Original Article

Molecular Changes and Their Ratio in Preeclamptic Patients

Siddika Khatun[1], Abu Kholdun Al Mahmood[2], Syeda Fahmida Afrin[3], Sarwat Jahan[4], Ummey Salma[5], Manira Khanam Nishi[6]

ABSTRACT

Background

Preeclampsia is a leading cause of maternal and fetal morbidity and mortality. Although its exact etiology remains unclear, alterations in serum uric acid and creatinine levels are thought to be associated with the condition.

Objective

This study was aimed to evaluate serum uric acid and creatinine levels and their ratio in preeclamptic women for early diagnosis and prevent the complications by using these easy biochemical lab parameters.

Methods

A cross-sectional study was conducted in the Department of Biochemistry, Mymensingh Medical College, in collaboration with the Department of Obstetrics and Gynecology, Mymensingh Medical College & Hospital. A total of 120 pregnant women were selected through purposive (non-random) sampling based on specific inclusion and exclusion criteria. Of these, 60 were diagnosed with preeclampsia (cases), and 60 normotensive pregnant women served as controls. Serum levels of uric acid, and creatinine were measured and expressed as mean ± standard deviation (SD), and the ratio of SUA/Scr is analyzed by logistics regression analysis. Data were analyzed using SPSS version 21, and differences between groups were assessed using Student's unpaired *t*-test.

Results

The analysis revealed a highly significant increase ($P < 0.001$) in serum uric acid and creatinine levels in preeclamptic patients compared to controls.The ratio of SUA/Scr also higher as compare to control.

Conclusion

The study demonstrates that serum uric acid and creatinine levels and their ratio are significantly elevated in preeclamptic women, suggesting their potential role in the pathophysiology and management of preeclampsia.

Keywords

Preeclampsia; serum uric acid; serum creatinine; pregnancy, SUA/ SCr(Serum Uric Acid and serum Creatinine ratio)

INTRODUCTION

Pregnancy is a physiological state characterized by the implantation and growth of products of conception, either within the uterus or, in rare cases, at ectopic sites. It concludes with either spontaneous or elective abortion, or delivery. Throughout this period, the maternal body undergoes profound physiological changes affecting nearly all organ systems to support fetal development. Awareness and understanding of these adaptations are essential for healthcare providers to ensure optimal care for both the mother and the fetus[1].

Preeclampsia (PE) is a hypertensive disorder unique to pregnancy, typically manifesting after 20 weeks of gestation[2]. It is defined by elevated blood pressure in combination with proteinuria and/or other severe clinical features such as persistent headache, visual disturbances, and evidence of organ dysfunction. PE is part of

1. Siddika Khatun, MBBS, M.Phil, Assistant Professor, Department of biochemistry, Ibn Sina Medical college, Dhaka. Email: drsiddika87@gmail.com.
2. Abu Kholdun Al Mahmood, MBBS, M.Phil, PHD, Professor and Head, Department of Biochemistry, Ibn Sina Medical College, Dhaka. Email: kholdun.hotmail.com
3. Syeda Fahmida Afrin, MBBS, M.Phil, Professor, Department of Biochemistry, Ibn Sina Medical College, Dhaka. Email: drfahmida77@gmail.com.
4. Sarwat Jahan, MBBS, M. Phil, Assistant professor, Department of Pharmacology and Therapeutics, Ibn Sina Medical College, Dhaka. Email: dr.sarwatdmc@gmail.com.
5. Ummey Salma, MBBS, MPhil, Lecturer, Department of Biochemistry, Dhaka Medical College, Dhaka. Email: ummey4046@gmail.com.
6. Manira Khanam Nishi, MBBS, M.Phil, Assistant Professor, Department of Pharmacology & Therapeutics, Shaheed Monsur Ali Medical College. Email: dr.manira@gmail.com.

Correspondence

Dr Siddika Khatun, MBBS, Mphil (biochemistry), Assistant Professor, Ibn Sina Medical College. E mail: drsiddika87&gmail.com.

