International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Ferdous NJ et al. Int J Reprod Contracept Obstet Gynecol. 2026 Jul;15(7):2424-2430
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20262086

Original Research Article

Platelet count as a first line screening test for the detection of coagulation disorder in preeclamptic and eclamptic patients

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Received: 18 May 2026
Accepted: 15 June 2026

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ABSTRACT

Background: Pre-eclampsia and eclampsia are major obstetric complications and important causes of maternal morbidity and mortality in developing countries. Platelet count is a simple, inexpensive, and widely available investigation that may help detect coagulation disorders in these conditions. This study aimed to determine the sensitivity and specificity of platelet count for predicting coagulation disorders in pre-eclampsia and eclampsia.
Methods: This cross-sectional analytical study was conducted in the department of obstetrics and gynecology of Dhaka Medical College Hospital from June 2022 to May 2023. A total of 81 pregnant women were enrolled and divided equally into three groups: pre-eclampsia (n=27), eclampsia (n=27), and normotensive pregnancy (n=27). Platelet count, prothrombin time (PT), activated partial thromboplastin time (APTT), serum fibrinogen, and D-dimer were measured. Data were analyzed using SPSS version 26.
Results: Mean platelet count was significantly lower in eclampsia (186,296.3±91,728.6/µl) and pre-eclampsia (217,777.8±77,745.3/µl) compared to normal pregnancy (252,296.3±44,155.2/µl) ($p<0.001$). Thrombocytopenia was observed in 38.89% of pregnancy-induced hypertension cases. For detecting coagulation disorders, platelet count showed sensitivity of 45.45% and specificity of 90.00% in eclampsia, while sensitivity and specificity in pre-eclampsia were 46.51% and 81.82%, respectively.
Conclusions: Platelet count alone is not a reliable screening test for coagulation disorders in pre-eclampsia and eclampsia.

Keywords: Coagulation disorder, Eclampsia, Platelet count, Pre-eclampsia, Screening test

INTRODUCTION

Pregnancy induced hypertension (PIH) still remains a nightmare for every obstetrician. Eclampsia is an easily recognizable event and has been described in the medical literature as long as 4200 years ago[1]. 2000 years ago, celsus described seizure in pregnant women which abated with delivery. Since the condition seemed to arise without warning it was termed "eclampsia" from the Greek word "lighting".[1]

This condition promted the first caesarean section on dying convulsive parturients at least 2000 years ago; to try to save the newborns lives.[1] PIH can be classified as gestational hypertension, pre-eclampsia, chronic hypertension with superimposed Pre-eclampsia and Eclampsia.[2] Till now pre-eclampsia and eclampsia are

major obstetric problems in developing countries. They remain a significant cause of maternal mortality throughout the world.[3,4] Hypertensive disorders affect almost 7-15% of all pregnancies (Arias' high risk pregnancy and delivery).

Pre-eclampsia occurs in 5-8% of pregnancies worldwide and important cause of maternal and fetal death.[5] Its prevalence varies in different populations and in different ethnic groups.[6] Pre-eclampsia is a pregnancy specific multi system disorder which is characterized by the development of hypertension (BP≥140/90 mmHg) and proteinuria (≥0.3 gm/dl) after 20 weeks of gestation.[4,7] If pre-eclampsia is associated with convulsion the condition is called eclampsia.[4,7]

In developing countries most pre-eclampsia cases remain unrecognized until severe complications such as eclampsia develop. Platelets play an essential role in the pathogenesis of pre-eclampsia.[4,8] Platelets are normally present in the bloodstream in an inactive state, but they can be activated instantly when they come in contact with the damaged or activated endothelial wall.[9] Platelet activation begins in the first month of pregnancy in women with risk for pre-eclampsia.[10]

Increased plasma levels of platelet activation markers (β-thromboglobulin and platelet factor-4) and increased expression of activation markers on the surface of platelets in pre-eclamptic women confirm platelet activation in this disease.[5,11] Platelet count decreases by an average of 10% during the third trimester of uncomplicated pregnancy due to haemodilution.[12] Increased consumption of platelets causes thrombocytopenia which is an essential sign of severe pre-eclampsia. Thrombocytopenia occurs in up to 50% of women with pre-eclampsia.[13]

Thrombocytopenia is classically defined as a platelet count less than 1,50,000/mm^3.[14,15] The degree of thrombocytopenia increases with the severity of disease, Lower the platelet count, greater are maternal and fetal mortality and morbidity.[15] Low platelet count in pre-eclampsia are associated with abnormal activation of coagulation system and accelerated platelet consumption.[15]

Thrombocytopenia is a well-documented condition in pre-eclampsia. Out of all other parameters the platelet count is a simple and cost-effective way to predict pre-eclampsia and eclampsia.[16,17] Pre-eclampsia and maternal mortality might be reduced through serial monitoring of platelet count as a part of ante-natal check-up. But very few studies are present on this ground in our country.

