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Diagnostic Accuracy of Platelet Count for Detection of Coagulation Disorder in Pre-Eclamptic and Eclamptic Patients

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Abstract **Original Research Article**

Background: Pre-eclampsia and eclampsia are leading causes of maternal morbidity and mortality, especially in developing countries. Coagulation dysfunction is a serious complication in these disorders. Platelet count, routinely part of a complete blood count, has been proposed as a diagnostic marker. However, its diagnostic accuracy remains insufficiently evaluated in this population. This study aimed to determine the diagnostic accuracy of platelet count, using ROC analysis, for detecting coagulation disorder in pre-eclamptic and eclamptic patients. ***Methods:*** A cross-sectional analytical study was conducted in the Department of Obstetrics and Gynaecology, Dhaka Medical College Hospital, Dhaka, Bangladesh, from June 2022 to May 2023. A total of 81 pregnant women were enrolled and divided into three equal groups of 27 each: pre-eclampsia, eclampsia and normal pregnancy (control). Platelet count and standard coagulation parameters (PT, APTT, serum fibrinogen, D-dimer) were measured. ROC analysis was performed to determine optimal diagnostic cut-off values, AUC, sensitivity and specificity. ***Results:*** Platelet count was significantly lower in pre-eclampsia (mean 217,777.8 ± 77,745.3 mm^3) and eclampsia (mean 186,296.3± 91,728.6 mm^3) compared to normal pregnant women (mean 252,296.3 ± 44,155.2 mm^3; $p<0.001$). ROC analysis identified an optimal cut-off of 203,500 mm^3 for eclampsia (AUC=0.778, sensitivity 70.4%, specificity 92.6%) and 218,000 mm^3 for pre-eclampsia (AUC=0.719, sensitivity 66.7%, specificity 85.2%). At these cut-offs, sensitivity for detecting actual coagulation disorder fell to 45.45% and 46.51%, respectively, with an accuracy of 53.70% in both groups. ***Conclusion:*** Platelet count demonstrates moderate discriminatory capacity for distinguishing hypertensive pregnant women from normal pregnancies, but has poor sensitivity for detecting actual coagulation disorder. It cannot be recommended as a standalone diagnostic test for coagulation dysfunction in pre-eclampsia or eclampsia.

Keywords: Pre-eclampsia, eclampsia, platelet count, diagnostic accuracy.

INTRODUCTION

Pre-eclampsia and eclampsia remain among the most serious complications of pregnancy, especially in low- and middle-income countries. Hypertensive disorders of pregnancy affect approximately 7 to 15 percent of all pregnancies, with pre-eclampsia occurring in 5 to 8 percent of pregnancies worldwide [1, 2]. These conditions are associated with substantial maternal and perinatal morbidity and mortality and their burden is disproportionately concentrated in developing nations where advanced diagnostic facilities are often unavailable [3].

Pre-eclampsia is a pregnancy-specific multisystem disorder defined by the onset of hypertension (blood pressure of 140/90 mmHg or higher) and proteinuria of 0.3 g or more in a 24-hour urine specimen after 20 weeks of gestation [4]. When convulsions occur in a woman with pre-eclampsia and cannot be attributed to other causes, the condition is designated eclampsia [4]. Pathophysiologically, both conditions involve widespread endothelial dysfunction, abnormal platelet activation and disruption of the coagulation cascade, which can culminate in life-threatening complications including disseminated intravascular coagulation (DIC), HELLP syndrome and acute kidney injury [5].

Platelets play a central role in the pathogenesis of pre-eclampsia. In normal pregnancy, platelet count declines by approximately 10 percent during the third trimester owing to haemodilution [6]. In pre-eclamptic women, however, endothelial injury triggers platelet activation and accelerated consumption, resulting in thrombocytopenia, classically defined as a platelet count below 150,000 per cubic millimeter [7]. Thrombocytopenia is observed in up to 50 percent of women with pre-eclampsia and is considered an indicator of disease severity; the lower the platelet count, the greater the risk of maternal and fetal mortality and morbidity [7, 8].

