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Original Research Article

Cross-Sectional Study on Blood Coagulation Profile and Platelet Indices in Normal Term Pregnancy and Term pregnancy with Preeclampsia

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Abstract:

Background: Preeclampsia is a significant hypertensive disorder of pregnancy associated with endothelial dysfunction, altered coagulation, and platelet abnormalities. These haemostatic changes increase the risk of maternal and fetal complications. Evaluating coagulation parameters and platelet indices can aid in early detection, risk stratification, and management of preeclampsia.

Methods: A cross-sectional observational study was conducted among 180 term pregnant women (90 normotensive and 90 preeclamptic) at Burdwan Medical College. Participants were selected using simple random sampling. Clinical evaluation and laboratory investigations including BT (Bleeding Time), CT (Clotting Time), PT (Prothrombin Time), APTT (Activated Partial Thromboplastin Time), platelet count, MPV (Mean Platelet Volume), PDW (Platelet Distribution Width), and D-dimer levels were performed. Data were analyzed using SPSS with appropriate statistical tests, considering $p \leq 0.05$ as significant.

Results: Preeclamptic women showed significantly higher systolic and diastolic blood pressure ($p < 0.001$). Coagulation parameters-BT, CT, PT, and APTT-were significantly prolonged in the preeclamptic group ($p < 0.001$). Platelet count was significantly reduced (1.17 ± 0.6 vs. 1.438 ± 0.36 lakh/mm³; $p = 0.033$), while MPV and PDW were significantly elevated ($p < 0.05$), indicating increased platelet activation and turnover. D-dimer levels were also significantly higher in preeclamptic women ($p < 0.001$), reflecting enhanced fibrinolytic activity.

Conclusion: Preeclampsia is associated with significant alterations in coagulation profile and platelet indices, indicating a hypercoagulable yet consumption-driven state. Routine monitoring of these parameters can facilitate early diagnosis, assess disease severity, and prevent complications such as DIC and HELLP syndrome, thereby improving maternal and fetal outcomes.

Keywords: Preeclampsia, Coagulation Profile, Platelet Indices, MPV, PDW, D-dimer, Pregnancy, Thrombocytopenia.

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Introduction

Elevated blood pressure and proteinuria are the hallmarks of preeclampsia, a hypertensive condition unique to pregnancy that develops after 20 weeks of gestation. The American College of Obstetricians and Gynaecologists (ACOG, 2020) states that it is diagnosed when proteinuria exceeds 300 mg in a 24-hour period and blood pressure is ≥140/90 mmHg on two separate occasions. Severe preeclampsia is associated with complications such as thrombocytopenia, renal dysfunction, elevated liver enzymes, and neurological symptoms, indicating significant maternal risk. [1,2]

Preeclampsia significantly contributes to maternal and foetal morbidity and mortality. Intrauterine growth restriction, premature birth, eclampsia, and HELLP syndrome-a potentially fatal illness characterised by haemolysis, increased liver enzymes, and low platelet count-can result from it.[3] In India, hypertensive disorders of pregnancy have a prevalence of approximately 7.8%, with preeclampsia accounting for 5.4%, making it a major public health concern.[4]

During normal pregnancy, the haemostatic system undergoes physiological changes, resulting in a hypercoagulable state characterized by increased clotting factors and reduced natural anticoagulants. These adaptations help prevent excessive bleeding during delivery. However, in preeclampsia, this hypercoagulable state is exaggerated due to endothelial dysfunction, leading to an imbalance between coagulation and fibrinolysis and increasing the risk of both thrombosis and bleeding. [5,6]

Haematological alterations are prominent in preeclampsia. Thrombocytopenia is one of the most common abnormalities and correlates with disease severity. Platelet parameters including MPV (Mean Platelet Volume) and PDW (Platelet Distribution Width), which indicate higher platelet turnover and dysfunction, fluctuate as a result of platelet activation and increased consumption. [5,7]

Prolonged PT (Prothrombin Time), APTT (Activated Partial Thromboplastin Time), and increased D-dimer values are examples of coagulation anomalies that show continued fibrinolysis and coagulation. These changes may predispose patients to severe complications such as DIC (Disseminated Intravascular Coagulation).[8]

Understanding these haemostatic changes is essential for early diagnosis, monitoring disease progression, and improving maternal and foetal outcomes in preeclampsia.

