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Original Research Article

First trimester blood indices: a predictor of early and late onset preeclampsia

Meera*, Ambika Patil

Department of Obstetrics and Gynecology, Al-Ameen Medical College and Hospital, Vijaypura, Karnataka, India

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***Correspondence:**
Dr. Meera,
E-mail: meerajabnoor01@gmail.com

ABSTRACT

Background: Preeclampsia is a condition that falls under the hypertension spectrum and is more common in pregnant women who are 20 weeks or older. It causes complications in 2% to 8% of pregnancies. This study sought to identify haematological preeclampsia markers in pregnant women who received prenatal care at tertiary care centre at Vijayapur, Karnataka, India.

Methods: This was a case-control study conducted at a tertiary care centre in Vijayapura Karnataka, from 01 December 2023 to 31 May 2024. A total of 75 preeclamptic patients with early (<34 weeks of gestation) and late presentation (≥34 weeks of gestation) were selected as cases and equal number of normotensive pregnant females were taken as controls. All the cases and controls were analysed for blood indices. The means of continuous variables were compared with two tailed students t-test by using SPSS version 26.0 statistical software.

Results: In the present study, we observed that 75 patients with diagnosed cases of preeclampsia, among them, 42.1% were early onset preeclampsia and 56.6% were late onset. After comparing means of blood indices between early and late onset of preeclampsia showed, WBC (early- 17.92±0.98; late- 16.08±0.78), neutrophils (early- 77.52±1.22; late- 75.97±0.47), lymphocytes (early- 26.33±.2.78; late- 31.01±2.62), platelets (early- 128.59±2.22; late- 131.93±3.62), NLR (early- 2.97±0.28; late- 2.46±0.19), PLR (early- 4.93±0.46; late- 4.28±0.34) and the statistical significant difference ($p<0.05$) seen in these parameters. Blood indices of cases and controls were as follows, hemoglobin (cases- 10.45±1.31; controls- 10.89±0.53), MCV (cases- 87.67±1.39; controls- 85.14±2.82), RDW (cases- 13.09±78; controls- 13.80±0.0), WBC (cases- 16.87±1.6; controls- 15.58±1.22), eosinophils (cases- 4.49±0.79; controls- 4.08±0.47), lymphocytes (cases- 29.01±3.54; controls- 22.73±0.86), platelets (cases- 130.16±3.50; controls- 132.16±3.98), NLR (cases- 2.68±0.34; controls- 3.65±4.09), PLR (cases- 4.55±0.51; controls- 5.82±0.24). There was a significant difference ($p<0.05$) between cases and controls in above parameters. According to these results, blood indices of preeclampsia with early and late onset differed significantly from healthy controls.

Conclusions: According to the study's findings, elevated first-trimester RDW, WBC, neutrophils, lymphocytes, platelets, and NLR/PLR ratios may serve as clinically valuable indicators for preeclampsia prediction. Changes in several indicators point to a possible major role for inflammation in the pathophysiology of preeclampsia.

Keywords: Blood indices, Hematocrit, NLR, PLR, Preeclampsia, RDW

INTRODUCTION

A severe condition known as preeclampsia is characterized by the development of new hypertension beyond 20 weeks of gestation, along with proteinuria or other end-organ dysfunctions in the mother. This condition can cause morbidity and mortality in both the mother and the fetus.[1] It has been found that preeclampsia accounts for 18% of maternal mortality.[2] Preeclampsia occurs early if the illness starts before 34 weeks of pregnancy and late if it starts beyond 34 weeks.[3] Preeclampsia is a systemic illness that can lead to many organ dysfunctions in mothers, such as hepatic, renal, pulmonary, neurological, and hematologic issues. Furthermore, oligohydramnios,

growth restriction, premature birth, placental abruption, and perinatal death are among the foetal issues that preeclampsia can cause.[5] Preeclampsia later in pregnancy is caused by insufficiency from trophoblastic invasion in the first trimester, according to data from earlier publications.[6] The participation of T-helper 1 (Th1) and T-helper 2 (Th2) cells in the inflammatory response is another condition of systemic inflammation in preeclampsia. Furthermore, it was discovered that decidual lymphocytes and peripheral mononuclear blood cells produce enough Th1 cytokines in preeclamptic patients.[7] Preeclampsia is also thought to be caused by the involvement and over-reactivation of inflammatory cells as well as immune responses that release inflammatory cytokines and antibodies that cause endothelial disorders like increased vascular tone, microvascular thrombosis, and capillary permeability.[8]

The International Society for Study of Hypertension in Pregnancy (ISSHP) advises that in order to diagnose preeclampsia and identify maternal organ dysfunction, pregnant women with de novo hypertension should undergo laboratory testing that measures serum creatinine, platelet count, haemoglobin, liver enzymes, and serum uric acid.[9] In contrast, in Ethiopia, the diagnosis and prognosis of PE mostly depend on the evaluation of a few risk factors and a limited number of diagnostic techniques (such as proteinuria and blood pressure). The risk variables that have been found are insufficient in accurately predicting the beginning of the condition, despite its great incidence. Furthermore, prophylactic treatments only slightly lower a woman's chance of developing preeclampsia.[10] Therefore, it is essential to be able to forecast the risk of preeclampsia early in pregnancy utilizing an effective, simple, and inexpensive laboratory procedure to avert complications and improve outcomes. Therefore, this study set out to determine the haematological indicators of preeclampsia in pregnant women.