The objective of this study was to find out the association of platelet count with pre-eclampsia and eclampsia and coagulation disorders developed in pre-eclampsia and eclampsia; thus, platelet count can be used as first line screening test for the detection of coagulation disorder in pre-eclamptic and eclamptic patients.

METHODS

This cross-sectional analytical study was conducted in the department of obstetrics and gynecology, Dhaka Medical College Hospital from June 2022 to May 2023. The study population included pregnant women admitted to the eclampsia unit who fulfilled the inclusion criteria. A total of 81 participants were enrolled using purposive and convenient sampling techniques and were divided equally into three groups: pre-eclamptic women (n=27), eclamptic women (n=27), and normotensive pregnant women (n=27). Pregnant women with features of pre-eclampsia or eclampsia and those willing to provide informed consent were included. Patients with chronic renal or liver disease, diabetes mellitus, hematological or coagulation disorders, HELLP syndrome, antiplatelet drug use, major fetal anomalies, or intrauterine fetal death were excluded.

Detailed history, clinical examination, blood pressure measurement, and BMI assessment were performed for all participants. Approximately 2 ml of venous blood was collected aseptically into EDTA tubes for laboratory investigations. Platelet count, prothrombin time (PT), activated partial thromboplastin time (APTT), serum fibrinogen, and D-dimer levels were analyzed. Samples were processed within 4-6 hours of collection using an automated hematology analyzer (Sysmex X-E 2000i, Kobe, Japan), while coagulation profiles were analyzed using Stago analyzers. Coagulation disorder was defined by the presence of at least one abnormal coagulation parameter. Data were analyzed using SPSS version 26. Comparative analysis among the three groups was performed, and the sensitivity, specificity, predictive values, likelihood ratios, and diagnostic accuracy of platelet count as a screening test for coagulation disorder were calculated.

All collected data were recorded in tabular form and analyzed using Statistical Package for Social Science (SPSS) version 26. Continuous variables were expressed as mean±SD, while categorical variables were presented as frequency and percentage. ANOVA test, Chi-square test, and Kruskal-Wallis test were performed where applicable. Receiver operating characteristic (ROC) curves were plotted for total platelet count in the pre-eclampsia and eclampsia groups. Sensitivity, specificity, and area under the curve (AUC) were calculated for different cut-off values of platelet count, and the parameter with the highest AUC was considered the best predictor. A p value of <0.05 was considered statistically significant. The findings were presented using appropriate tables and figures.

RESULTS

Table 1 shows the demographic characteristics of the 81 study respondents divided into preeclampsia (n=27), eclampsia (n=27), and normal pregnancy (n=27) groups. The mean age was 26.8±6.13 years in the preeclampsia group, 25.2±5.87 years in the eclampsia group, and

26.9±3.35 years in the normal group, with no statistically significant difference (p=0.408). The highest proportion of patients fell into the 21-30 years age group across all categories, particularly in the normal group (85.2%). Regarding residence, the majority of patients in all three groups came from rural areas- 70.4% in preeclampsia, 85.2% in eclampsia, and 81.5% in normal pregnancy- and the difference was not statistically significant (p=0.380). These findings indicate that the three groups were comparable at baseline for age and residence, allowing valid further comparisons of platelet count and coagulation parameters.

Table 1: Demographic characteristics of the study respondents (n=81).

Variables	Preeclampsia (n=27)	Eclampsia (n=27)	Normal (n=27)	P value
Age group (years), N (%)				
<20	6 (22.2)	9 (33.3)	0 (0.0)	0.408
21-30	16 (59.3)	15 (55.6)	23 (85.2)	
31-40	5 (18.5)	3 (11.1)	4 (14.8)	
Mean age (years) ±SD	26.8±6.13	25.2±5.87	26.9±3.35	
Residence, N (%)				
Urban	8 (29.6)	4 (14.8)	5 (18.5)	0.380
Rural	19 (70.4)	23 (85.2)	22 (81.5)	

Table 2: Comparison of anthropometric variable among three groups (n=81).

