Original Research

The Relationship Between High-Sensitivity CRP and Pre-eclampsia Severity: An Observational Study

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ABSTRACT:
Background: Preeclampsia is a multifactorial pregnancy-specific disorder marked by hypertension and proteinuria, leading to significant maternal and fetal complications. High sensitive C-reactive protein (hs-CRP), a marker of systemic inflammation, has gained attention for its possible role in predicting disease severity. **Aim:** To study whether hs-CRP has any prognostic significance in determining the severity of preeclampsia. **Materials and Methods:** A comparative observational study was conducted on 90 pregnant women in their third trimester. Participants were categorized into three groups: Group I (30 normotensive healthy pregnant women), Group II (30 women with mild preeclampsia), and Group III (30 women with severe preeclampsia). hs-CRP levels were estimated using immunoturbidimetric assay. Blood pressure, gestational age, and birth weight were also recorded. Data analysis was performed using SPSS version 16.0 with $p<0.05$ considered statistically significant. **Results:** hs-CRP levels were significantly higher in the preeclamptic groups compared to controls, with the highest levels observed in severe preeclampsia (5.08 ± 0.34 mg/L), followed by mild PE (2.95 ± 0.25 mg/L), and controls (1.12 ± 0.21 mg/L) ($p<0.0001$). hs-CRP showed strong positive correlations with systolic and diastolic blood pressures and a significant negative correlation with neonatal birth weight, particularly in the severe PE group. **Conclusion:** hs-CRP is significantly elevated in preeclampsia, correlating with disease severity. It may serve as a valuable prognostic biomarker in predicting maternal hypertension and fetal compromise in preeclamptic pregnancies.
Keywords: High-sensitive CRP, preeclampsia, inflammation, biomarker, birth weight, hypertension

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INTRODUCTION

Preeclampsia is a complex multisystem disorder of pregnancy, characterized by the new onset of hypertension and proteinuria after 20 weeks of gestation. It remains a leading cause of maternal and perinatal morbidity and mortality worldwide, particularly in low- and middle-income countries [1]. Despite extensive research, the exact pathophysiological mechanisms underlying preeclampsia remain incompletely understood. However, it is widely accepted that endothelial dysfunction, systemic inflammation, and abnormal placentation are key contributing factors [2].

Among the biomarkers implicated in the inflammatory cascade of preeclampsia, high-sensitive C-reactive protein (hs-CRP) has gained attention due to its sensitivity in detecting subclinical inflammation. hs-CRP is a hepatic acute-phase reactant regulated by interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), and even mild elevations are considered predictive of cardiovascular and metabolic disorders [3]. Pregnancy itself is a pro-inflammatory state, but the exaggerated inflammatory response seen in preeclampsia is reflected by significantly elevated hs-CRP levels [4].

Recent literature suggests that elevated hs-CRP levels may correlate with the severity of preeclampsia, possibly serving as a prognostic biomarker [5]. Increased hs-CRP levels have been associated with early-onset preeclampsia, severe hypertension, fetal growth restriction, and adverse perinatal outcomes [6]. Its role as a non-invasive and cost-effective biomarker makes hs-CRP a promising candidate for monitoring the progression and severity of preeclampsia in clinical settings.

Some studies propose that the exaggerated inflammatory milieu seen in severe preeclampsia contributes to endothelial activation and dysfunction, both central features of disease pathology [7]. hs-CRP, therefore, may reflect not only systemic inflammation

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but also the degree of vascular injury, which aligns with disease progression. Moreover, the persistent elevation of hs-CRP during gestation has been linked to oxidative stress and placental hypoxia, further supporting its role in the pathogenesis of preeclampsia [8].

Despite these associations, the utility of hs-CRP as a prognostic indicator in preeclampsia is still under investigation. Various studies report conflicting results regarding its sensitivity and specificity in predicting disease severity. Some suggest that hs-CRP levels rise significantly only in severe cases, while others find minimal variation between mild and severe preeclampsia [9].

Given these ambiguities, further investigation is warranted to clarify the prognostic value of hs-CRP in preeclampsia. Thus, the present study aims **to evaluate the levels of high-sensitive CRP in patients with preeclampsia and to assess whether this parameter holds any prognostic significance in determining the severity of the disease**. Establishing a reliable association could facilitate early risk stratification, targeted monitoring, and improved maternal-fetal outcomes.

MATERIAL AND METHODS

A hospital-based observational comparative study was conducted in the Department of Obstetrics and Gynecology at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of 12 months and included a total of 90 pregnant women in their third trimester, who were divided into three groups.