The assessment of coagulation status in pre-eclampsia and eclampsia is clinically important, as unrecognized coagulopathy significantly increases the risk of haemorrhage, particularly during operative delivery. Standard coagulation tests such as prothrombin time (PT), activated partial thromboplastin time (APTT), serum fibrinogen and D-dimer provide comprehensive information but may not be universally accessible or rapidly available in resource-constrained settings [9]. In contrast, platelet count is routinely obtained as part of a complete blood count (CBC) and is inexpensive, widely available and simple to perform.

Several studies have investigated the relationship between platelet count and coagulation abnormalities in pregnancy-induced hypertension. Chaware et al. reported significant thrombocytopenia across different severities of pre-eclampsia and eclampsia and suggested platelet count as an effective screening parameter [10]. Javed et al. demonstrated that low platelet count was significantly associated with pre-eclampsia and proposed it as an optimal screening test for early detection and severity prediction [11]. Freitas et al., using ROC analysis among women with severe pre-eclampsia, reported a sensitivity of 68.77 percent and specificity of 70.69 percent at a cut-off below 221,000 mm^3, with an AUC indicating regular diagnostic significance [12].

Despite these findings, there remains a gap in the literature regarding the precise diagnostic accuracy of platelet count as determined by ROC-derived optimal cut-off values in a population that includes both pre-eclamptic and eclamptic women. Diagnostic accuracy studies using ROC analysis provide a more rigorous evaluation, allowing clinicians to identify the threshold that optimally balances sensitivity and specificity for a given clinical condition. Understanding whether platelet count meets an acceptable level of diagnostic accuracy (AUC of 0.7 or above) for detecting coagulation disorder is essential before it can be reliably incorporated into clinical decision-making.

The present study was therefore designed to determine the diagnostic accuracy of platelet count for detecting coagulation disorder in pre-eclamptic and eclamptic patients, using receiver operating characteristic analysis to identify optimal cut-off values, area under the curve and associated diagnostic performance measures.

MATERIALS & METHODS

A cross-sectional analytical study was conducted in the Department of Obstetrics and Gynaecology at Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh, from June 2022 to May 2023. A total of 81 pregnant women were enrolled and divided into three equal groups of 27: Group 1, comprising women diagnosed with pre-eclampsia; Group 2, comprising women diagnosed with eclampsia; and Group 3, comprising normal pregnant women who served as the control group.

Sample Selection

Inclusion Criteria

- Pregnant women aged 18 years and above admitted to the Department of Obstetrics and Gynaecology, DMCH.
- Women diagnosed with pre-eclampsia (blood pressure of 140/90 mmHg or higher with proteinuria of 0.3 g or more per 24 hours after 20 weeks of gestation).
- Women diagnosed with eclampsia (pre-eclampsia with convulsions not attributable to other causes).
- Normal pregnant women (gestational age above 20 weeks, no hypertension, no proteinuria) were included as controls.
- Gestational age above 20 weeks confirmed by last menstrual period and/or ultrasonography.
- Women are willing to participate and provide written informed consent.

Exclusion Criteria

- Women with pre-existing chronic hypertension or superimposed pre-eclampsia on chronic hypertension.
- Patients with known haematological disorders, including pre-existing coagulation disorders or bleeding disorders.
- Women with diabetes mellitus, chronic liver disease, or chronic kidney disease.
- Multiple pregnancies.
- Women with known thrombocytopenia unrelated to pregnancy-induced hypertension.
- Patients who refused to give informed consent.

Study Procedure

After obtaining written informed consent, each participant underwent a detailed clinical assessment including history, physical examination and anthropometric measurement. Demographic data comprising age, educational status, occupation and residence were recorded using a pre-tested structured

data collection sheet. Blood pressure was measured twice in the right arm using a standardized sphygmomanometer with the patient in a sitting position and the mean of two readings was recorded. Body weight and height were measured to calculate body mass index (BMI). For laboratory investigations, 2 ml of venous blood was collected by venepuncture under strict aseptic conditions; blood for platelet count was collected in an EDTA tube and processed immediately. A complete blood count including total platelet count was performed using an automated haematology analyzer. Coagulation parameters, namely prothrombin time (PT), activated partial thromboplastin time (APTT), serum fibrinogen and D-dimer, were performed in the Department of Haematology, DMCH. Participants were allocated to the study groups based on their clinical diagnosis as per standard criteria applied at admission. All results were entered into the data collection sheet by the principal investigator.

