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ORIGINAL ARTICLE

Assessment of Diagnostic accuracy of Platelet Distribution Width as predictor of Preelampsia

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ABSTRACT

Aim: Assessment of diagnostic accuracy of platelet distribution width in prediction of preeclampsia in females presenting with singleton pregnancy
Study Design: A Descriptive case series study.
Setting: Department of Obstetrics & Gynecology, Unit II, DHQ Teaching Hospital Gujranwala.
Duration of Study: Seven months from 1st March 2019 till 30st September 2019.
Methods: Total 170 pregnant females with age ranging between 18-40 years and gestational age from 16-20 weeks having less than 5 children were admitted from OPD of Department of Obstetrics & Gynecology, DHQ hospital, Gujranwala. Females with multiple pregnancy (on ultrasound), those diagnosed with chronic hypertension (BP≥140/90mmHg or taking anti-hypertensive) and those with Liver disease (ALT>40IU, AST>40IU), renal impairment (creatinine > 1.2mg/dl), chronic or gestational diabetes (BSR > 200mg/dl) were excluded. After taking informed consent, patient's biodata including name, age, BMI, gestational age and parity was noted. At baseline, blood sample was collected in 5cc disposable syringe.
Results: All patients were followed-up in OPD till term whereby they were evaluated for blood pressure and presence of proteinuria and preeclampsia was confirmed as positive or negative in accordance with operational definition. Quantitative variables like BMI, age of the patient and gestational age were presented in the form of mean and standard deviation whereas qualitative variables including preeclampsia (on PDW and actual event) were presented in the form of percentage and frequency. Presenting parity as frequency we generated 2x2 table for calculation of NPV, PPV specificity, sensitivity and diagnostic accuracy of PDW taking actual clinical occurrence of preeclampsia as gold standard. Data was stratified for age, parity, BMI of the patient and gestational age calculated in weeks.
Conclusion: On the basis of this study we concluded that the PDW is a useful tool for prediction of preeclampsia in females presenting with singleton pregnancy but less had low sensitivity.
Keywords: Preeclampsia, Platelet Distribution Width, blood pressure, proteinuria

INTRODUCTION

It's a proven fact on the basis of several studies that Preeclampsia is a major health concern complicating many pregnancies. It not only complicates a significant number of pregnancies ranging between 3% to 8% but also and causes marked increase in both maternal and perinatal morbidity and mortality[1]. Preeclampsia is still one of the major causes of maternal mortality even in the developed countries wherein the reported incidence of 15%-20%[2]. In Pakistan, preeclampsia is even higher whereby it is present in 21% pregnancies[3]. The exact mechanism of how preeclampsia worsen maternal and fetal outcome remains to be elucidated. Uncontrolled inflammation which is a hallmark of preeclampsia, might be related to the development of intrauterine pathologies[4].

Maintenance of heamostsis which is prevention of bleeding is a complex mechanism whereby the dynamic particles platelets function in tandom with coagulation factors. Platelets interact with leukocytes and endothelial cells in addition to interacting with each other, as a mechanism of searching sites of injury in the vascular beds. On encountering injured vascular bed they become activated followed by stimulation, as a result of which they undergo a shape change which leads to an increased surface area. Platelets adhere to damaged blood vessel play a pivotal role in the first steps to form clot which stops bleeding. Platelets cause activation of coagulation factors by donating their membrane phospholipids[5,6].

Indices used to assess platelet functions include for the platelet count, mean platelet volume (MPV), the ratio of the two, and platelet distribution width (PDW); PDW is a measure of platelet size distribution[7]. One study had shown the sensitivity and specificity of PDW 96.3% and 91.3% respectively for prediction of preeclampsia[8]. Yang *et al* has reported the sensitivity of 72% and specificity of 71%[9]. But, Freitas *et al.*, found the sensitivity of 55.17% which is lower and specificity of 86.21% which is slightly higher as compared to study by Yang *et al*[10].

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The main objective of our study is to assess the diagnostic accuracy of PDW for prediction of preeclampsia in females with singleton pregnancy. Literature showed that PDW can be a reliable predictor for preeclampsia but a controversy exist in accuracy of PDW for prediction of preeclampsia. Moreover there is no local study found which could help us in implementation of PDW for prediction of preeclampsia.

Therefore this study was conducted to find reliability of PDW in local population. This study can help us to get local data and will help to implement the assessment of PDW to predict preeclampsia in early trimester and preeclampsia can be prevented.