BMI (kg/m²)	Preeclampsia (n=27) (%)	Eclampsia (n=27) (%)	Normal (n=27) (%)	P value
Normal (18.99-24.9)	6 (22.2%)	1 (3.7%)	16 (59.3%)	<0.001
Overweight (25.0-29.9)	17 (63.0%)	13 (48.1%)	10 (37.0%)	
Obese (>30.0)	4 (14.8%)	13 (48.1%)	1 (3.7%)	
Mean ± SD	27.4±2.94	29.5±1.61	24.9±2.48	

Table 3: Comparison of Hb and total platelet count among three groups (n=81).

Outcome variables	Preeclampsia (n=27)	Eclampsia (n=27)	Normal (n=27)	P value
Hb%				
Mean±SD	10.54±1.54	10.87±1.38	10.64±1.71	0.722
Range	(6.9-13.7)	(8.3-12.9)	(8.0-14.4)	
Total platelet count				
Mean±SD	217777.8±77745.3	186296.3±91728.6	252296.3±44155.2	<0.001
Median	201000	140000	250000	
Range	(120000-410000)	(107000-438000)	(160000-325000)	

Table 4: Association of platelet count among three study groups (n=81).

Total platelet count	Preeclampsia (n=27) (%)	Eclampsia (n=27) (%)	Normal (n=27) (%)	P value
100000-150000	5 (18.5)	16 (59.3)	0 (0.0)	<0.001
150000-200000	8 (29.6)	3 (11.1)	2 (7.4)	
>200000	14 (51.9)	8 (29.6)	25 (92.6)	
Total	27 (100.0)	27 (100.0)	27 (100.0)	

Table 2 compares the body mass index (BMI) among the three study groups. The mean BMI was highest in the eclampsia group (29.5±1.61 kg/m^2), followed by the preeclampsia group (27.4±2.94 kg/m^2), and lowest in the normal pregnancy group (24.9±2.48 kg/m^2). This difference was statistically highly significant (p<0.001). Regarding BMI categories, the majority of preeclamptic patients (63.0%) were overweight, while nearly half of eclamptic patients (48.1%) were obese. In contrast, most normal pregnant women (59.3%) had a normal BMI. Notably, obesity was present in 48.1% of eclamptic patients compared to only 14.8% of preeclamptic and 3.7% of normal pregnant women.

Table 3 compares hemoglobin (Hb) levels and total platelet counts among the preeclampsia, eclampsia, and normal pregnancy groups. Regarding hemoglobin, the mean Hb level was 10.54±1.54 gm/dl in the preeclampsia group, 10.87±1.38 gm/dl in the eclampsia group, and 10.64±1.71 gm/dl in the normal group, with no statistically significant difference between the groups (p=0.722). Regarding total platelet count, a statistically highly

significant difference was observed among the three groups (p<0.001). The mean platelet count was highest in the normal pregnancy group (252,296.3±44,155.2/µl), followed by the preeclampsia group (217,777.8±77,745.3/µl), and lowest in the eclampsia group (186,296.3±91,728.6/µl). The median platelet count showed a similar trend: 250,000/µl in normal pregnancies, 201,000/µl in preeclampsia, and markedly lower at 140,000/µl in eclampsia. The platelet count range was widest in the eclampsia group (107,000-438,000/µl). Significant thrombocytopenia was found in both preeclamptic and eclamptic patients compared to normal pregnant women.

Table 4 shows the association of platelet count categories among the three study groups. A statistically highly significant difference was observed across the groups (p<0.001). In the normal pregnancy group, the vast majority (92.6%) had platelet counts above 200,000/µl, and none had platelet counts in the 100,000-150,000/µl range. In contrast, among preeclamptic patients, 18.5% had platelet counts in the 100,000-150,000/µl range, 29.6% had counts between 150,000-200,000/µl, and 51.9% had counts above 200,000/µl. The most striking finding was in the eclampsia group, where the majority (59.3%) had platelet counts in the lowest category of 100,000-150,000/µl, indicating significant thrombocytopenia. Only 29.6% of eclamptic patients had platelet counts above 200,000/µl. Overall, in all cases of pregnancy-induced hypertension (PIH), which included both preeclampsia and eclampsia (n=54), thrombocytopenia (defined as platelet count <150,000/µl) was observed in 38.89% of cases (21 out of 54 patients). This association was statistically highly significant (p<0.001).