Ethical Consideration

Ethical approval for this study was obtained from the Ethical Review Committee (ERC) of Dhaka Medical College Hospital, Dhaka, Bangladesh. Financial support was provided by the Bangladesh Medical Research Council. Written informed consent was obtained from all participants or their guardians before enrolment. Patients were informed of the purpose, procedures, potential risks and benefits of the study and were clearly advised of their right to withdraw at any time without consequence. All personal and clinical data were treated as strictly confidential and used solely for research purposes. Patient identifiers were not disclosed to third parties. Laboratory blood samples (2 ml) were drawn as part of a routine clinical investigation, posing minimal physical risk to participants.

Statistical Analysis

All data were entered and analyzed using SPSS version 26. Continuous variables were expressed as mean with standard deviation and categorical variables were expressed as frequency and percentage. Comparisons across the three groups were performed using one-way ANOVA for normally distributed continuous variables, the Kruskal-Wallis test for non-normally distributed continuous variables and the chi-square test for categorical variables. The primary analytical tool for this study was receiver operating characteristic (ROC) curve analysis. ROC curves were generated for platelet count in the pre-eclampsia versus normal pregnancy group and in the eclampsia versus normal pregnancy group. The area under the curve (AUC), standard error (SE) and 95 percent confidence interval (CI) were calculated for each comparison. A p-value of 0.05 or below was considered statistically significant for all tests.

RESULTS

Table 1: Baseline and Obstetric Characteristics of the Study Participants (n=81)

Variable		Pre-eclampsia (N=27) N (%)	Eclampsia (N=27) N (%)	Normal Pregnancy (N=27) N (%)	p-value
Age group (years)	<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± SD (years)	26.8± 6.13	25.2± 5.87	26.9± 3.35	
Residence	Urban	8 (29.6)	4 (14.8)	5 (18.5)	0.38
	Rural	19 (70.4)	23 (85.2)	22 (81.5)	
Gestational Age (weeks)	Mean± SD	33.0± 4.58	34.7± 3.86	32.9± 4.67	0.247
Gravitational State	Primigravida	10 (37.0)	20 (74.1)	13 (48.1)	0.02
	Multigravida	17 (63.0)	7 (25.9)	14 (51.9)	

Table 1 presents the baseline and obstetric characteristics of the three study groups. The mean age was 26.8± 6.13 years in the pre-eclampsia group, 25.2± 5.87 years in the eclampsia group and 26.9± 3.35 years in the normal pregnancy group, with no statistically significant difference among groups (p=0.408). The majority of participants in all groups resided in rural areas. Mean gestational age was comparable across groups (p=0.247). Regarding gravitational status, most women with eclampsia were primigravida (74.1%), which was significantly different from the pre-eclampsia and normal pregnancy groups (p=0.020).

Table 2: Comparison of Total Platelet Count Among the Three Study Groups (n=81)

Total Platelet Count (mm^3)	Pre-eclampsia (N=27)	Eclampsia (N=27)	Normal Pregnancy (N=27)	p-value
Mean± SD	217,777.8± 77,745.3	186,296.3± 91,728.6	252,296.3± 44,155.2	<0.001
Median	201000	140000	250000	
Range	120,000 - 410,000	107,000 - 438,000	160,000 - 325,000	

Table 2 demonstrates that platelet count was significantly lower in the pre-eclampsia group (mean 217,777.8± 77,745.3 mm^3, median 201,000 mm^3) and in the eclampsia group (mean 186,296.3± 91,728.6 mm^3, median 140,000 mm^3) compared to the normal pregnancy group (mean 252,296.3± 44,155.2 mm^3, median 250,000 mm^3), with the difference being statistically highly significant ($p<0.001$). The eclampsia group showed the lowest median platelet count and the widest range, indicating a greater degree of thrombocytopenia in eclampsia than in pre-eclampsia.

Table 3: ROC Analysis Summary for Platelet Count in Detection of Coagulation Disorder in Pre-eclampsia and Eclampsia

Group	AUC	SE	Optimal Cut-off (mm^3)	Sensitivity	Specificity	p-value	95% CI Lower	95% CI Upper
Eclampsia vs Normal	0.778	0.07	203500	0.704	0.926	<0.001	0.64	0.916
Pre-eclampsia vs Normal	0.719	0.074	218000	0.667	0.852	0.006	0.574	0.865

AUC: area under the curve; SE: standard error; CI: confidence interval. ROC analysis performed comparing each hypertensive group against normal pregnant controls.

