Uterine Artery Doppler and Platelet Indices At 11-14 Weeks Gestation As A Predictor of Preeclampsia: Observational Study

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Abstract

Background: Preeclampsia is still one of the major antenatal risk factors which cause significant mortality and morbidity. Early diagnostic tests might help to reduce the incidence. The objective of our study is

1. To assess the predictive value of uterine artery PI at 11–14 weeks gestation for hypertensive disorders during pregnancy;

2. To compare the platelet indices value at 11-14 weeks between preeclampsia and normotensive mothers.

Methodology: 50 antenatal women were enrolled and platelet indices and USG uterine artery Doppler were done at 11-14 weeks of gestational age and followed up till delivery. The data were analyzed using SPSS 20. The mean with SD was compared using a t-test and proportions were compared using the Chi square test. The sensitivity analysis is done to assess the diagnostic value of PI and RI

Results: The mean PI is 1.059+/-0.856 &1.723+/-0.261 and the mean RI is 0.48+/-0.11 & 0.67+/-0.15 in normotensive and Preeclampsia patients. The mean platelet value at 11-14 weeks was significantly higher in Preeclampsia patients. The PC/MPV & PCT/MPV ratio was significantly lower in Preeclampsia patients. The Plateletcrit, Platelet count, and Platelet distribution range were not different between the two groups. The sensitivity, specificity, PPV, and NPV of the pulsatility

index are 92.9%, 88.9%, 76.4%, and 96.9% whereas for Resistance index is 85.8%, 83.4%, 66.6%, and 93.7%.

Conclusion: Our study concludes uterine artery mean PI &RI and platelet indices at 11–14 weeks of gestation are effective predictive tests for hypertensive disorders of pregnancy.

Keywords: Pulsatility Index, Resistance Index, Platelet Indices, Doppler, Preeclampsia

Introduction

One of the most common obstetric complications, hypertensive disorders of pregnancy are linked to high rates of morbidity and mortality in both the mother and the fetus.[1] Maternal mortality is primarily caused by bleeding (27%), with hypertension coming in second at 14%.[2] Its etiology is still mostly unclear. Although the symptoms usually appear in the latter half of the second or third trimester, the pathology is likely present from the first trimester.

It is believed that poor trophoblastic invasion of the mother spiral arteries causes high resistance maintenance vessels, insufficient placental perfusion, tissue damage, and an increase in the synthesis of vasoconstrictive substances, which in turn causes pregnancy-related hypertensive disorders. The idea of using uterine artery Doppler as a screening method came about as a result of abnormal uteroplacental blood flow.[3] One noninvasive technique for evaluating the earliest alterations in the uteroplacental circulation is Doppler.[4] The idea is that as pregnancy goes on, impedance to uterine artery flow velocimetry rises, most likely as a result of abnormal placentation. It is a fast, safe, repeatable, and dependable tool that can also be used with a nuchal translucency scan.

Mean platelet volume and other platelet indices were investigated in diagnosing of PIH as it is a easy and relatively low cost procedure and also many studies have suggested PIH have significant relation to change in platelet count and mean platelet volume in early gestational age.[9]

Priority should be given to reducing maternal and perinatal death and morbidity as a result of hypertensive disorders of pregnancy through early prediction. The pathophysiology and etiology are still unknown despite much research. The majority of studies conducted to date have focused on low-risk women, and there are few studies conducted in India that reflect the reference and predictive values of the uterine artery mean pulsatility index (PI) for pregnancy-related hypertensive disorders.[5] Therefore, the objective of our study is 1.To assess the predictive value of uterine artery PI at 11–14 weeks gestation for hypertensive disorders during pregnancy; 2. To compare the platelet indices value at 11-14 weeks between preeclampsia and normotensive mothers.

Methodology

Using a non-probability simple random sampling technique, this prospective observational study of 50 antenatal women between 11 and 14 weeks of gestation was conducted over the course of a year (January 2023–January 2024) in a tertiary care center. Permission from the institutional ethics committee was obtained, and the subjects provided informed consent before the start of study. Around 50 Women of 11-14 weeks gestational age who were booked in our institution and willing to come for checkups till the end of third trimester were included in our study.