MATERIALS AND METHODS

This descriptive case series was conducted in the Department of Obstetrics & Gynecology, Unit II, DHQ Teaching hospital Gujranwala after IRB permission for a period of seven months from 01/03/2019 till 30/09/2019. A sample size of 170 patients is calculated with 95% confidence level with expected percentage of preeclampsia 21% and sensitivity of PDW 72% with 15% margin of error and specificity 71% with 8% margin of error. Non probability, consecutive sampling technique was used.
Inclusion Criteria: Females between 18-40 years of age, having a parity of <5, presenting at gestational age 16-20weeks calculated by LMP.
Exclusion Criteria: Females with multiple pregnancy (on ultrasound) and females with chronic hypertension wither either BP≥140/90mmHg or on anti-hypertensive drugs.Liver disease (ALT>40IU, AST>40IU), renal impairment (creatinine>1.2mg/dl), chronic or gestational diabetes (BSR>200mg/dl).
Data collection procedure: 170 patients falling in the inclusion criteria, were admitted from OPD of Department of Obstetrics & Gynecology, DHQ hospital, Gujranwala. After taking informed consent, patient biodata including name, age, BMI, gestational age and parity was noted. As baseline test blood sample was taken in a 5cc disposable syringe. All samples thus collected were tested in hospital laboratory to asses PDW. Reports were obtained and

in accordance with operational definition patients were labeled either positive or negative . Then females were followed-up in OPD till term whereby those with high blood pressure and presence of proteinuria and preeclampsia were confirmed as positive or negative in acoordance with operational definition. All this information was recorded on attached proforma .

Data analysis: For data analysis we used SPSS version 21 for entry and analysis of data. All quantitative variables like age, gestational age and BMI were presented in the form of mean and standard deviation whereas qualitative variables like preeclampsia (on PDW and actual event) were presented in the form of percentage and frequency. In addition to this parity was presented as frequency as well. 2x2 table was generated to calculate specificity, sensitivity, NPV, PPV and diagnostic accuracy of PDW whereby actual preeclampsia being gold standard. Data was stratified for age, parity, gestational age and BMI. Post-stratification, 2x2 tables were generated to calculate specificity, sensitivity, NPV, PPV and diagnostic accuracy of PDW actual preeclampsia taken as gold standard.

RESULTS

This study included 170 pregnant females. The age ranged between 21 and 35 years whereas the mean age of the females was found to be 26.09±3.26 years (Table 1). The weight range was found to be from 50 to 72kg and the mean value of weight was 63.02±6.014 kg (Table 2). The mean gestational age was found to be 37.63±3.76 weeks with minimum being 20 and maximum 41 weeks (Table 3). We also analyzed the parity and found that 59(34.71%) females were nulliparous, 60(35.29%) females had parity 1, 34(20%) females were para 2, 8(4.71%) females wre para 4 and 9(5.29%) females had parity 6, (Fig. 1). The mean PDW of the females was 16.69±2.97 with minimum and maximum values of 10.00 & 22.00 respectively (Table 4). Preeclampsia was diagnosed positive among 27(15.88%) females by PDW, (Fig. 2). However preeclampsia by blood pressure & Proteinuria was found negative in all the females at 20th, 24th & 30th weeks (Table 5). Out of 170 females at 36th week the preeclampsia diagnosed by blood pressure & Proteinuria was noted in 33(19.4%) females (Table 6).

Out of 170 females at 38th week the preeclampsia diagnosed by blood pressure & Proteinuria was noted in 33(19.4%) females (**Fig. 3)**. Our study showed the specificity,sensitivity, NPV, PPV and diagnostic accuracy of PDW was 83.94%,15.15%,80.42%,18.52%, & 70.59% taking actual preeclampsia as gold standard (Table 7).

It was observed that among patients with age ≤ 28 years the specificity, sensitivity,and diagnostic accuracy of PDW was 87.83%,13.79% & 72.92% taking actual preeclampsia as gold standard. Similarly among patients with age >28 years the specificity, sensitivity and diagnostic accuracy of PDW was 63.64%, 25% & 57.69% taking actual preeclampsia as gold standard (Table 8).

Table 1: Descriptive statistics for age in years

Age (years)	n	170
	Mean	26.09
	Standard Deviation	3.26
	Minimum	21.00
	Maximum	35.00

Table 2: Descriptive statistics of weight (kg)

Weight (kg)	n	170
	Mean	63.02
	Standard Deviation	6.014
	Minimum	50.00
	Maximum	72.00

Table 3: Descriptive statistics for gestational age in weeks

Gestational age (weeks)	n	170
	Mean	37.63
	Standard Deviation	3.76
	Minimum	20.00
	Maximum	41.00

Analyzing on the basis of gestational age among patients with gestational age ≤37 weeks the specificity, sensitivity and diagnostic accuracy of PDW was 77.78%, 12.5% & 65.91% taking actual preeclampsia as gold standard. Similarly among patients with gestational age >37 years the specificity, sensitivity and diagnostic accuracy of PDW was 86.14%,16% & 72.22% taking actual preeclampsia as gold standard (Table 9).