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a spectrum of hypertensive disorders in pregnancy, beginning with gestational hypertension and potentially advancing to more severe conditions including eclampsia and HELLP (Hemolysis, Elevated Liver enzymes, Low Platelet count) syndrome [3]. Clinical hallmarks include hypertension, proteinuria, edema, and rapid weight gain. Laboratory findings often reveal thrombocytopenia, hyperuricemia, elevated liver enzymes, and hemoconcentration[4].

Preeclampsia remains a leading cause of maternal and fetal morbidity and mortality worldwide. The condition can progress rapidly and may result in serious complications if not promptly recognized and managed[5]. According to the World Health Organization (WHO), the global incidence of PE ranges from 2% to 10% of pregnancies. The burden is particularly high in developing countries, with reported rates ranging from 1.8% to 16.7%, compared to approximately 0.4% in developed regions [6]. Although the exact etiology of PE remains uncertain, current hypotheses suggest abnormal placental implantation and defective trophoblastic invasion as contributing factors. Its molecular pathogenesis is also yet to be fully elucidated. Elevated serum uric acid (SUA) and creatinine levels have been associated with the clinical severity of preeclampsia and adverse perinatal outcomes.

SUA, the final oxidation product of purine metabolism, has been implicated in pregnancy-related complications, including preeclampsia and eclampsia [7]. Hyperuricemia is a prominent biochemical feature of PE and is primarily attributed to decreased glomerular filtration secondary to endothelial dysfunction. Multiple studies have demonstrated a positive correlation between elevated SUA levels and unfavorable maternal and fetal outcomes. While SUA is a marker of renal dysfunction, its biological significance may vary depending on the presence of underlying renal impairment. Consequently, the serum uric acid-to-creatinine ratio (SUA/SCr) has recently been proposed as a more accurate indicator than SUA alone[8].

Creatinine, a metabolic waste product of muscle activity, is predominantly excreted via the kidneys and serves as a dependable marker of renal function. During pregnancy, renal physiology is markedly altered. In preeclampsia, decreased renal perfusion, glomerular filtration rate (GFR), and tubular function contribute to elevated serum creatinine concentrations[9]. This study aims to investigate the relationship between the SUA/SCr ratio and the development of preeclampsia, as well as its associated maternal complications [10].

MATERIALS AND METHODS

Study Design

Cross sectional study.

Study Places

This study was carried out at the Department of Biochemistry, Mymensingh Medical College and the subjects were collected from Department of Obstetrics & Gynecology, Mymensingh Medical College Hospital, Mymensingh.

Period of the Study

July 2018 to June 2019.

Sample Size

A total of 120 subjects included in this studied. Out of them 60 were case (Group-II) and 60 were control (Group-I).

Inclusion criteria

Group-I (control): 60 apparently normal healthy pregnant women aged between 20-40 years and gestational age more than 20 weeks selected as control in this study.

Group-II (case): 60 diagnosed preeclamptic patients aged between 20-40 years and gestational age more than 20 weeks selected as case in this study.

Exclusion Criteria

1. Pre-existing hypertension before pregnancy- from history.
2. Liver disease- from history and other clinical findings.
3. Renal disease- from history and other clinical findings.
4. Subjects taking any drugs that containing calcium, magnesium, phosphorus, zinc or iron for last 5 months- from history.

Data Collection tools

A survey questionnaire was designed. Data were collected through a preformed data collection sheet (questionnaire). Measurements of height, weight were done with light clothes and without shoes. Blood pressure was taken after 10 minutes rest with standard cuffs for adults fitted with a mercury sphygmomanometer.

Data collection procedure

Data was collected after direct interview from patients or attendants. Informed consent were obtained from all participants. Blood was collected and analyzed for investigation. Structured case record forms were included.

Study procedure

For the purpose of the study, subjects both normal pregnant and preeclamptic patients were collected from the antenatal Obstetric ward of Mymensingh Medical College Hospital, Mymensingh. The study subjects were selected on the basis of inclusion and exclusion criteria. Their informed written consent was taken. Age, gestational age, occupation, socio-economic status, residential address, family history of diabetes, hypertension, drug history, height, weight and other relevant data were collected and recorded in a preformed data collection sheet. For laboratory investigations, required amount of blood was collected, processed and preserved for estimation of different biochemical parameters. Data were then processed, analyzed to draw a conclusion.