Table 3 presents the ROC analysis results. For the eclampsia versus normal pregnancy comparison, the AUC was 0.778 (95% CI: 0.640 to 0.916; $p<0.001$), indicating acceptable to good discriminatory capacity. The optimal cut-off value was 203,500 mm^3, yielding a sensitivity of 70.4% and specificity of 92.6% for distinguishing eclamptic women from normal pregnant women. For the pre-eclampsia versus normal pregnancy comparison, the AUC was 0.719 (95% CI: 0.574 to 0.865; $p=0.006$), indicating moderate discriminatory capacity. The optimal cut-off was 218,000 mm^3, with a sensitivity of 66.7% and specificity of 85.2%.

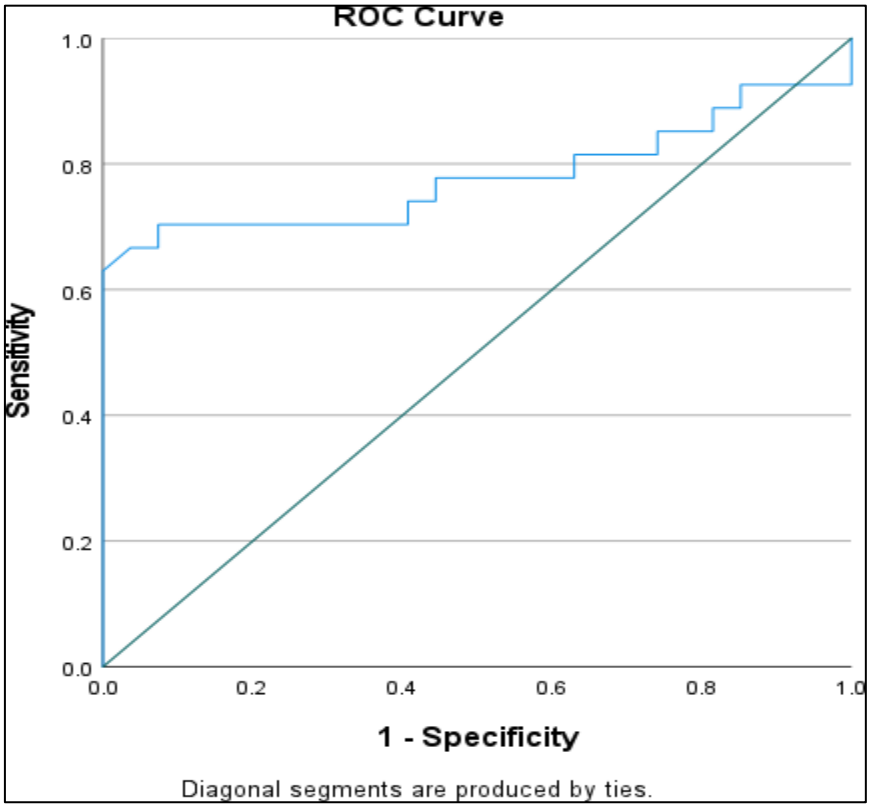

Figure 1: ROC Curve for Total Platelet Count in Eclampsia versus Normal Pregnancy

Figure 1. ROC analysis for total platelet count comparing eclampsia versus normal pregnancy. AUC=0.778 (95% CI: 0.640-0.916); optimal cut-off=203,500 mm^3; sensitivity=70.4%; specificity=92.6%.