Aims and Objectives: The goal of this study is to assess the platelet indices and blood coagulation profile in both preeclamptic and normal term pregnancies. It focuses on measuring important coagulation parameters in both groups, such as bleeding time, clotting time, prothrombin time, and activated partial thromboplastin time. The study also assesses platelet-related metrics like platelet distribution width, mean platelet volume, and platelet count. Furthermore, a comparative analysis is undertaken to identify differences in coagulation profile and platelet indices between normotensive and preeclamptic term pregnancies, thereby providing insights into the haemostatic alterations associated with preeclampsia.

Materials and Methods

Study Design: This study was designed as a cross-sectional observational study conducted in the Department of Obstetrics and Gynaecology at Burdwan Medical College and Hospital (BMCH). The study was carried out over a period of 18 months following approval of the synopsis by the West Bengal University of Health Sciences, with the study duration extending from June 2023 to December 2024. The study population comprised all normotensive and preeclamptic term pregnant women admitted to BMCH during the study period.

Inclusion and Exclusion Criteria: The study included normotensive term pregnant women (after 37 weeks of gestation) and pregnant women diagnosed with preeclampsia who provided informed consent to participate. However, pregnant women with a known history of bleeding disorders, those receiving anticoagulant therapy, and those diagnosed with conditions such as abruptio placentae, IUD (Intrauterine Death), or DIC (Disseminated Intravascular Coagulation) were excluded from the study. Additionally, pregnant women who were in labour at the time of evaluation were also excluded to avoid confounding factors affecting coagulation parameters.

Sample Size Calculation: As per the study of Khan NMS et al., (2018) [9] it is seen that haematological changes due to pre-eclampsia and eclampsia tend to affect 6-8% of all pregnancies. Taking this study as reference and using this prevalence (P) = 0.06, the sample size is calculated by the formula

(n) = (Z1-α/2) 2 × P × (1- P)/(d)2

Where, **n** is the required sample size

Z = statistic for a level of confidence (Z value is 1.96 for 95% confidence level)

P (prevalence) = 6% or 0.06, so (1-P) = 0.94

D (absolute precision) = 5% or 0.05 Substituting the values,

n = (1.96)2X 0.06X 0.94/(0.05)^2 ≈ **87**

In this study we have taken normotensive and pre-eclampsia patients in a 1:1 ratio; considering the non-response rate, 90 study subjects were considered in each group. So, the total sample size is (90 + 90) = 180.

Data Collection Tools: Data were collected using structured clinical assessment and laboratory investigations. Tools included detailed obstetric history records, clinical examination parameters such as blood pressure, weight, and presence of oedema, and laboratory tests including platelet count, PT, APTT, fibrinogen levels, and D-dimer. These tools were used to assess coagulation profiles and platelet indices in both normotensive and preeclamptic pregnancies.

Data Collection Procedure: After obtaining approval from the WBUHS (West Bengal University of Health Sciences), informed written consent was obtained from all participants. Baseline data were collected through detailed history taking and thorough clinical examination to identify relevant maternal parameters and risk factors. Blood samples were then collected and analysed for coagulation parameters and platelet indices. Additionally, patient management details and clinical outcomes, including maternal and foetal complications, were recorded. The collected data were systematically compiled to compare coagulation profiles between normotensive and preeclamptic pregnancies and to assess their clinical significance.

Statistical Analysis: To guarantee accuracy and appropriate data management, the gathered data were methodically recorded and arranged in Microsoft Excel. SPSS software (version 23.0) was used for statistical analysis. Categorical variables were shown as frequencies and percentages, but continuous variables, such as age, blood pressure, and lab results, were reported as mean and standard deviation. The independent t-test was utilised for continuous variables and the chi-square test for categorical variables in order to compare the normotensive and preeclamptic groups. A statistically significant p-value was defined as ≤0.05.

Results

Table 1: Age Distribution of Study Subjects

Age Group (years)	Normotensive	Preeclampsia	Total
≤20	23	26	49
21–30	61	57	118
31–40	6	7	13
Total	90	90	180

Table 1 illustrates age distribution. Most participants (65.6%) were in the 21–30 years group, with no significant difference between groups (p = 0.882).

Table 2: BMI Distribution

BMI Category (kg/m²)	Normotensive	Preeclampsia	Total
18.5–24.9	32	33	65
25–30	47	50	97
>30	11	7	18
Total	90	90	180

Table 2 shows BMI distribution. The majority (53.9%) were overweight. No statistically significant difference was observed (p = 0.607).