Table 5: Diagnostic performance test for the detection of coagulation disorder in eclampsia (n=54).

Contingency table			
Platelet count	**Coagulation disorder present**	**Coagulation disorder absent**	**Total**
≤203500	20	1	21
>203500	24	9	33
Total	44	10	54
Diagnostic statistics			
Statistic	**Value**	**95% CI lower**	**95% CI upper**
Sensitivity	45.45%	30.39%	61.15%
Specificity	90.00%	55.50%	99.75%
Positive likelihood ratio	4.55	0.69	30.01
Negative likelihood ratio	0.61	0.43	0.85
Positive predictive value	95.24%	75.18%	99.25%
Negative predictive value	27.27%	21.07%	34.50%
Accuracy	53.70%	39.61%	67.38%

Table 6: Diagnostic performance test for the detection of coagulation disorder in pre-eclampsia (n=54).

Contingency table			
Platelet count	**Coagulation disorder present**	**Coagulation disorder absent**	**Total**
≤218000	20	2	22
>218000	23	9	32
Total	43	11	54
Diagnostic statistics			
Statistic	**Value**	**95% CI lower**	**95% CI upper**
Sensitivity	46.51%	31.18%	62.35%
Specificity	81.82%	48.22%	97.72%
Positive likelihood ratio	2.56	0.7	9.33
Negative likelihood ratio	0.65	0.44	0.97
Positive predictive value	90.91%	73.28%	97.33%
Negative predictive value	28.12%	20.88%	36.72%
Accuracy	53.70%	39.61%	67.38%

Table 5 presents the diagnostic performance of platelet count at a cut-off value of ≤203,500/µl for detecting coagulation disorders in patients with eclampsia (n=54, combining the eclampsia and normal pregnancy groups). Among 44 patients with coagulation disorders, the test correctly identified 20 cases (true positives) and missed 24

cases (false negatives). Among 10 patients without coagulation disorders, the test correctly identified 9 cases (true negatives) and had 1 false positive. The sensitivity of the test was 45.45% (95% CI: 30.39-61.15%), indicating that less than half of the patients with coagulation disorders were detected. However, the specificity was high at 90.00% (95% CI: 55.50-99.75%), meaning that the test correctly ruled out coagulation disorders in 90% of unaffected patients. The positive predictive value was excellent at 95.24% (95% CI: 75.18-99.25%), indicating that when the platelet count was ≤203,500/µl, there was a 95% chance that a coagulation disorder was present. However, the negative predictive value was low at 27.27% (95% CI: 21.07-34.50%), meaning that a platelet count above the cut-off does not reliably exclude a coagulation disorder. The overall accuracy was 53.70% (95% CI: 39.61-67.38%). These findings suggest that while a low platelet count (≤203,500/µl) is highly predictive of the presence of a coagulation disorder, a normal platelet count does not rule out coagulopathy, and therefore platelet count alone is not sufficient as a standalone screening test.

Table 6 presents the diagnostic performance of platelet count at a cut-off value of ≤218,000/µl for detecting coagulation disorders in patients with pre-eclampsia (n=54, combining the pre-eclampsia and normal pregnancy groups). Among 43 patients with coagulation disorders, the test correctly identified 20 cases (true positives) and missed 23 cases (false negatives). Among 11 patients without coagulation disorders, the test correctly identified 9 cases (true negatives) and had 2 false positives. The sensitivity of the test was 46.51% (95% CI: 31.18-62.35%), indicating that less than half of the patients with coagulation disorders were detected. The specificity was 81.82% (95% CI: 48.22-97.72%), meaning that the test correctly ruled out coagulation disorders in approximately 82% of unaffected patients. The positive predictive value was high at 90.91% (95% CI: 73.28-97.33%), indicating that when the platelet count was ≤218,000/µl, there was a 91% chance that a coagulation disorder was present. However, the negative predictive value was low at 28.12% (95% CI: 20.88-36.72%), meaning that a platelet count above the cut-off does not reliably exclude a coagulation disorder. The overall accuracy was 53.70% (95% CI: 39.61-67.38%), identical to that observed in eclampsia. These findings suggest that while a low platelet count (≤218,000/µl) has good predictive value for the presence of a coagulation disorder in pre-eclampsia, a normal platelet count cannot rule out coagulopathy.