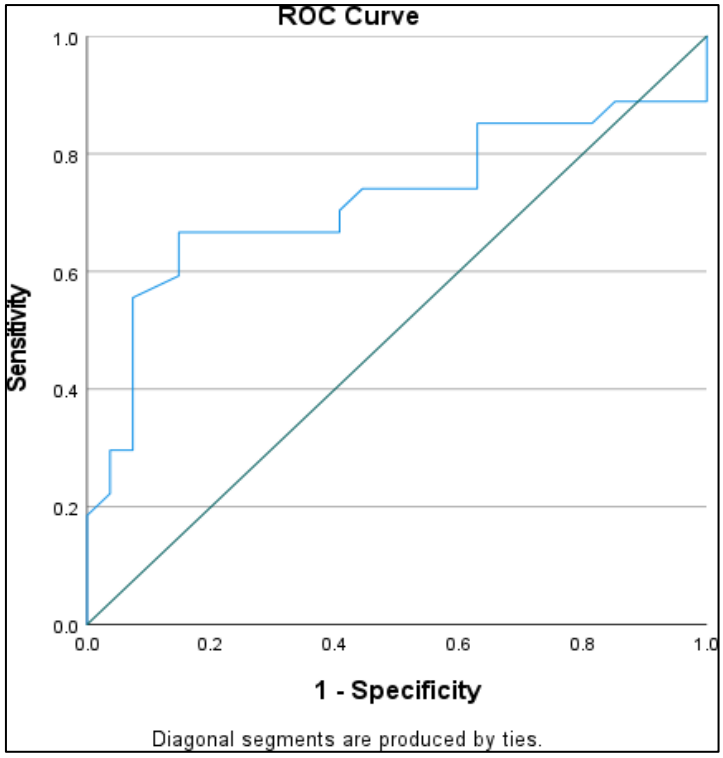

Figure 2: ROC Curve for Total Platelet Count in Pre-eclampsia versus Normal Pregnancy

Figure 2. ROC analysis for total platelet count comparing pre-eclampsia versus normal pregnancy. AUC=0.719 (95% CI: 0.574-0.865); optimal cut-off=218,000 mm^3; sensitivity=66.7%; specificity=85.2%.

DISCUSSION

This study evaluated the diagnostic accuracy of platelet count for the detection of coagulation disorder in pre-eclamptic and eclamptic patients, using ROC analysis to derive optimal cut-off values and to determine the area under the curve alongside associated diagnostic performance measures. The study population comprised 81 pregnant women divided equally into pre-eclampsia, eclampsia and normal pregnancy groups, with 27 participants in each.

Regarding baseline characteristics, no statistically significant difference was found among the three groups in terms of age (p=0.408) or residence (p=0.380). The mean ages were 26.8± 6.13 years, 25.2±5.87 years and 26.9±3.35 years in the pre-eclampsia, eclampsia and normal pregnancy groups respectively, consistent with findings reported by Chaware et al., who noted mean ages of 24 years in mild pre-eclampsia and 22.7 years in severe pre-eclampsia and by Rahman et al., who recorded mean ages of 27.4± 6.67 years and 26.85± 5.25 years in their pre-eclampsia and eclampsia groups [10,13]. There was no statistically significant difference in gestational age among the groups (p=0.247). Mean gestational ages of 33.0± 4.58 weeks, 34.7± 3.86 weeks and 32.9± 4.67 weeks were recorded, results broadly in agreement with Rahman et al., who reported mean gestational ages of 33.6± 3.9 weeks in pre-eclampsia and 32.1± 3.21 weeks in eclampsia [13].

A statistically significant difference in gravitational status was observed across the groups (p=0.020). Eclampsia was more common in primigravida women, with 74.1 percent of eclampsia cases occurring in primigravid patients, compared to 37.0 percent in the pre-eclampsia group. This finding is consistent with results reported by Chaware et al., who found 73.3 percent of eclampsia cases occurring in primigravida women and supports the well-established clinical association between primigravidity and eclampsia [10].

The central finding of this study pertains to the platelet count values across the three groups. Total platelet count was significantly lower in the pre-eclampsia group and in the eclampsia, group compared to normal pregnant women (p<0.001). The eclampsia group showed the most marked reduction, with a median of 140,000 mm^3 compared to 201,000 mm^3 in the pre-eclampsia group and 250,000 mm^3 in the control group. Rahman et al. similarly reported significantly lower platelet counts in eclampsia compared to pre-eclampsia and controls [13]. Sameer et al. and Annam et al. likewise found significant reductions in platelet count in both pre-eclampsia and eclampsia compared to their respective control groups (p<0.01 and p<0.001 respectively) [14,15]. These findings confirm that platelet count decreases progressively with the severity of hypertensive disease in pregnancy, a trend attributed to endothelial

injury, platelet activation and accelerated consumption [16].

