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Original Article

Correlation of Coagulation Parameters (PT, APTT) with Ocular Fundus Changes in Preeclampsia and Eclampsia

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ABSTRACT

Background: Preeclampsia and eclampsia are hypertensive disorders of pregnancy associated with multisystem involvement, including coagulation abnormalities and ocular fundus changes. Both reflect underlying endothelial dysfunction and disease severity. The present study aimed to evaluate the correlation between coagulation parameters—prothrombin time (PT) and activated partial thromboplastin time (aPTT)—and ocular fundus changes in preeclampsia and eclampsia.
Methods: This prospective observational study was conducted over one year at Muzaffarnagar Medical College, Uttar Pradesh. A total of 130 pregnant women diagnosed with preeclampsia or eclampsia were enrolled. Detailed clinical evaluation, coagulation profile assessment (PT, INR, and aPTT), and ophthalmologic fundus examination were performed. Fundus findings were graded based on severity. Statistical analysis was carried out using SPSS version 26.0. Correlation between coagulation parameters and fundus changes was assessed using Pearson's or Spearman's correlation tests, as appropriate.
Results: Abnormal fundus findings were observed in 64.6% of patients. Mean PT, INR, and aPTT values were significantly higher in patients with abnormal fundus findings compared to those with normal fundus ($p < 0.001$). A significant moderate positive correlation was observed between the severity of fundus changes and PT ($r = 0.48$), INR ($r = 0.51$), and aPTT ($r = 0.44$), all with p-values < 0.001.
Conclusion: Coagulation abnormalities show a significant positive correlation with ocular fundus changes in preeclampsia and eclampsia. Combined assessment of coagulation parameters and fundus examination may serve as a useful tool for evaluating disease severity and guiding clinical management.

Keywords*: Preeclampsia; Eclampsia; Prothrombin Time; Activated Partial Thromboplastin Time; Ocular Fundus Changes; Coagulation Abnormalities.*

INTRODUCTION

Preeclampsia and eclampsia are serious hypertensive disorders of pregnancy and remain major contributors to maternal and perinatal morbidity and mortality worldwide, particularly in developing countries like India [1]. Preeclampsia is characterised by new-onset hypertension and proteinuria after 20 weeks of gestation, while eclampsia represents the severe end of the disease spectrum, marked by the occurrence of seizures not attributable to other neurological causes [2]. These conditions are associated with multisystem involvement affecting the cardiovascular, renal, hepatic, neurological, haematological, and ocular systems.

The pathophysiology of preeclampsia is complex, involving abnormal placentation, endothelial dysfunction, vasospasm, and activation of the coagulation cascade [3]. Endothelial injury leads to platelet activation and consumption of clotting factors, resulting in a hypercoagulable state that may progress to coagulation abnormalities in severe cases [4]. Alterations in coagulation parameters such as prothrombin time (PT) and activated partial thromboplastin time (aPTT) have been documented in preeclampsia and eclampsia. They are considered markers of disease severity and systemic involvement [5].

Ocular manifestations are common in hypertensive disorders of pregnancy and reflect the underlying systemic vascular pathology. Retinal changes occur due to vasospasm, increased vascular permeability, and ischemia, resulting in arteriolar narrowing, haemorrhages, exudates, and, in severe cases, papilledema [6]. The fundus examination provides a unique opportunity to directly visualise the microvasculature and has been regarded as a window to assess the severity of hypertensive damage in preeclampsia and eclampsia [7].

Several studies have demonstrated an association between the severity of retinal changes and adverse maternal and fetal outcomes [8]. However, limited data are available correlating coagulation abnormalities with ocular fundus changes in preeclampsia and eclampsia. Understanding this relationship is clinically relevant, as both coagulation derangement and retinal involvement are manifestations of widespread endothelial dysfunction and microvascular damage [9].

Early identification of patients at risk of severe disease through simple laboratory parameters and fundoscopic findings may help in risk stratification, closer monitoring, and timely intervention [10]. Therefore, the present study was undertaken to evaluate the correlation between coagulation parameters (PT and aPTT) and ocular fundus changes in patients with preeclampsia and eclampsia at a tertiary care teaching hospital.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted over a period of one year from March 2024 to Sept 2025 in the Department of Obstetrics &Gynaecology in collaboration with the Departments of Biochemistry and Ophthalmology at Muzaffarnagar Medical College, Uttar Pradesh, India.

Study Population

A total of 130 pregnant women diagnosed with preeclampsia and eclampsia were enrolled consecutively. Patients were recruited from the antenatal wards, emergency department, and labour room of Muzaffarnagar Medical College.