METHODS

This was a case-control study conducted at a tertiary care centre in Vijayapura Karnataka, IND, over a period of six months. Total 75 patients with preeclampsia were selected as cases and equal number of normotensive pregnant females were taken as controls. All the cases were selected after strictly adhering to certain inclusion and exclusion criteria.

Study design

This was a case-control study conducted between 01 December 2023 to 31 May 2024 at a tertiary care centre in Vijayapura Karnataka, IND.

Population

Total of 75 patients with preeclampsia were selected as cases, among them 32 (42.1%) were <34 weeks of gestation taken as early onset of preeclampsia (EOPE) and 43 (56.6%) were ≥34 weeks of gestation late onset of preeclampsia (LOPE). Equal number of normotensive pregnant females were taken as controls.

Data collection

All the participants of the current study were assessed for blood indices like Hb, haematocrit, MCV, RDW, WBC, neutrophils, eosinophils, lymphocytes, basophils, platelets, urine routine for protein and the data was calculated for NLR and PLR.

Inclusion criteria

Patients with gestational age ≥20 weeks. Blood pressure of ≥140/90 mmHg. Proteinuria.

Exclusion criteria

Patients with eclampsia. The study excluded pregnant women with heart, renal, or hepatic dysfunction, inflammation, active infection, smoking, haematological diseases, poor past obstetric history (such as repeated miscarriages, preterm labour, intrauterine growth restriction), gestational or insulin-dependent diabetes, and haematological disorders. Patients not giving consent.

Statistical method employed for analysis of data

All the collected data was entered in Microsoft excel sheet and was imported to SPSS version 26.0 statistical software for the analysis. Descriptive statistics were used for calculation of frequency, mean, mode, standard deviation and two tailed students t-test were used for the comparing the means of two continuous variables. Finally, results obtained were represented as tables and diagrams.

RESULTS

According to Table 1, statistically significant difference (<0.05) seen in parameters like, WBC, neutrophils, eosinophils, lymphocytes, platelets, NLR, PLR.

As per Table 2, there was a significant difference (<0.05) for the blood indices seen between cases and controls (Hb, MCV, RDW, WBC, eosinophils, lymphocytes, platelets, PLR).

Management

All the patients who came with preeclampsia during ANC visits were assessed and given tablet labetalol 100 mg OD/BD depending upon blood pressure levels and monitored on weekly bases with USG doppler to look for foetal growth restriction and for AFI (amniotic fluid index). Along with this, oral iron and calcium supplementations were also given until delivery.

Table 1: Comparing the blood indices changes between early onset of preeclampsia and late onset of preeclampsia.

Parameters	EOPE	LOPE	P value
Haemoglobin (gm/dl)	10.68±0.56	10.51±0.47	0.161
Haematocrit (%)	37.99±1.59	37.94±1.35	0.872
MCV	87.95±1.85	87.46±0.89	0.134
RDW (%)	12.58±0.77	12.40±0.65	0.266
WBC (10^3/µl)	17.92±0.98	16.08±0.78	0.000
Neutrophils (%)	77.52±1.22	75.97±0.47	0.000
Eosinophils (%)	4.33±0.65	4.60±0.88	0.142
Basophils (%)	0.50±0.50	0.48±0.50	0.922
Lymphocytes (%)	26.33±2.78	31.01±2.62	0.000
Platelets (10^3/µl)	128.59±2.22	131.93±3.62	0.000
NLR	2.07±0.28	2.46±0.19	0.000
PLR	4.93±0.46	4.28±0.34	0.000

Hb- hemoglobin, MCV- mean corpuscular volume, RDW- red cell distribution width, WBC- white blood cells, NLR- neutrophils to lymphocytes ratio, PLR- platelets to lymphocytes ratio.

Table 2: Comparing the blood indices changes between cases and controls.

Parameters	Cases	Controls	P value
Haemoglobin (gm/dl)	10.45±1.31	10.89±0.53	0.009
Haematocrit (%)	37.96±1.45	38.04±1.64	0.744
MCV	87.67±1.39	85.14±2.82	0.000
RDW (%)	13.09±0.78	13.80±0.00	0.000
WBC (10^3/µl)	16.87±1.26	15.58±1.22	0.000
Neutrophils (%)	76.63±1.16	83.00±92.50	0.552
Eosinophils (%)	4.92±0.79	4.80±0.47	0.000
Basophils (%)	0.49±0.50	0.48±0.50	0.871
Lymphocytes (%)	29.01±3.54	22.73±0.86	0.000
Platelets (10^3/µl)	130.50±3.50	132.16±3.98	0.008
NLR	2.68±0.34	3.65±4.09	0.042
PLR	4.55±0.51	5.82±0.24	0.000

Hb- hemoglobin, MCV- mean corpuscular volume, RDW- red cell distribution width, WBC- white blood cells, NLR- neutrophils to lymphocytes ratio, PLR- platelets to lymphocytes ratio.