The ROC analysis revealed an AUC of 0.778 (95% CI: 0.640 to 0.916) for eclampsia and 0.719 (95% CI: 0.574 to 0.865) for pre-eclampsia, both statistically significant. These values indicate an acceptable to moderate discriminatory capacity of platelet count for distinguishing hypertensive pregnant women from normal pregnant controls. The optimal cut-off for eclampsia was 203,500 mm^3, which yielded a sensitivity of 70.4% and specificity of 92.6% and for pre-eclampsia was 218,000 mm^3, yielding a sensitivity of 66.7% and specificity of 85.2%. Freitas et al., in a study among women with severe pre-eclampsia, reported an AUC indicating regular diagnostic significance for platelet count, with a sensitivity of 68.77% and specificity of 70.69% at a cut-off below 221,000 mm^3 [12]. The AUC of 0.719 in the current study's pre-eclampsia group is broadly comparable to these findings. Rahman et al. reported sensitivity and specificity of plateletcrit (PCT) for pre-eclampsia of 75% and 55% respectively, suggesting platelet count alone may be a more specific though less sensitive marker than plateletcrit [13].

When the ROC-derived cut-off values were applied against the criterion standard of confirmed coagulation disorder, the diagnostic performance declined considerably. At a cut-off of 203,500 mm^3 for eclampsia, the sensitivity for detecting actual coagulation disorder was only 45.45%, with a specificity of 90.00% and an overall accuracy of 53.70%. For pre-eclampsia, at a cut-off of 218,000 mm^3, sensitivity was 46.51%, specificity was 81.82% and accuracy was again 53.70%. The negative predictive values were particularly poor, at 27.27% and 28.12% respectively, meaning that a platelet count above the cut-off value could not reliably exclude coagulation disorder. These findings are consistent with the observation by Prieto et al., who found no significant correlation between platelet count levels and PT, APTT, or fibrinogen in pre-eclamptic patients with marked thrombocytopenia [17]. Metz et al. also highlighted that elevated D-dimer without accompanying thrombocytopenia was common, suggesting that coagulation dysfunction in pre-eclampsia is multifactorial and not always reflected by platelet count alone [9].

The high positive predictive value at the derived cut-offs suggests that when platelet count falls below these thresholds, the likelihood of coagulation disorder is high. However, the very low sensitivity implies that a substantial proportion of women with coagulation disorder will be missed if platelet count alone is used as a diagnostic criterion. Lei Han et al. found that among blood coagulation parameters and platelet indices, thrombin time (TT) with an optimal cut-off of greater than 12.65 seconds was a superior monitoring index for pre-eclampsia, while mean platelet volume (MPV) demonstrated potential for predicting disease severity [18]. This reinforces the view that platelet count should not be used in isolation but may be most valuable as part of a multiparameter diagnostic panel. Bhutani et al. similarly demonstrated that platelet parameters in combination with coagulation indices provided a more comprehensive assessment of haemostatic status in pregnancy-induced hypertension than any single test alone [19].

Taken together, the findings of this study demonstrate that while platelet count has a statistically significant and clinically relevant relationship with hypertensive severity in pregnancy, its diagnostic accuracy for identifying actual coagulation disorder is insufficient for standalone clinical use. In resource-limited settings where comprehensive coagulation panels are unavailable, platelet count may serve as a useful adjunct and risk-stratification tool, particularly when it falls markedly below the cut-off thresholds identified by ROC analysis. However, clinical decisions regarding anticoagulation therapy, operative delivery, or transfusion support should not be based on platelet count alone.

Limitations of the study

The single-center study design with a small sample size reduces the generalizability of findings. Larger multicenter studies are warranted to further validate its role within a combined diagnostic approach for hypertensive disorders of pregnancy.

CONCLUSION

Platelet count alone has limited diagnostic accuracy for detecting coagulation disorder in pre-eclamptic and eclamptic patients and cannot be recommended as a standalone diagnostic test. It may serve as a useful adjunct in resource-limited settings, but should always be interpreted alongside standard coagulation parameters.

Conflicts of interest: There are no conflicts of interest.

Ethical Approval: This study approved by the institutional ethical review committee.

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