Inclusion Criteria

- Pregnant women aged 18–45 years
- Gestational age ≥ 20 weeks
- Clinically diagnosed cases of preeclampsia and eclampsia according to ACOG criteria:
    - Preeclampsia: Blood pressure ≥140/90 mmHg on two occasions ≥4 hours apart, after 20 weeks of gestation, with proteinuria ≥300 mg/24 hr or protein/creatinine ratio ≥0.3
    - Eclampsia: Preeclampsia with seizures not attributable to other causes

Exclusion Criteria

- Pre-existing liver or kidney disease
- Coagulation disorders or anticoagulant therapy before admission
- Chronic hypertension prior to pregnancy
- Diabetes mellitus
- HIV, hepatitis, or other systemic illnesses
- Ocular pathology unrelated to hypertensive disorders of pregnancy

Ethical Considerations

Approval was obtained from the **Institutional Ethics Committee** of Muzaffarnagar Medical College. Written informed consent was taken from all participants after explaining the purpose, procedures, benefits, and risks of the study in the local language.

Clinical Assessment

Upon admission, a detailed **history and physical examination** were recorded, including:

- Age
- Gestational age
- Parity
- Blood pressure measurement (sitting position, mercury sphygmomanometer)
- Proteinuria by dipstick and/or 24-hour urinary protein

Ophthalmologic Evaluation

All subjects underwent a comprehensive ocular fundus examination by an experienced ophthalmologist within 24 hours of enrollment:

1. Visual acuity assessment (Snellen's chart)

2. Pupillary examination
3. Fundus examination using:
    - Direct and indirect ophthalmoscopy
    - Fundus photography, where available

Fundus findings were documented and graded as:

- Normal
- Mild arteriolar changes
- Moderate-severe arteriolar changes
- Exudates, haemorrhages, or papilledema

Sample Collection and Laboratory Analysis

Blood Sampling

- 5 mL of venous blood was drawn from each participant using aseptic technique into a sodium citrate anticoagulated tube (9:1 ratio) for coagulation studies.
- Samples were transported immediately to the Biochemistry Laboratory and centrifuged at 3000 rpm for 15 minutes to obtain platelet-poor plasma.

Coagulation Parameters

1. **Prothrombin Time (PT)**
    - Performed using standard commercial reagents
    - Results expressed in **seconds** and **International Normalized Ratio (INR)**
2. **Activated Partial Thromboplastin Time (aPTT)**
    - Measured using a standard coagulometer
    - Results expressed in **seconds**

Quality control procedures were followed as per the manufacturer's recommendations.

Data Collection and Management

Data were recorded on pre-designed case record forms. Information included:

- Demographic and clinical data
- Blood pressure readings
- Urinalysis results
- Fundus examination findings
- PT, INR, and aPTT values

Data were entered into a secure database and verified for accuracy by two independent investigators.

Statistical Analysis

Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were summarised as frequencies and percentages. The correlation between coagulation parameters, namely prothrombin time (PT) and activated partial thromboplastin time (aPTT), and ocular fundus changes was assessed using Pearson's correlation coefficient for normally distributed variables and Spearman's rank correlation test for non-parametric data. Comparisons between groups were performed using the Student's t-test for parametric data and the Mann–Whitney U test for non-parametric data. Associations between categorical variables were analysed using the Chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

A total of 130 pregnant women diagnosed with preeclampsia and eclampsia were included in the study. The analysis focused on demographic characteristics, distribution of ocular fundus changes, coagulation parameters, and their correlation.

Table 1: Demographic and Clinical Characteristics of Study Participants (n = 130)

Variable	Mean ± SD / n (%)
Age (years)	26.8 ± 4.3
Gestational age (weeks)	33.6 ± 3.9
Primigravida	78 (60.0%)
Multigravida	52 (40.0%)
Preeclampsia	92 (70.8%)
Eclampsia	38 (29.2%)
Systolic BP (mmHg)	164.5 ± 18.6
Diastolic BP (mmHg)	108.2 ± 12.4

Table 2: Distribution of Ocular Fundus Findings

Fundus Finding	Number (n)	Percentage (%)
Normal fundus	46	35.4
Mild arteriolar narrowing	38	29.2
Moderate–severe arteriolar changes	26	20.0
Haemorrhages/exudates	14	10.8
Papilledema	6	4.6
Total	**130**	**100**

Table 3: Coagulation Parameters in Study Population

Parameter	Mean ± SD	Reference Range
Prothrombin Time (PT) (seconds)	14.9 ± 2.6	11–15
INR	1.18 ± 0.22	0.8–1.2
aPTT (seconds)	36.7 ± 6.4	25–35

Table 4: Comparison of Coagulation Parameters Based on Fundus Changes

Parameter	Normal Fundus (n=46)	Abnormal Fundus (n=84)	p-value
PT (seconds)	13.6 ± 1.9	15.7 ± 2.8	<0.001
INR	1.05 ± 0.14	1.26 ± 0.23	<0.001
aPTT (seconds)	33.9 ± 4.8	38.3 ± 6.7	<0.001