Group I consisted of 30 healthy, normotensive pregnant women serving as controls.

Group II included 30 pregnant women diagnosed with mild preeclampsia.

Group III comprised 30 pregnant women diagnosed with severe preeclampsia.

Preeclampsia was diagnosed based on the criteria defined by the American College of Obstetricians and Gynecologists (ACOG), which includes systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg measured on two occasions at least four hours apart after 20 weeks of gestation in a previously normotensive woman, along with proteinuria ≥300 mg in a 24-hour urine specimen. Severe preeclampsia was defined by systolic BP ≥160 mmHg and/or diastolic BP ≥110 mmHg, along with evidence of end-organ dysfunction such as elevated liver enzymes, thrombocytopenia, or renal impairment.

Inclusion criteria included pregnant women aged 18–35 years, with singleton pregnancies and gestational age ≥28 weeks, who fulfilled the diagnostic criteria for mild or severe preeclampsia.

Exclusion criteria comprised women with chronic hypertension, renal or hepatic disorders, diabetes mellitus, autoimmune diseases, multiple pregnancies, infections, or any known inflammatory conditions.

After obtaining written informed consent from all participants, detailed demographic and clinical data were recorded, including age, gestational age, blood pressure readings, and obstetric history. Venous blood samples were collected under aseptic conditions after an overnight fast.

Serum was separated and stored at –20°C until analysis. The levels of high-sensitive C-reactive protein (hs-CRP) were measured using an immunoturbidimetric assay with a high-sensitivity CRP kit and automated biochemistry analyzer. All biochemical tests were performed in accordance with manufacturer protocols in the central clinical laboratory.

The data were compiled using Microsoft Excel and analyzed using SPSS version 22.0 (IBM Corp., USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were represented as frequency and percentage. Comparison of hs-CRP levels between the three groups was performed using one-way ANOVA followed by post hoc Tukey's test for intergroup comparison. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1 presents the demographic and clinical parameters of the study participants across the three groups. There was no statistically significant difference in maternal age among the groups. However, the gestational age at the time of serum sampling was significantly lower in the mild and severe preeclampsia groups compared to the control group ($p = 0.0003$ and $p< 0.0001$, respectively). Both systolic and diastolic blood pressures were significantly elevated in the preeclamptic groups compared to controls ($p< 0.0001$), with the highest values noted in the severe preeclampsia group. Similarly, the mean birth weight of neonates was significantly lower in both preeclamptic groups, with the most profound reduction observed in severe preeclampsia cases ($p< 0.0001$).

Table 2 highlights the comparison of hs-CRP levels among the three groups. The mean hs-CRP level in the control group was 1.12 ± 0.21 mg/L, whereas it increased to 2.95 ± 0.25 mg/L in mild preeclampsia and further rose to 5.08 ± 0.34 mg/L in severe preeclampsia. These differences were highly statistically significant between all groups ($p< 0.0001$), suggesting a strong association between elevated hs-CRP levels and the severity of preeclampsia.

Table 3 shows the correlation analysis between hs-CRP levels and clinical parameters in preeclamptic patients. In group II (mild preeclampsia), hs-CRP levels were positively correlated with systolic (r = 0.38, $p = 0.01$) and diastolic blood pressure (r = 0.70, $p< 0.0001$), and negatively correlated with birth weight (r = –0.39, $p = 0.02$). In group III (severe preeclampsia), these correlations were even stronger,

with r values of 0.85 and 0.89 for systolic and diastolic blood pressures respectively (*p*< 0.0001 for both), and –0.41 for birth weight (*p* = 0.01). These findings indicate a direct and progressive relationship between rising hs-CRP levels, increased blood pressure, and reduced neonatal birth weight as disease severity increases.

Table 1: Demographic Parameters in Studied Groups

Parameters	Group I (Control) (n = 30)	Group II (Mild PE) (n = 30)	P (I vs II)	Group III (Severe PE) (n = 30)	Pa (II vs III)	Pb (I vs III)
Maternal age (yrs)	23.8 ± 2.6	23.4 ± 2.7	0.39	22.6 ± 2.3	0.11	0.09
Gestational age at sampling (wks)	36.2 ± 1.4	34.4 ± 2.4	0.0003	33.0 ± 1.7	0.01	<0.0001
Systolic BP (mm Hg)	117.6 ± 5.2	150.7 ± 4.5	<0.0001	169.2 ± 4.1	<0.0001	<0.0001
Diastolic BP (mm Hg)	78.2 ± 4.8	98.9 ± 3.5	<0.0001	118.3 ± 3.7	<0.0001	<0.0001
Birth weight (kg)	2.91 ± 0.17	2.57 ± 0.08	<0.0001	2.30 ± 0.08	<0.0001	<0.0001