Considering the parity among null & primary parity patients the specificity, sensitivity and diagnostic accuracy of PDW was 91.58%, 4.17% & 73.95% taking actual preeclampsia as gold standard. Similarly among multiparous patients the specificity, sensitivity and diagnostic accuracy of PDW was 66.67%, 44.44% & 62.75% taking actual preeclampsia as gold standard (Table 10).

Table 4: Descriptive statistics of PDW

PDW	n	170
	Mean	16.69
	Standard Deviation	2.97
	Minimum	10.00
	Maximum	22.00

Table 5: Distribution of preeclampsia diagnosed on blood pressure & Proteinuria at 20th, 24th & 30th week

Preeclampsia (BP & Proteinuria)		Frequency	Percent
20 weeks	Negative	170	100.0
24 weeks	Negative	170	100.0
30 weeks	Negative	170	100.0

Table 6: Distribution of preeclampsia diagnosed on blood pressure & Proteinuria at 36th week

Preeclampsia (BP & Proteinuria)		Frequency	Percent
36th weeks	Positive	33	19.4
	Negative	137	80.6
	Total	170	100.0

Table 7: Validity of PDW for preeclampsia taking actual preeclampsia as gold standard

PDW	Preeclampsia (blood pressure & Proteinuria)		Total
	Positive	Negative	
Positive	5	22	27
	18.5%	81.5%	100.0%
Negative	28	115	143
	19.6%	80.4%	100.0%
Total	33	137	170
	19.4%	80.6%	100.0%

Sensitivity:15.15% Specificity: 83.94% PPV:18.52%
NPV:80.42% Diagnostic Accuracy:70.59%

Table 8: Validity of PDW for preeclampsia taking actual preeclampsia as gold standard stratified by age

Age (years)	PDW (preeclampsia)	Actual Preeclampsia		Total
		Positive	Negative	
≤28	Positive	4(22.2%)	14(77.8%)	18(100%)
	Negative	25(19.8%)	101(80.2%)	126(100%)
>28	Positive	1(11.1%)	8(88.9%)	9(100%)
	Negative	3(17.6%)	14(82.4%)	17(100%)

PDW	Age (years)	
	≤28	>28
Sensitivity	13.79%	25%
Specificity	87.83%	63.64%
PPV	22.22%	11.11%
NPV	80.16%	82.35%
Diagnostic Accuracy	72.92%	57.69%

Table 9: Validity of PDW for preeclampsia taking actual preeclampsia as gold standard stratified by gestational age

Gestational age	PDW [30]	Actual Preeclampsia		Total
		Positive	Negative	
≤37	Positive	1(11.1%)	8)88.9%)	9(100%)
	Negative	7(20%)	28(80%)	35(100%)
>37	Positive	4(22.2%)	14(77.8%)	18(100%)
	Negative	21(19.4%)	87(80/6%)	108(100%)

PDW	Gestational Age	
	≤37	>37
Sensitivity	12.5%	16%
Specificity	77.78%	86.14%
PPV	11.11%	22.22%
NPV	80%	80.56%
Diagnostic Accuracy	65.91%	72.22%

Table 10: Validity of PDW for preeclampsia taking actual preeclampsia as gold standard stratified by parity

Parity	PDW (preeclampsia)	Actual Preeclampsia		Total
		Positive	Negative	
Null & primary	Positive	1	8	9
		11.1%	88.9%	100.0%
	Negative	23	87	110
		20.9%	79.1%	100.0%
Multiple	Positive	4	14	18
		22.2%	77.8%	100.0%
	Negative	5	28	33
		15.2%	84.8%	100.0%

PDW	Parity	
	Null or Primary	Multiple
Sensitivity	4.167%	44.44%
Specificity	91.58%	66.67%
PPV	11.11%	22.22%
NPV	79.09%	84.85%
Diagnostic Accuracy	73.95%	62.75