Anthropometric measurements

Anthropometric measurements including height in meter (m), body weight in kilogram (kg) were measured using standardized techniques. Body mass indexes (BMI) of the subjects were calculated using standard formula, BMI= Weight (kg)/ [Height (m)]^2.

Study parameter

Following study parameters were analyzed in the study subjects:

- Serum uric acid
- Serum creatinine

Laboratory investigations:

The following laboratory investigations were done for each of the subjects:

Serum Uric acid: Serum uric acid was determined by colorimetric method by using the test kit **Serum Creatinine:** Serum creatinine was estimated by colorimetric method by using the test kit

Statistical methods

All biochemical values were expressed as mean ±SD (Standard deviation). Statistical significance of difference between two groups were evaluated by using Student's unpaired 't' test. All statistical analysis were done by using SPSS (Statistical Package for Social Science) version 21 windows package.

Ethical Clearence

The study was approved by the ethics committee of the Mymensingh Medical College.

RESULTS

In this study, a total number of 120 subjects were participated. Out of them 60 normal healthy pregnant women were as control group (Group-I) and another 60 preeclamptic patients were selected as case group (Group-II). Different variables of the subjects were being analyzed and compared between Group-I and Group-II. Serum uric acid, creatinine levels were estimated from blood samples collected from 120 subjects. Some physical aspects such as maternal age, BMI, systolic (SBP) and diastolic blood pressure (DBP) of the subjects were also analyzed.

Serum uric acid and creatinine levels were expressed in mg/dl. Maternal age expressed in years, gestational age in weeks, BMI in Kg/m^2, systolic blood pressure (SBP) and diastolic blood pressure (DBP) in mm of Hg. All the values were expressed as mean ±SD and statistical significance of difference between two groups were evaluated by Student's unpaired 't' test.

$P<0.001$ considered as highly significant result.

$P<0.05$ considered as significant result.

$P\geq0.05$ considered as not significant (NS) result.

This study showed that serum uric acid and creatinine levels were higher in case (Group-II) when compared with control (Group-I) group. It was observed that mean serum uric acid, and creatinine levels were 6.91±0.58 mg/dl and 2.46±0.51 mg/dl in Group-II (case) and 4.60±0.47 mg/dl, 0.86±0.10 mg/dl and in Group-I (control) respectively. Statistical analysis of these parameter showed that the difference of mean values between case and control were significant (<0.05) and highly significant (P<0.001).

In this study mean maternal age of the Group-II (case) and Group-I (control) were 29.70 ±4.02 and 27.23±4.40 years The difference of mean values was not significant (P>0.05). Mean BMI, SBP and DBP of the subjects were higher in case than control. Mean BMI, SBP and DBP were 28.41±1.25 kg/m^2, 148.50±6.44 mm of Hg and 95.97±4.80 mm of Hg in Group-II (case)

and 26.27±1.11 kg/m², 112.3±6.93 mm of Hg and 72.73±5.32 mm of Hg in Group-I (control) respectively. When case and control were compared the difference of mean values was highly significant (p<0.001)

Analysis of clinical parameters in the study population

In this study, maternal age range was from 20 to 40 years for both case and control group. It was observed that the mean age of the Group-II (case) and Group-I (control) group were 29.70±4.02 and 27.23±4.40 years respectively and the level of significance was 0.002 (P<0.05). Thus, the difference in mean age was significant between preeclamptic patients (case) and normal healthy pregnant women. In our study, it was observed that mean BMI of the Group-II (case) and Group-I (control) were 28.41±1.25 and 26.27±1.11 Kg/m² respectively. A highly significant (P<0.001) increase in BMI was observed in preeclamptic patients (case) compared to that of the healthy pregnant women. The study was revealed that the systolic blood pressure was higher in preeclamptic (case) group than in normal healthy pregnant control group. The mean systolic blood pressure of the Group-II and Group-I were 148.50 ± 6.44 and 112.30 ±6.93 mm of Hg respectively. A highly significant (P<0.001) increase in systolic blood pressure was observed in preeclamptic patients (case) compared to that of the healthy pregnant women. On the other hand, the diastolic blood pressure was higher in preeclamptic (case) group than in normal healthy pregnant control group. The mean diastolic blood pressure of the Group-II and Group-I were 95.97±4.80 and 72.73±5.32 mm of Hg respectively. A highly significant (P<0.001) increase in diastolic blood pressure was observed in preeclamptic patients (case) compared to that of the healthy pregnant women.