Table 3: Parity and Gestational Age Distribution

Parameter	Normotensive	Preeclampsia	Total
Parity			
0+0	40	36	76
1+0	36	38	74
Others	14	16	30
Gestational Age			
37–38 weeks	19	29	48
38–39 weeks	36	28	64
39–40 weeks	35	33	68

Table 3 presents parity and gestational age. Most women were primigravida or second gravida and admitted between 38 and 40 weeks. No significant differences were observed (p > 0.05).

Table 4: Urinary Protein Distribution

Protein Level	Normotensive	Preeclampsia	Total
Negative	22	0	22
1+	68	1	69
2+	0	66	66
3+	0	23	23

Table 4 demonstrates a highly significant difference in proteinuria (p < 0.001). Moderate and severe proteinuria was seen only in preeclamptic women.

Table 5: Comparison of Blood Pressure

Parameter	Normotensive (Mean ± SD)	Preeclampsia (Mean ± SD)	p-value
SBP (mmHg)	130.13 ± 14.89	168.37 ± 23.75	<0.001
DBP (mmHg)	78.35 ± 11.50	102.06 ± 11.08	<0.001

Table 5 shows significantly elevated systolic and diastolic blood pressure in preeclamptic women ($p < 0.001$), confirming hypertension as a defining characteristic.

Table 6: Comparison of Coagulation Profile

Parameter	Normotensive (Mean ± SD)	Preeclampsia (Mean ± SD)	p-value
BT (min)	2.99 ± 0.679	4.14 ± 0.728	<0.001
CT (min)	7.56 ± 1.05	9.16 ± 1.15	<0.001
PT (sec)	12.6 ± 0.89	14.82 ± 1.31	<0.001
APTT (sec)	32.86 ± 3.57	38.38 ± 1.97	<0.001
D-dimer	0.32 ± 0.12	0.50 ± 0.37	<0.001

Table 6 illustrates significant prolongation of coagulation parameters and increased D-dimer levels in preeclampsia, indicating altered haemostasis and enhanced fibrinolysis.

Table 7: Comparison of Platelet Indices

Parameter	Normotensive (Mean ± SD)	Preeclampsia (Mean ± SD)	p-value
Platelet Count (lakh/mm³)	1.438 ± 0.36	1.17 ± 0.6	0.033
MPV (fL)	9.93 ± 0.95	10.67 ± 1.17	0.001
PDW	12.84 ± 1.05	13.26 ± 1.17	0.012

Table 7 shows reduced platelet count with increased MPV and PDW in preeclamptic women ($p < 0.05$), reflecting increased platelet activation and consumption

Discussion

Preeclampsia is a complex multisystem disorder characterised by widespread endothelial dysfunction, leading to significant alterations in coagulation pathways and platelet function. The present cross-sectional study conducted at Burdwan Medical College demonstrated marked derangements in haemostatic parameters among preeclamptic women compared to normotensive controls, supporting the concept of a hypercoagulable yet consumptive state.

The sociodemographic characteristics of the study population revealed that the majority of participants belonged to the 21–30 year age group, which is consistent with findings reported by Bhutani et al.[10] and Priya et al.[11] Furthermore, the absence of a statistically significant age difference between the groups aligns with observations made, suggesting that preeclampsia can occur across a broad reproductive age range. Similarly, no significant differences were observed in BMI, parity, or gestational age between the study groups, indicating well-matched cohorts. However, proteinuria was significantly higher in the preeclamptic group ($p < 0.001$), consistent with diagnostic criteria.

The significantly elevated systolic and diastolic blood pressures observed in preeclamptic women in the present study and are consistent with the diagnostic thresholds established by the ACOG (American College of Obstetricians and Gynecologists).[12] These elevated values reflect the severity of the hypertensive state and its association with endothelial injury and haemostatic imbalance.

Bleeding time was significantly prolonged in preeclamptic women, indicating impaired primary haemostasis due to platelet dysfunction and endothelial damage. as observations cited by Bhutani et al.,[10] all of which reported prolonged BT in preeclampsia. These findings suggest that defective platelet plug formation is a hallmark of the disease.