Depending on the timing of their last menstrual cycle, early ultrasound scan, or menstrual cycle regularity, women were critically assessed for gestational age. A thorough physical examination and history were taken. Using a mercury manometer, blood pressure was taken

during each prenatal visit while the patient was sitting with their arm at heart level for diagnosing preeclampsia. The measurement was repeated after ten minutes of rest. The Doppler USG was performed during routine USG checkup at 11-14 weeks of gestational age and pulsatility index(P.I) and Resistance index(R.I) was calculated.[8] Also the blood sample was collected and the mean platelet count (PC), mean platelet volume (MPV), platelet distribution range (PDW), plateletcrit (Pct), Pct / MPV ratio and PC / MPV ratio was recorded.[9]

According to a study by Bindal J & Chugh N[6] the reference value of raised mean uterine artery PI for prediction of hypertensive disorders of pregnancy at 11–14 weeks of gestation was deemed to be 1.71 and for RI it is 0.58.[7] Women with hypertension were started on aspirin at a dose of 1-3 mg/kg body weight and were managed accordingly for PIH. The continuous parameters were expressed in terms of mean and standard deviation, while the categorical parameters were expressed in terms of frequency and percentage. Using Pearson's Chi-square test and the t-test for independent samples, respectively, the distribution of women in the hypertensive and normotensive groups based on sociodemographic, clinical, and means of continuous parameters were compared for statistical significance.

Results

Around 50 antenatal women were followed up at all prenatal visits72% were normotensive and 28% were diagnosed with preeclampsia.

Table 1: Distribution of socio-demographic variables

Variables	N	%
Age in years		
20-24	22	44
25-29	13	26
30-34	8	16
>35	7	14
Parity		
Primi	25	50
Para 1	18	36
Para 2 or more	7	14
Gestational age in weeks at first Doppler USG conducted		
11	13	26
12	16	32
13	11	22
14	10	20

The results in Table 1 show majority were inthe age group 20-24 years (44%) and 50% were Primi. The mean PI is 1.059+/-0.856 &1.723+/-0.261 and the mean RI is 0.48+/-0.11 & 0.67+/-0.15 in normotensive and Preeclampsia patients. The results were significant.(Table 2). The platelet indices in tab.2 show Mean platelet value at 11-14 weeks was significantly higher in Preeclampsia patients. The PC/MPV & PCT/MPV ratio was significantly lower in Preeclampsia patients. The PCT, PC, and PDW were not different between the two groups.

Table 2: P.I, R.I and platelet indices at 11-14 weeks

Variables	Normotensive (36)	Preeclampsia (14)	P value
P.I	1.059+/-0.856	1.723+/-0.261	<0.001
R.I	0.48+/-0.11	0.67+/-0.15	<0.001
Platelet indices			
Mean platelet volume(MPV)	8.45+/-1.14	9.71+/-1.05	<0.001
		233.35+/-53.6	0.766
Platelet count(PC)	239.33+/-67.88	17.62+/-0.77	0.536
		0.21+/-0.07	0.741
Platelet distribution width Plateletcrit (PCT),	17.86+/-0.94	0.021+/-0.003	<0.001
	0.23+/-0.22	24.01+/-8.35	<0.001

PCT / MPV ratio	0.027+/-0.023		
PC / MPV ratio	28.32+/-9.89		

Table 3: Categorical distribution of PI and RI

Variables(at 11-14 weeks of gestation)	Hypertensive (N=14)	Normotensive (N=36)	P Value
PI High Normal	13, 92.9% 1, 7.1%	4, 11.1% 32, 88.9%	<0.001
RI High Normal	12, 85.8% 2, 14.2%	6, 16.6% 30, 83.4%	<0.001

Table 4: Sensitivity analysis of Pulsatility index and Resistance index

Variables	Pulsatility index	Resistance index
Sensitivity	92.9%	85.8%
Specificity	88.9%	83.4%
Positive predictive value(PPV)	76.4%	66.6%
Negative predictive value(NPV)	96.9%	93.7%

The sensitivity, specificity, PPV, and NPV of the pulsatility index are 92.9%, 88.9%, 76.4%, and 96.9% whereas for Resistance index is 85.8%, 83.4%, 66.6%, and 93.7%.

