monitoring fetal growth and implementing strategies to support adequate intrauterine growth in pregnancies affected by pre-eclampsia.

Apgar scores at 1 and 5 minutes provide valuable insights into the immediate well-being of newborns. Apgar scores measure the neonate's heart rate, respiratory effort, muscle tone, reflex irritability, and skin color, with higher scores indicating better overall health (American Academy of Pediatrics, 2015). Our study revealed a mean Apgar score of 7.8 (±1.2) at 1 minute and 8.5 (±1.0) at 5 minutes. These scores, while within the normal range (7-10), suggest that some neonates born to mothers with pre-eclampsia may require additional support immediately after birth. Previous research has shown that pre-eclampsia is associated with an increased risk of low Apgar scores and the need for resuscitative measures [12]. Therefore, vigilant monitoring and prompt intervention should be a priority in the management of pre-eclamptic pregnancies to ensure the well-being of neonates.

Preterm birth is a significant concern in pregnancies complicated by pre-eclampsia. In our study, we observed a preterm birth rate of 32%, defined as births occurring before 37 weeks of gestation. This finding is consistent with the existing literature, which consistently reports a higher incidence of preterm birth in pre-eclamptic pregnancies [13]. Preterm birth is associated with numerous neonatal complications, including respiratory distress syndrome, intraventricular hemorrhage, and sepsis. Preventing preterm birth in pre-eclampsia is a major clinical challenge, and further research is needed to identify effective strategies for prolonging gestation in affected pregnancies.

Neonatal Intensive Care Unit (NICU) admission rates provide insights into the severity of neonatal morbidity and the need for specialized care. Our study reported a NICU admission rate of 25% among neonates born to mothers with pre-eclampsia. This finding highlights the significant burden of neonatal illness associated with pre-eclampsia. NICU admissions are often required for neonates with respiratory distress, feeding difficulties, or other complications related to preterm birth and low birth weight. Reducing the need for NICU care in pre-eclamptic pregnancies is a key goal in improving neonatal outcomes and reducing healthcare costs [14].

The incidence of fetal distress is an important consideration in the management of pre-eclampsia, as it reflects the compromised intrauterine environment. In our study, we observed a fetal distress rate of 15%, indicating that a substantial proportion of pre-eclamptic pregnancies are associated with fetal compromise. Fetal distress may result from impaired placental function and inadequate oxygen and nutrient delivery to the fetus (American College of Obstetricians and Gynecologists, 2019). It is essential for healthcare providers to closely monitor fetal well-being in pre-eclamptic pregnancies and be prepared to intervene promptly if signs of distress are detected.

In conclusion, our study provides valuable insights into the perinatal outcomes associated with pre-eclampsia, a condition that poses significant risks to both mothers and neonates. Our findings highlight the increased likelihood of preterm birth, low birth weight, and the need for specialized neonatal care in pre-eclamptic pregnancies. These results underscore the importance of early diagnosis, close monitoring, and timely interventions in the management of pre-eclampsia to optimize maternal and fetal outcomes. Further research is needed to develop effective strategies for mitigating the adverse effects of pre-eclampsia on neonatal health.

References

1. Sibai BM. Diagnosis and management of gestational hypertension and preeclampsia. Obstetrics & Gynecology. 2003 Jul;102(1):181-92.
2. Obstetricians ACOG. Hypertension in pregnancy. Report of the American college of obstetricians and gynecologists' task force on hypertension in pregnancy. Obstet gynecol. 2013;122(5):11-22.
3. Roberts JM, Bell MJ, IfI BM. Global Pregnancy Collaboration symposium: Pre-eclampsia and the hypertensive disorders of pregnancy. Pregnancy Hypertension. 2018;12:16-18.
4. Gant NF, Daley GL, Chand S, Whalley PJ, MacDonald PC. A study of angiotensin II pressor response throughout primigravid pregnancy. The Journal of clinical investigation. 1973 Nov;52(11):2682-9.
5. Hawkins TA, Roberts JM, Mangos GJ, Davis GK, Roberts LM, Brown MA. Plasma uric acid

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 12, 2023

remains a marker of poor outcome in hypertensive pregnancy: a retrospective cohort study. BJOG: An International Journal of Obstetrics & Gynaecology. 2012 Mar;119(4):484-92.
6. Conde-Agudelo A, Villar J, Lindheimer M. World Health Organization systematic review of screening tests for preeclampsia. Obstetrics & Gynecology. 2004 Dec;104(6):1367-91.
7. Ryu A, Cho NJ, Kim YS, Lee EY. Predictive value of serum uric acid levels for adverse perinatal outcomes in preeclampsia. Medicine, 2019 May, 98(18).
8. Magee LA, Helewa M, Moutquin JM, Von Dadelszen P, Hypertension Guideline Committee. Diagnosis, evaluation and management of the hypertensive disorders of pregnancy. Journal of obstetrics and gynaecology Canada. 2008 Mar;30(3(1)):S1-48.
9. Lawn JE, Cousens S, Zupan J. 4 million neonatal deaths: when? Where? Why? The lancet. 2005 Mar;365(9462):891-900.
10. Roberts JM, Pearson G, Cutler J, Lindheimer M. Summary of the NHLBI working group on research on hypertension during pregnancy. Hypertension. 2003 Mar;41(3):437-45.
11. Kramer MS, Séguin L, Lydon J, Goulet L. Socio-economic disparities in pregnancy outcome: why do the poor fare so poorly? Paediatric and perinatal epidemiology. 2000 Jul;14(3):194-210.
12. Sibai BM, Mercer BM, Schiff E, Friedman SA. Aggressive versus expectant management of severe preeclampsia at 28 to 32 weeks' gestation: a randomized controlled trial. American journal of obstetrics and gynecology. 1994 Sep;171(3):818-22.
13. Sibai BM. Management of late preterm and early-term pregnancies complicated by mild gestational hypertension/pre-eclampsia. In Seminars in perinatology WB Saunders. 2011 Oct;35(5)292-296.
14. Lawrence ER, Beyuo TK, Kobernik EK, Moyer CA, Oppong SA. A comparative analysis of neonatal outcomes in pregnancies complicated by preeclampsia and eclampsia in Ghana. AJOG Global Reports. 2022 Aug;2(3):100-061.