DISCUSSION

Pregnancy is associated with complex and incompletely understood changes involving the blood coagulation. A cross-sectional analytical study was performed to see the relationship between platelet count with coagulation disorder in pre-eclampsia and eclampsia and also to determine the sensitivity and specificity of platelet count to predict complications of pre-eclampsia and eclampsia. Subjects were recruited after fulfilling the inclusion and exclusion criteria. A total 81 patients out of which 27 were with pre-eclampsia, 27 were with eclampsia and 27 were normal pregnant women. This study was carried out in obstetrics and gynecology department of Dhaka Medical College Hospital from June, 2022 to May, 2023.

The mean age of pre-eclampsia was 26.8±6.13 years. Most (59.3%) of the patients of this group were in the age group of 21-30 years followed by 22.2% cases in the age group of below 20 years and 18.5% cases in the age group of 31-40 years. Mean age of women with eclampsia was 25.2±5.87 years. Maximum (55.6%) patients were in the age group of 21-30 years followed by 33.3% cases were in the age group of below 20 years and 11.1% cases in the age group of 31-40 years. Mean age of healthy pregnant women was 26.9±3.35 years. Maximum (85.2%) cases were in the 21-30 years age group followed by 14.8% cases in the age group of 31-40 years. Chaware et al, found most patients in normal pregnant control group and patients with pregnancy induced hypertension were in age ranging between 21 to 29 years and mean age in mild pre-eclampsia was 24 years, in severe pre-eclampsia was 22.7 years.[1] There was no or little difference regarding age among these three groups. Rahman et al., also found no statistically significant difference regarding age in pre-eclampsia and eclampsia[4]. In their study mean age in pre-eclampsia group was 27.4±6.67 years and in eclampsia group was 26.85±5.25 years. Prakash et al., found mean age of pre-eclampsia group 24.75 years (Range 19-32). Findings of current study regarding age was consistent with these findings.[18] There was no significant difference of age between healthy pregnant women and patients with pre-eclampsia and eclampsia.

Maximum patients of this study were from rural area and 70.4% of pre-eclampsia, 85.2% of eclampsia and 81.5% of normal pregnant group. No statistically significant differences among the groups (p=0.380) found.

In this study maximum patients 17 (63%) with pre-eclampsia were overweight and 4 (14.8%) patients were obese, while in eclampsia group 13 (48.1%) patients were overweight and 13 (48.1%) patients were obese. Mean BMI in pre-eclampsia was 27.4±2.94 kg/m^2, in eclampsia 29.5±1.61 kg/m^2 and normal pregnant women 24.9±2.48 kg/m^2. The result was statistically significant (p<0.001). This finding was consistent with the findings of Lewandowska et al., where they found 37.5% pre-eclampsia patients with obesity and 16.7% patients with overweight and also showed marked gestational weight gain in pregnancy induced hypertension.[19] Rahman et al, also found mean BMI in pre-eclampsia group 27.8±1.65 kg/m^2, in eclampsia group 28.7±7.29 kg/m^2, in normal pregnant women group 27.82±3.3.39 kg/m^2. Increased BMI may have relation with pre-eclampsia and eclampsia.[4]

The mean haemoglobin concentration in pre-eclampsia was 10.54±1.54 (6.9-13.7) gm %, in eclampsia 10.87±1.38 (8.3-12.9) gm% and in normal pregnant women

10.64±1.71 (8.0-14.4) gm%. There was no statistically significant difference of hemoglobin concentration among these three groups (p>0.05). Chaware et al found mean hemoglobin concentration 11 gm/dl (5.3-14.1) in mild pre-eclampsia, 11 gm/dl (6.7-14.8) in severe pre-eclampsia and 11.2 gm/dl (8-14.9) in eclampsia.[1] They showed little difference in hemoglobin concentration in different severity of pre-eclampsia. Current study was in agreement with this study.