Discussion

Predicting preeclampsia in the second trimester can be done with high accuracy and utility using Doppler velocimetry of the uterine arteries.[7,10] Many studies have assessed the value of uterine artery Doppler velocimetry in the prognosis of preeclampsia; however, comparatively few have examined the predictive function of this test in pregnancies at high risk.[7,10] The majority of research on uterine artery Doppler velocimetry's predictive value for preeclampsia involved non-selected populations.[11-13] Several studies have defined abnormal Doppler using different velocimetry indices. This study defined abnormal Doppler as having a high RI ($\geq$ 0.58). This threshold value is consistent with the RI that has been deemed abnormal in other published works.[7,10]

In this study, the group with high RI and High PI had a significantly higher prevalence of preeclampsia (p<0.05) than the group with normal PI and RI. Thus, in high-risk pregnancies, the presence of high RI was found to be predictive of preeclampsia. It was discovered that every diagnostic index was high. Yusuf et al.'s study, which is comparable to ours, revealed sensitivity (70.5%), specificity (92.6%), PPV (57.1), and NPV (95.7).[15] This study's high sensitivity and specificity are comparable to findings from studies by Arduini et al., Jacobson et al., Zimmerman et al., and others.[7,10,14-15] Shinde et al have shown results similar to ours with the Pulsatility index's sensitivity, specificity, PPV, and NPV to be 89.3%, 95.8%, 90.5%, and 95.1%.[16]

A slight rise in platelet aggregation is seen during a typical pregnancy, but this is offset by an increase in platelet synthesis. Increased platelet synthesis also increases in mean platelet volume (MPV]. Uncontrolled intravascular platelet activation and increased platelet destruction are expected outcomes of preeclampsia, which is characterized by endothelial damage. Young, large platelets are released into the circulation and new platelet synthesis is stimulated in the bone marrow by a decrease in platelet count. Because of the platelet's involvement in the pathophysiology of preeclampsia, preeclampsia platelet indices values can differ.[9] The comparison of platelet indices in our study shows Mean platelet value at 11-14 weeks was significantly higher in Preeclampsia patients. The PC/MPV & PCT/MPV ratio was significantly lower in Preeclampsia patients. The PCT, PC, and PDW were not different between

hypertensive and normotensive. The study conducted by Temur et al compared the platelet indices of the preeclampsia group with the control (Normotensive) group. The results showed that there was no significant difference (p>0.05) in the platelet indices-mean platelet count (227.22 ± 78.58 vs 236.69 ± 64.30), platelet crit (PCT) (0.21 ± 0.06 vs 0.24 ± 0.27), and platelet distribution width (PDW) (17.11 ± 0.80 vs 17.29 ± 0.82). But similar to our study there was a significant difference in MPV values between the preeclampsia and control groups (9.66 ± 1.62 and 8.92 ± 1.33, respectively) (p < 0.001). Also, they showed significantly lower PC/MPV and PCT/MPV ratios in preeclampsia patients. [9]

MPV, a complete blood count parameter that is simple, quick, and inexpensive to assess in any hospital, was found to be elevated in preeclampsia in our study. Evaluation of the MPV value, PCT/MPV, and PC/MPV ratio during prenatal follow-up may help predict preeclampsia.

Our study has some limitations like small sample size and non-randomized sampling method use. So, further studies with a large cohort and randomized sampling at a multi-centric level are suggested to increase the evidence on the use of uterine artery Doppler and platelet indices for early prediction of PIH.

Conclusion

Hypertensive disorders in pregnancy remain poorly understood. According to the results of our investigation, the uterine artery means PI, RI, and platelet indices at 11–14 weeks of gestation have superior positive, negative, and sensitivity predictive values. The last ten years have seen a rise in awareness regarding pregnancy-related hypertensive disorders screening techniques. To prevent complications for both the mother and the newborn, early diagnosis and prompt intervention are essential components of the art of good obstetric care. Therefore, the best noninvasive method to evaluate changes in uteroplacental hemodynamics for early prediction of the development of hypertensive disorders during pregnancy is to measure mean uterine artery PI, RI, and platelet indices at 11–14 weeks gestation.

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