DISCUSSION

Preeclampsia is a progressive, unpredictable, and incurable disease for which there is currently no treatment other than ending the pregnancy. It is crucial to detect preeclampsia as soon as possible in order to monitor the patient's clinical condition and the pregnancy so that mothers and children conceived can be born.[11] These days, EOPE and LOPE are recognized as two distinct illnesses with distinct pathophysiologies. EOPE is mostly linked to impaired placental development in the early stages of pregnancy, while LOPE is more commonly connected with maternal vascular instability brought on by endothelial damage. The reciprocal impact of these several dysfunctions is increased inflammation, and it is believed that these inflammatory alterations or processes are to blame for the difficulties that affect both the mother and the fetus.[12]

In this study we analysed blood indices in early onset of preeclampsia (EOPE), late onset of preeclampsia (LOPE) and healthy pregnant women as controls. As per Table 1, our data showed that, WBC in EOPI was 17.92±0.98 this finding was significantly higher as compared to LOPE (16.08±0.78) with (p<0.000) suggest statistically significant. Neutrophils in EOPI was 77.52±1.22 and in LOPE it was 75.97±0.47 with p<0.000 showed statistically significant.

Likewise, lymphocytes in EOPE and LOPE were 26.33±2.78 and 31.01±2.62 respectively and it showed statistically significant difference between the two groups (p<0.000). Platelets in EOPE 128.59±2.22 and in LOPE was 131.93±3.62 with (p<0.000). Neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR) in EOPI were 2.07±0.28, 4.93±0.46 and in LOPE they were 2.46±0.19, 4.28±0.34 respectively with (p<0.000) showed statistically significant difference. Apart from these factors, there was a statistical difference between early and late onset preeclampsia. Wu et al found a significant correlation between LOPE and a white blood cell count of >10×10^9/l during the first and second

trimesters.[13] This finding is in line with our own research and Research by Örgül et al revealed comparable results.[14] Our research indicates that there is a large increase in neutrophils in EOPE when compared to LOPE, which may indicate that the inflammatory cascade is activated NLR of EOPE (2.07±0.28) and NLR of LOPE (2.46±0.19) with (p<0.000) demonstrating statistically significant difference between two groups were other significant blood index alterations observed in our study. At the conclusion of pregnancy, NLR and MPV looked to be larger and PLR lower in the PE group compared to the controls, according to a Mannaerts et al study.[15] Similarly, differences were observed in PLR between the two groups (EOPE-PLR 4.93±0.46 and LOPE-PLR 4.28±0.34). According to Aktün Lebriz et al study (2016), there is a significant correlation between high levels of NLR and PDW, as well as low lymphocyte count levels and early-onset preeclampsia.[16] We also found that NLR was low in early-onset preeclampsia.

Table 2 shows that when we compared the means of blood indices between the cases and the controls, we found that several parameters, including hemoglobin, MCV, RDW, WBC, eosinophils, lymphocytes, platelets, and PLR, had changed in a way that was statistically significant (p<0.000). Hemoglobin decreases because of hemoconcentration in later weeks of gestation. According to Kirbas et al, the severe preeclampsia group had considerably higher NLR levels than the control group (p<0.001), while in our analysis, the only difference between the patients and controls was in PLR.[17] Preeclampsia was associated with higher white blood cell (WBC) and neutrophil counts, lower platelet counts, and an NLR value that was significantly higher in PE patients than in GH patients (p=0.011) according to a retrospective study by Jeon et al on blood indices of preeclampsia, gestational hypertension, and healthy controls.[18] PLR value was lower in PE patients as compared to GH patients; this study is like the one being conducted now.

NLR and PLT are two other inflammatory markers that can easily be calculated. An elevated NLR in cardiovascular disorders has been well-documented in the literature as a predictive factor, and in preeclampsia, neutrophilia with a stable lymphocyte count is associated with an elevated NLR.[19] According to several studies, an increased NLR may be a useful marker for predicting the severity of the condition and preeclampsia.[20] Our findings indicate that blood index values can be used to predict the incidence of preeclampsia. These parameter checks are quick, inexpensive, and simple to perform. Clinicians can identify women who may be at risk for preeclampsia without exhibiting any symptoms by using the study's data. Future research with bigger sample sizes is anticipated to investigate the deeper potential application of blood index values alone as a predictor of preeclampsia incidence.

Due to the small sample size and potential confounding variables like body mass index and systemic disease, the results of this study may not be clearly visible.

CONCLUSION

Finally, we have shown that the only CBC indices linked to the onset time of preeclampsia are leucocytosis, neutrophilia, lymphocytosis, platelets, and NLR and PLR in cases of early onset preeclampsia. When comparing the EOPE group to the LOPE group and healthy controls, we found no discernible differences in the other inflammatory indicators (hematocrit, MCV, RDW, eosinophils, and basophils). It is necessary to do more carefully planned studies involving many centers to determine whether first trimester CBC parameters differ in EOPE.

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