The values of all the clinical and biochemical parameters of the study subjects (case and control) were presented in Table- 1

Uric acid

In this study, it was observed that the mean values of serum uric acid levels were 6.91 ±0.58 and 4.60 ±0.47 mg/dl in Group-II (case) and Group-I (control) respectively. A highly significant (P<0.001) increase in serum uric acid levels were observed in preeclamptic patients (case) when compared to that of the normal healthy pregnant women. Analysis of mean serum uric acid levels of study population were presented in fig-01

Table 1: Mean ±SD of clinical parameters of the study population

Variables	Group-I (Control) Mean ±SD	Group-II (Case) Mean ±SD	P value
Maternal age(years)	27.23±4.40	29.70±4.02	0.002^{NS}
BMI (Kg/m²)	26.27±1.11	28.41±1.25	P<0.001**
Systolic Blood Pressure (mm of Hg)	112.3±6.93	148.50±6.44	P<0.001**

P less than 0.05 taken as the level of significance.
P<0.001 considered as highly significant result.
P<0.05 considered as significant result.
P≥0.05 considered as not significant (NS) result.
SD= Standard deviation

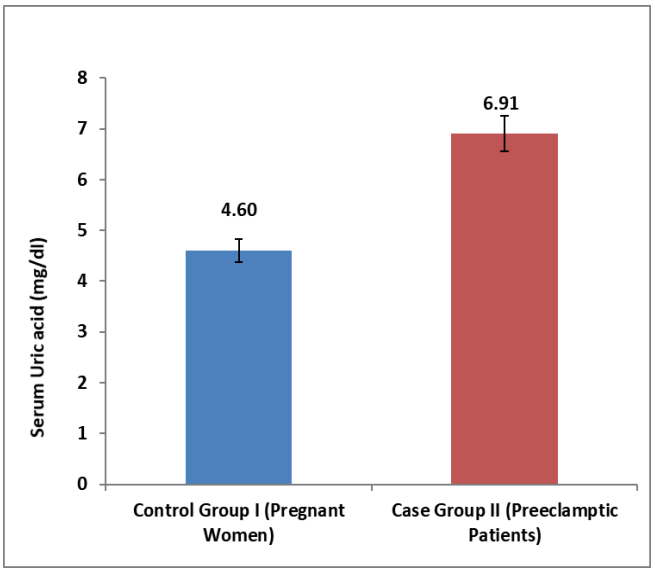

Fig-I: Comparison of mean serum uric acid levels in the study population

Creatinine

In this study, it was observed that the mean values of serum creatinine levels were 1.63 ±0.17 and 0.86 ±0.10 mg/dl in Group-II (case) and Group-I (control) respectively. A highly significant (P<0.001) increase in serum creatinine levels were observed in preeclamptic patients (case) when compared to that of the normal healthy pregnant women. Analysis of mean serum creatinine levels of study population were presented in fig I1.