Student's t-test applied

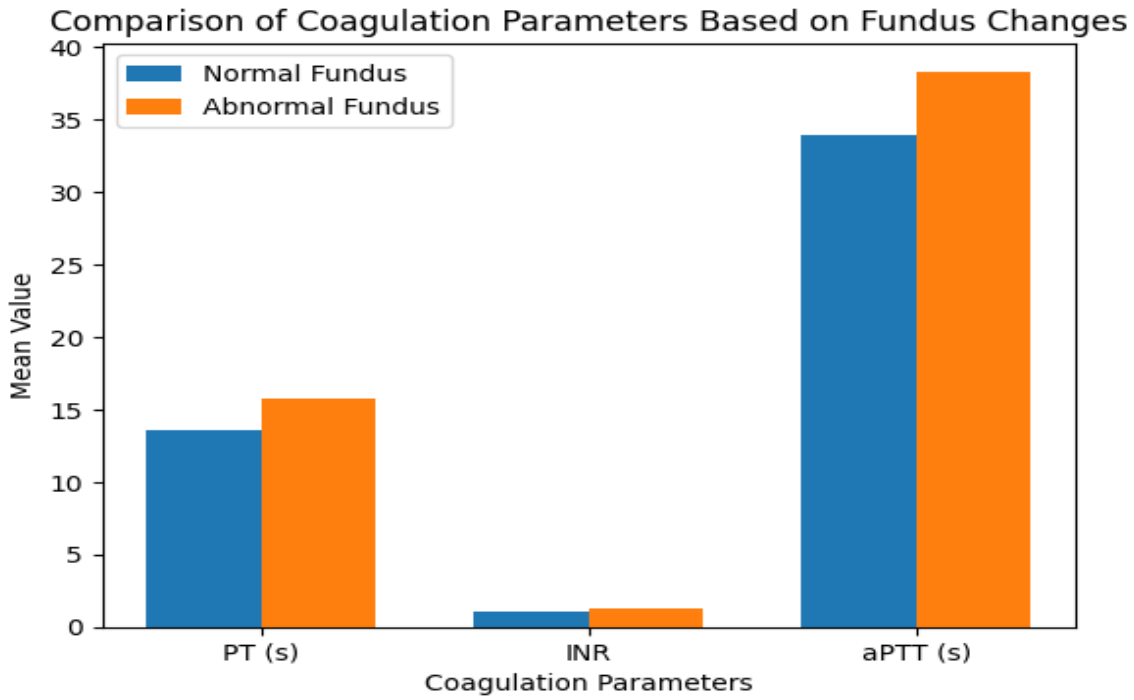
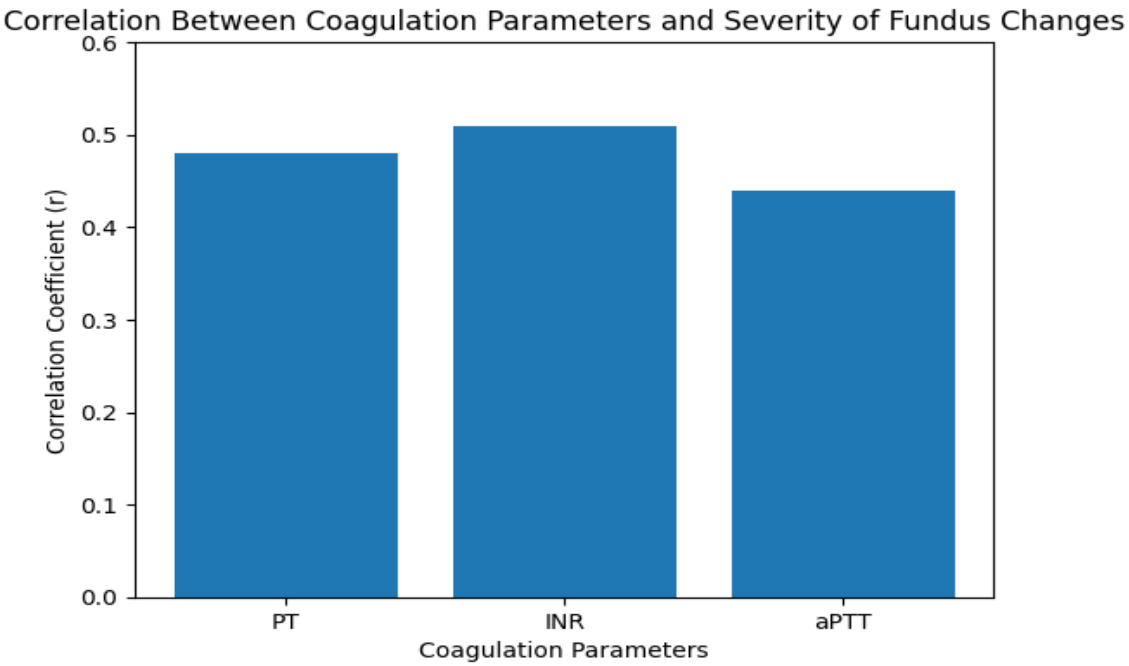