Total platelet count in women with pre-eclampsia was 2.17,777.8±77745.3 (1,20,000-4,10,000), in women with eclampsia 1.86, 296.3±91,728.6 (1,07,000-4,38,000) and in normal pregnant women was 2,52296.3±44,155.2 (1,600,00-3,25,00). The results were statistically significant (p<0.001) Platelet count in pre-eclampsia and eclampsia group were significantly lower than the healthy pregnant women. Rahman et al found significantly lower platelet count in pre-eclampsia group (Mean±SD =207±42 x 10^3/ml) than the control group (214±56 x 10^3/ml) (p=0.04).[4] Additionally platelet count was significantly lower in eclampsia group (mean±SD =142±77 x 10^3/ml) than pre-eclampsia group (Mean±SD =207±42 x 10^3/ml) (p=0.01).

Current study showed thrombocytopenia in pre-eclampsia and eclampsia in comparison to platelet count of normal pregnant women. Platelet count of most (92.6%) of the normal pregnant women was more than 2,00,000/mm^3 and only 7.4% patients had count between 1,50,000-2,00,000/mm^3. In pre-eclampsia group 5 (18.5%) patients had thrombocytopenia while others had normal platelet count. In eclampsia group, 16 (59.3%) patients had thrombocytopenia. In all cases of PIH (pre-eclampsia + eclampsia =54 cases) thrombocytopenia was seen in 38.89% cases (21/54). This was consistent with Gupta et al., study that found a significant decrease in platelet count in pre-eclampsia patients (168±74.29 10^3/µl) compared to the control group (229.61±73.27 × 10^3/µl) (p=0.02).[20] Additionally, Sameer et al, observed that the platelet count was significantly lower in pre-eclampsia (p<0.01) and eclampsia (p<0.01) than the control group.[21] Platelet count showed a significant decrease in patients with pre-eclampsia and eclampsia compared to the control group. There was statistically significant association of thrombocytopenia with pre-eclampsia and eclampsia.

The optimal cut-off value of 203,500 platelets/mm^3 stroked a balance between sensitivity (70.4%) and specificity (92.6%), Performance was done using cut off value of 2,03,500 platelets/mm^3 (95% CI= 0.640-0.916, p<0.05) for prediction of coagulation disorder in eclampsia and showed 45.45% sensitivity, 90% specificity 95.24% PPV, 27.27% NPV, LR+=4.55, LR-=0.61 and accuracy =53.70%.

The ROC analysis for using total platelet count as a diagnostic tool for pre-eclampsia detection showed its moderate discriminatory capacity. The AUC of 0.719 highlighted its potential to differentiate between pre-eclamptic and normal pregnancy cases. The calculated optimal cut-off value of 218,000 platelets/mm^3 stroked a balance between sensitivity (66.7%) and specificity (85.2%). Performance was done using cut off value of 2,18,000 platelets/mm^3 (AUC=0.719, 95% CI=0.574-0.865, p<0.05) for prediction of coagulation disorder in pre-eclampsia and showed 46.51% sensitivity, 81.82% specificity 90.91% PPV, 28.12% NPV, LR+=2.56, LR-=0.65 and accuracy =53.70%. These findings indicate poor predictability of platelet count for coagulation disorder in pre-eclamptic and eclamptic patients. Current study finding was consistent with the study of Prieto et al. They observed no correlation between platelet count levels and PT, APTT or fibrinogen.[22]

This study was conducted in a single center at Dhaka Medical College Hospital, which may limit the generalizability of the findings. The sample size was relatively small due to time constraints. Patients were observed only during their hospital stay, and long-term follow-up was not possible. In addition, some laboratory reports were collected from multiple centers, which might have affected the uniformity of quality control.

CONCLUSION

The findings of this study demonstrated that reduced platelet count had poor sensitivity for detecting coagulation disorders in patients with pre-eclampsia and eclampsia. Although thrombocytopenia was more common in these patients, platelet count alone was not sufficiently reliable as a screening test for coagulation disorders. Therefore, platelet count should not be used as the sole screening tool for the detection of coagulopathy in pre-eclampsia and eclampsia.

Recommendations

Future studies should include multicenter sampling with proper randomization to obtain more representative results. A larger sample size is recommended to improve the validity and reliability of the findings. Long-term follow-up of patients should also be considered to assess maternal and fetal outcomes more comprehensively. For better quality assurance and consistency, laboratory investigations should preferably be performed in a single center.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Ferdous NJ, Tarafder S, Akter Y, Das JR, Salma U, Sultana S. Platelet count as a first line screening test for the detection of coagulation disorder in preeclamptic and eclamptic patients. Int J Reprod Contracept Obstet Gynecol 2026;15:2424-30.