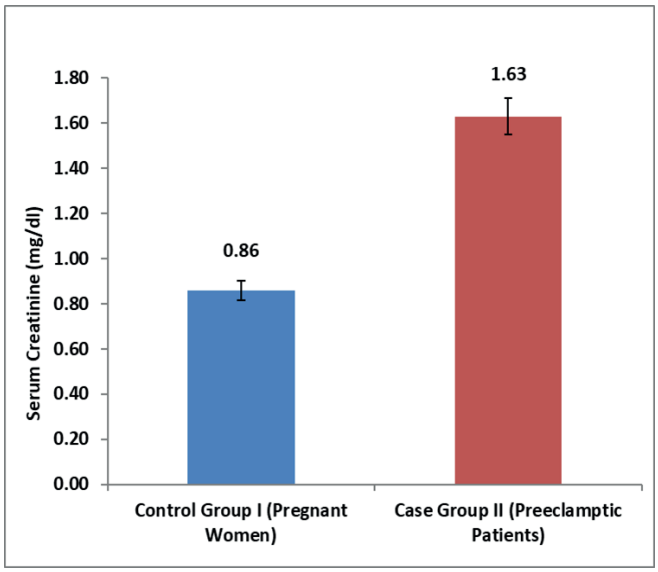

Fig- I1: Comparison of mean serum creatinine levels in the study population

Serum Uric Acid and serum Creatinine ratio:

Parameter	Case Group	Control Group	Interpretation
Median SUA/SCr	~5.0	~3.0	Higher central tendency in the case group
Interquartile Range (IQR)	~4.0 – 5.6	~2.5 – 3.8	Wider range in cases, indicating greater variability
Minimum (Whisker Low)	~2.6	~2.1	Slightly lower minimum in controls
Maximum (Whisker High)	~7.4	~5.5	Higher maximum in cases
Outliers Present	No	Yes (values >6.0)	Control group shows high-value outliers
Spread of Data	Relatively broad but compact	More tightly clustered with outliers	Controls have more extreme high SUA/SCr values
Overall SUA/SCr Level	Elevated	Lower	Suggests a potential association with case status

Description of Box Plot In this comparative analysis of SUA/SCr ratios stratified by age, boxplots illustrate distinct distributional differences between case and control groups. The case group exhibited a higher median SUA/SCr ratio (~5.0) compared to the control group (~3.0), suggesting a potential elevation in serum uric acid relative to creatinine among cases. The interquartile range (IQR) was broader in the case group (~4.0 to 5.6), reflecting greater variability within the middle 50% of the data.

Conversely, the control group displayed a narrower IQR (~2.5 to 3.8) but had several high-value outliers (>6.0), indicating the presence of individuals with disproportionately elevated SUA/SCr levels relative to the rest of the group. Despite these outliers, the overall SUA/SCr profile remained lower in the controls.

The absence of outliers in the case group and a higher upper whisker (~7.4) further reinforces a consistent elevation of SUA/SCr in this population. Collectively, these findings may suggest a potential association between elevated SUA/SCr and case status, warranting further investigation into its pathophysiological or diagnostic significance.

Result of Simple Logistic Regression:

Term	Estimate	OR (exp)	95% CI for OR	p-value	Interpretation
Intercept	-3.461	0.031	0.007 – 0.119	1.31e-06 ***	Baseline odds when SUA/SCr = 0 (not directly interpretable)
SUA/SCr	0.853	2.35	1.71 – 3.34	4.50e-07 ***	**Statistically significant**: each 1 unit increase in SUA/SCr more than doubles the odds of being a case

The SUA/SCr ratio is a highly significant predictor of disease status. An odds ratio of 2.35 means that for every 1 unit increase in SUA/SCr, the odds of being in the case group (group = 1) increase by 135%. The 95% confidence interval for the odds ratio (1.71 – 3.34) does not cross 1, confirming statistical significance. sWith a p-value of 4.5×10^{-7}, this result is highly significant, indicating a strong and likely robust association.

DISCUSSION

Preeclampsia remains a leading contributor to maternal and fetal morbidity and mortality, affecting approximately 5–7% of pregnancies globally. Despite extensive research, the precise etiology of preeclampsia is still not fully understood. However, nutritional deficiencies and metabolic disturbances have been frequently implicated, especially in low-resource settings where the prevalence of the condition is higher.

Among the many biochemical parameters investigated, serum uric acid (SUA) and serum creatinine (SCr) have emerged as potential markers associated with the onset and severity of preeclampsia[10].