Figure 1 Comparison of Coagulation Parameters Based on Fundus Changes

Table 5: Correlation Between Coagulation Parameters and Severity of Fundus Changes

Parameter	Correlation Coefficient (r)	p-value
PT vs Fundus grade	+0.48	<0.001
INR vs Fundus grade	+0.51	<0.001
aPTT vs Fundus grade	+0.44	<0.001



Figure; 2 Correlation Between Coagulation Parameters and Severity of Fundus Changes

DISCUSSION

Hypertensive disorders of pregnancy, particularly preeclampsia and eclampsia, are associated with widespread endothelial dysfunction leading to multisystem involvement. The present prospective observational study evaluated the correlation between coagulation parameters and ocular fundus changes in preeclampsia and eclampsia, highlighting the interrelationship between systemic coagulation abnormalities and retinal microvascular damage.'

In the present study, the majority of patients were young women with a mean age of 26.8 ± 4.3 years, and primigravida constituted 60% of the study population. This observation is consistent with previous studies that report a higher incidence of preeclampsia among younger and first-time mothers [11,12]. The predominance of preeclampsia (70.8%) over eclampsia (29.2%) in our cohort is comparable to findings reported in other tertiary care hospital-based studies [13]. Ocular fundus examination revealed abnormal retinal findings in 64.6% of patients, with arteriolar narrowing being the most common abnormality, followed by moderate-to-severe changes, hemorrhages, exudates, and papilledema. These findings are in agreement with earlier studies, which have demonstrated that retinal vascular changes are frequent in preeclampsia and correlate with disease severity [14,15]. Retinal arteriolar narrowing reflects vasospasm, while hemorrhages and exudates indicate breakdown of the blood-retinal barrier due to severe endothelial injury [16].

Coagulation abnormalities were evident in the study population, with mean PT and aPTT values being higher than reference ranges, particularly in patients with abnormal fundus findings. Patients with abnormal fundus changes had significantly prolonged PT, INR, and aPTT compared to those with normal fundus ($p < 0.001$). These findings support the concept that preeclampsia and eclampsia are associated with activation and subsequent consumption of coagulation factors, leading to deranged coagulation profiles in severe disease [17].

The significant difference in coagulation parameters between patients with normal and abnormal fundus findings suggests that ocular involvement may serve as a clinical marker of systemic coagulation derangement. Similar observations have been reported by Dusse et al. and Cunningham et al., who emphasized that worsening coagulation parameters reflect increasing endothelial damage and disease severity in preeclampsia [18,19].

A key finding of this study is the statistically significant moderate positive correlation between coagulation parameters and severity of fundus changes. INR showed the strongest correlation with fundus grade ($r = 0.51$), followed by PT ($r = 0.48$) and aPTT ($r = 0.44$), all with p-values <0.001. This indicates that as retinal changes progress in severity, there is a corresponding worsening of coagulation abnormalities. These findings are biologically plausible, as both retinal vascular damage and coagulation derangement result from the same underlying endothelial dysfunction and microangiopathy [20]. Previous studies evaluating fundus changes in pregnancy-induced hypertension have mainly focused on their association with blood pressure levels and maternal-fetal outcomes [21,22]. However, studies correlating ocular fundus findings with coagulation parameters are limited. The present study adds to existing literature by demonstrating that routine coagulation tests such as PT and aPTT may have predictive value in identifying patients at risk of severe retinal involvement.

From a clinical perspective, fundus examination is a simple, non-invasive bedside tool that can provide valuable information about systemic disease severity. When combined with basic coagulation parameters, it may help in early risk stratification, closer monitoring, and timely management of patients with preeclampsia and eclampsia, thereby reducing maternal and fetal complications [23].

The study has certain limitations. Being a single-centre study, the findings may not be generalizable to all populations. Additionally, advanced coagulation markers such as fibrinogen levels, D-dimer, and platelet function tests were not assessed. Future multicentric studies with larger sample sizes and extended coagulation profiles may further elucidate the role of coagulation abnormalities in predicting ocular and systemic complications of preeclampsia.

CONCLUSION

There is a significant association between coagulation abnormalities and ocular fundus changes in preeclampsia and eclampsia. Prolonged PT, INR, and aPTT correlate positively with the severity of retinal involvement, reflecting underlying endothelial dysfunction. Combined assessment of fundus findings and routine coagulation parameters may aid in early identification of severe disease and guide timely clinical management.

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