Clotting time was also significantly prolonged in the preeclamptic group. While Bhutani et al. [10] reported no significant difference in CT, the findings of the present study are in agreement with Mishra et al.,[13] who demonstrated that prolonged CT may indicate early coagulation pathway dysfunction and progression toward DIC. Variations between studies may be attributed to differences in disease severity and study populations.

Prothrombin time was significantly prolonged in preeclamptic women, reflecting impairment of the extrinsic coagulation pathway. These findings are supported by the meta-analysis conducted by Teklu et al. [14] which demonstrated a significant increase in PT among preeclamptic women. Similar trends were reported by Bhutani et al. [10] Mishra et al. [13] and Han et al. [15] all of whom observed progressive prolongation of PT with increasing disease severity.

Activated partial thromboplastin time was also significantly prolonged, indicating disturbances in the intrinsic coagulation pathway. These findings are consistent with the meta-analysis by Teklu et al. [14] and studies by Bhutani et al. [12] Han et al. [15] and Liu et al. [16] Notably, APTT is physiologically shortened in normal pregnancy; therefore, its prolongation in preeclampsia reflects a pathological deviation and is associated with adverse maternal and fetal outcomes.

Thrombocytopenia in preeclampsia is primarily due to increased platelet activation and consumption at sites of endothelial injury. This reduction in platelet count is clinically significant, as it may progress to severe complications such as HELLP syndrome.

MPV was significantly elevated in the preeclamptic group, indicating increased platelet activation and turnover. This finding is in agreement with studies by Thalor et al. [17] and Bhutani et al.,[12] all of which demonstrated higher MPV values in preeclampsia and a correlation with disease severity.

Similarly, PDW was significantly elevated, reflecting increased heterogeneity in platelet size. This observation is consistent with findings reported by Thalor et al. [17] Elevated PDW indicates increased platelet turnover and activation and may serve as a useful, cost-effective marker in clinical practice.

D-dimer levels were significantly higher in preeclamptic women, indicating increased fibrin formation and degradation. These findings are supported by studies conducted by Freitas et al. [18] Alemayehu et al. [19] and Liu et al. [16] all of which demonstrated elevated D-dimer levels in preeclampsia and their association with disease severity and adverse outcomes.

The present study demonstrates a consistent pattern of haemostatic derangement in preeclampsia, characterised by prolonged BT, CT, PT, and APTT; reduced platelet count; and elevated MPV, PDW, and D-dimer levels. These findings are in strong agreement with existing literature and reflect simultaneous impairment of primary haemostasis, secondary haemostasis, and fibrinolysis.

From a clinical perspective, these findings emphasise the importance of regular monitoring of coagulation parameters and platelet indices in preeclamptic pregnancies. Serial platelet counts, PT, and APTT assessments can aid in early detection of complications and guide clinical management, including decisions regarding anaesthesia and timing of delivery. Additionally, readily available platelet indices such as MPV and PDW can serve as cost-effective markers for disease severity, particularly in resource-limited settings.

The current study's strengths include a thorough assessment of haemostatic parameters and a well-matched sample size. The results' generalisability is improved by their congruence with research done in various regions by Bhutani et al. [10] Priya et al. [11] Mishra et al. [13] and others. However, further long-term research is needed to assess these measures' prognostic significance in the early stages of pregnancy.

Limitations

There are various limitations to the current investigation. The results of this single-center investigation, which was carried out in a tertiary care hospital, might not apply to larger populations with various demographic and ethnic variances. The lack of follow-up data limits the evaluation of long-term maternal and foetal outcomes, and the cross-sectional design makes it difficult to determine causal links between coagulation abnormalities and preeclampsia. Additionally, potential confounding factors such as underlying haematological disorders, medication use, and concurrent infections were not fully controlled, which may have influenced the results. Variability in laboratory techniques and measurement methods could also introduce bias and affect comparability with other studies.

Conclusion

This study demonstrates significant alterations in coagulation parameters and platelet indices in preeclamptic pregnancies, including prolonged BT, CT, PT, and APTT, reduced platelet count, and elevated MPV, PDW, and D-dimer levels, reflecting a hypercoagulable state and increased platelet activation. These findings highlight the importance of endothelial dysfunction and haemostatic imbalance in the pathogenesis of preeclampsia. Early identification and routine monitoring of these parameters can aid in risk stratification, timely intervention, and prevention of complications, thereby improving maternal and foetal outcomes.

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