Fig. 1: Distribution of parity

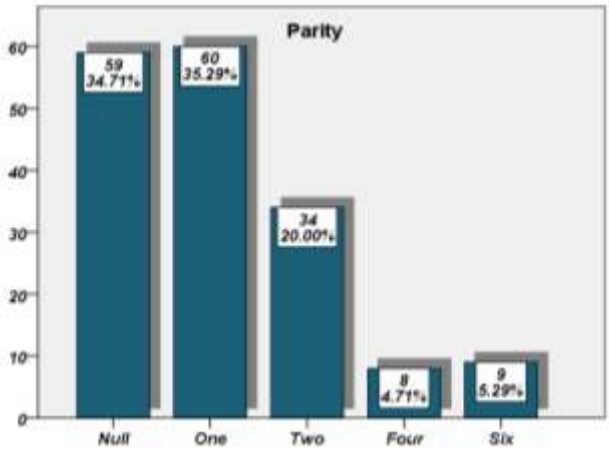


Fig. 2: Distribution of preeclampsia diagnosed by PDW

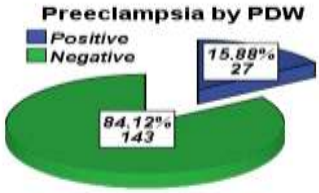
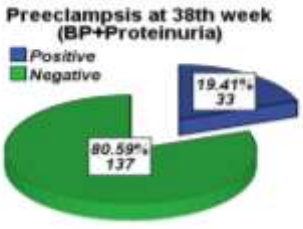


Fig. 3: Distribution of preeclampsia diagnosed on blood pressure & Proteinuria at 38th week



DISCUSSION

Our study was a descriptive case series study which was carried out at Department of Obstetrics & Gynecology, Unit II of DHQ Teaching Hospital Gujranwala aimed at assessment of diagnostic accuracy of PDW for prediction of preeclampsia in females presenting with singleton pregnancy. Pregnancy-induced hypertension is one of the very serious complications of pregnancy which is deleterious and affects as high as 5–10% of pregnancies. Preeclampsia is a proven major cause of morbidity and mortality in both mother and mother. Preeclampsia is a multi-organ disease although the eitiology still remains unknown, despite the fact that several studies have been conducted to investigate this condition.

There is a fall in platelet count with the progression of preeclampsia, and thus it is considered as a reliable marker of the severity of preeclampsia. Although preeclampsia is defined by hypertension and proteinuria, an important role is played by changing coagulation function between endothelial vascular cells and platelets , a process which is complex and involves series of events[56,57,59-61].

In our study the PDW showed diagnostic accuracy of 70.59% for prediction of preeclampsia while the sensitivity of PDW was found as low as 15.15%. The specificity of PDW was 83.94%. Therefore it is concluded that PDW is less sensitive but highly specific tool for prediction of preeclampsia in females taking actual preeclampsia as gold standard. Nitesh Thalor et al[58] conducted a study in 2019 to find a correlation between preeclampsia and platelet indices. The author concluded that the platelet indices, mainly including PDW and MPV are both easily available and economical and on top of it are quite reliable not only in the prediction but also early diagnosis of preeclampsia in addition to serving as a reliable marker pointing to severity of preeclampsia.

A study by Seung Woo Yang et al[55] identified PDW as quite a useful marker for early prediction of how severe preeclampsia will be. The increase in the MPV and PDW was distinctly greater in pregnant women with preeclampsia as compared to pregnant women. In preeclampsia there is alteration of the coagulation process involving both platelets and endothelial cells which is related to platelet activation. Basic research has demonstrated that there is an increase in plasma thrombopoietin with preeclampsia which is a major marker of platelet activity. Therefore, platelet activation parameters including PDW as well as MPV are increased in preeclampsia more in comparison to the values normal pregnant women[54].

In another study the sensitivity of PDW for prediction of preeclampsia was found to be 96.3% whereas the specificity was 91.3%[8]. Yang *et al*. has reported the sensitivity of 72% and specificity of 71%[9]. Karateke et al[1] and Freitas et al[10] have also demonstrated a that there is a significant decrease in the platelet concentration in patients with preeclampsia. Freitas *et al*[10] reported the sensitivity of 55.17% and specificity of 86.21%[10].

Dundar et al[53] also suggested in his study that there is value in using MPV as a marker for the prediction of preeclampsia development. However, in that study there is no proven evidence demonstrating the of relationship between the prediction and/or severity of preeclempsia and platelet indices. In this study, the values of PDW and MPV in pregnant women with preeclampsia showed a relatively greater increase in cases of severe preeclampsia as compared to healthy pregnancies. Moreover only PDW as a sole parameter showed significant increase as compared to the normal range in pregnancies with severe preeclampsia. Doğan et al[62] in contrast did not find any significant difference in PDW among women with preeclampsia both mild and severe as compared to each other and healthy controls. Nonetheless, a significantly higher level of PDW has recently been reported among women with preeclampsia[4,10,55].

Abha Singh and Ruchi Varma[59] conducted a study to find the role of plateletcrit and PDW in assessing of nonthrombocytopenic preeclampsia and eclampsia. The author concluded in their study results that the indices varied significantly with disease severity. Platelet indices can be used especially PDW and plateletcrit in addition to platelet count to evaluate the severity of preeclampsia and eclampsia instead of relying on platelet count alone.

CONCLUSION

Our study concluded that for prediction of preeclampsia in females presenting with singleton pregnancy PDW is a reliable and useful tool but has low sensitivity.

Conflict of interest: Nil

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