Table 2: hs-CRP Levels in Studied Groups

Parameter	Group I (Control) (n = 30)	Group II (Mild PE) (n = 30)	P (I vs II)	Group III (Severe PE) (n = 30)	Pa (II vs III)	Pb (I vs III)
hs-CRP (mg/L)	1.12 ± 0.21	2.95 ± 0.25	<0.0001	5.08 ± 0.34	<0.0001	<0.0001

Table 3: Correlation Coefficient in Group II (Mild PE) and Group III (Severe PE)

Correlation With	Group II (Mild PE) r value	Group II p value	Group III (Severe PE) r value	Group III p value
Systolic BP	0.38	0.01	0.85	<0.0001
Diastolic BP	0.70	<0.0001	0.89	<0.0001
Birth Weight	–0.39	0.02	–0.41	0.01

DISCUSSION

Preeclampsia (PE) is a complex pregnancy-specific disorder characterized by the triad of hypertension, proteinuria, and multi-organ dysfunction, commonly manifesting after 20 weeks of gestation. Increasing evidence suggests that systemic inflammation and endothelial dysfunction play a pivotal role in its pathogenesis. In this context, high-sensitive C-reactive protein (hs-CRP), a marker of low-grade systemic inflammation, has emerged as a potential biomarker in assessing both the presence and severity of preeclampsia.

The present study demonstrated significantly elevated hs-CRP levels in both mild and severe preeclamptic women when compared to normotensive pregnant controls. Moreover, hs-CRP levels were considerably higher in women with severe PE compared to those with mild PE. This pattern reinforces the growing belief that the inflammatory response intensifies with the progression of preeclampsia and that hs-CRP levels could serve as an indicator of disease severity.

These findings are consistent with earlier studies that link raised hs-CRP levels with increased endothelial dysfunction and oxidative stress in preeclampsia. For instance, Verlohren et al. reported that elevated inflammatory markers including hs-CRP were associated with more severe vascular involvement in PE patients, correlating with both maternal symptoms and fetal outcomes [11]. Additionally, a study by Elsharkawy et al. found that hs-CRP levels above 3 mg/L were predictive of adverse maternal outcomes such as early-onset hypertension and organ injury [12].

In our study, a strong positive correlation was observed between hs-CRP levels and both systolic and diastolic blood pressures, particularly in the severe PE group (r = 0.85 and r = 0.89, respectively). These findings suggest a proportional relationship between inflammatory burden and hypertension severity in PE, possibly due to immune-mediated vascular damage. Similar observations were made by Ertas et al., who highlighted the role of CRP as a reflection of the systemic vasoconstriction that characterizes worsening PE [13].

Additionally, the negative correlation between hs-CRP and neonatal birth weight suggests that inflammation not only affects maternal health but also impairs uteroplacental perfusion, leading to intrauterine growth restriction (IUGR). This aligns with a recent multicenter analysis by Basak et al., where elevated hs-CRP was significantly associated with fetal compromise and increased neonatal intensive care admissions [14].

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Given that hs-CRP is easily measurable and routinely available in most laboratories, its use as a prognostic tool in antenatal care holds promise. However, it is important to note that hs-CRP is a non-specific inflammatory marker and can be influenced by infections, chronic diseases, and lifestyle factors. Therefore, interpretation must always be done in the appropriate clinical context.

Furthermore, while our study supports the prognostic value of hs-CRP in PE, future longitudinal studies are necessary to validate cut-off values, predictive accuracy, and integration into antenatal screening algorithms. Recent work by Nair et al. emphasized the potential role of hs-CRP as part of a multi-marker panel for predicting hypertensive disorders in pregnancy [15].

CONCLUSION

This study demonstrates that hs-CRP levels are significantly elevated in women with preeclampsia and that the magnitude of elevation correlates with the clinical severity of the disease. The strong positive correlation with blood pressure and negative association with birth weight reinforce its role in both maternal and fetal outcome prediction.

Thus, hs-CRP may serve as a useful, cost-effective, and easily accessible inflammatory biomarker for the prognostication of preeclampsia severity. Incorporating hs-CRP into routine antenatal assessment protocols—especially in high-risk pregnancies—may aid in early risk stratification, improved monitoring, and timely intervention to reduce morbidity and mortality.

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