In the present study, we observed a highly significant elevation in serum uric acid levels among preeclamptic patients compared to normotensive pregnant controls. Specifically, the mean ± SD SUA level was 4.60 ± 0.47 mg/dL in the control group (Group I) and 6.91 ± 0.58 mg/dL in the preeclampsia group (Group II), with a P-value of < 0.001. This result is consistent with previous research demonstrating elevated SUA in preeclampsia, which has been attributed to multiple mechanisms. These include reduced renal clearance, increased oxidative stress, accelerated tissue breakdown, and elevated xanthine oxidase activity, all of which contribute to hyperuricemia[11]. One study similarly reported increased SUA levels in preeclamptic patients compared to normotensive pregnant women, which aligns closely with our findings[12].

Nevertheless, it is important to acknowledge that not all studies are in concordance. Some have reported no significant difference in SUA levels between preeclamptic and normotensive groups. These variations may be due to differences in study design, population characteristics, timing of gestational assessment, and inclusion/exclusion criteria.

In addition to uric acid, our study also found a significant increase in serum creatinine levels in the preeclampsia group. The mean ± SD SCr was 0.86 ± 0.10 mg/dL in the control group and 1.60 ± 0.21 mg/dL in the preeclampsia group (P < 0.001). This elevation in creatinine is in line with earlier findings, which have linked preeclampsia to impaired renal function. Other studies have also shown increased creatinine levels in preeclamptic women, and have noted positive correlations between creatinine levels and both systolic and diastolic blood pressure[13].

To the best of our knowledge, recent retrospective case-control studies have explored the clinical relevance of the serum uric acid-to-creatinine ratio (SUA/SCr) in pregnancy. In our study, The SUA/SCr ratio is a highly significant predictor of disease status. An odds ratio of 2.35 means that for every 1 unit increase in SUA/SCr, the odds of being in the case group (group = 1) increase by 135%. The 95% confidence interval for the odds ratio (1.71 – 3.34) does not cross 1, confirming statistical significance. sWith a p-value of 4.5×10^{-7}, this result is highly significant, indicating a strong and likely robust association.

In one such study involving women diagnosed with preeclampsia and healthy controls (n = 84 and n = 86, respectively), significantly higher SUA/SCr values were reported in the preeclampsia group[14]. Another recent study also confirmed elevated SUA/SCr ratios among preeclamptic patients compared to normotensive pregnant women[15].

Every mother hopes for a healthy child who will reach their fullest potential in both physical and psychological growth[16]. In developing countries, around 40,000 women,

die each year due to preeclampsia or eclampsia. Preeclampsia

itself is estimated to account for about 40% to 60% of maternal deaths in developing countries[17]. Given this, the SUA/SCr ratio may serve as an indirect and early marker of increased risk for developing preeclampsia. This hypothesis is further supported by evidence suggesting xanthine oxidase hyperactivity in preeclamptic women, which points to a hyperproduction of uric acid as a primary contributor to hyperuricemia, rather than reduced excretion alone due to impaired renal function[18].

In light of our findings and consistent with the current body of literature, it is evident that both SUA and SCr are readily accessible and cost-effective biochemical markers. Our study supports the notion that their combined use, specifically through the SUA/SCr ratio, may enhance the accuracy of existing risk prediction models for preeclampsia. Furthermore, this ratio may have prognostic value, particularly in identifying patients with hyperuricemia caused by increased production rather than decreased clearance—those potentially at greater cardiovascular and obstetric risk.

CONCLUSION

The findings of this study demonstrate that serum uric acid and creatinine levels are significantly elevated in women with preeclampsia compared to normotensive pregnant women. These alterations reflect underlying renal and metabolic disturbances associated with the condition. Therefore, incorporating routine screening of serum uric acid and creatinine into antenatal care protocols may aid in the early detection of preeclampsia—potentially before the onset of clinical symptoms. Infact the higher ratio between SUA/Scr

is also an important indicator and a valid prognostic marker. Early identification and intervention could significantly improve maternal and fetal outcomes, thereby reducing the burden of preeclampsia-related complications.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request

Author Contribution

Study design: Dr. Siddika Khatun

Data gathering: Dr. Siddika Khatun, Dr. Sarwat Jahan

Data analysis: Dr. Siddika Khatun, Dr Ummey Salma

Writing and submitting manuscript: Dr. Siddika khatun,

Editing and approval of final draft: prof. Dr. AK Al Mahmood, Prof. Dr. Syeda Fahmida Afrin

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