Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 6, 2025

ROLE OF UTERINE ARTERY DOPPLER PULSATILITY INDEX STUDY BETWEEN 11 TO 14 WEEKS AS A PREDICTOR OF PREECLAMPSIA

DR. SATHYA NARAYANA S[1],DR. SACHIN RATAN BAGALE [2],DR PRIYA S BAGALE[3]

1: DR. SATHYA NARAYANA S. SENIOR RESIDENT, DEPARTMENT OF RADIODIAGNOSIS, BJGMC AND SGH, PUNE.
2: DR. SACHIN RATAN BAGALE PROFESSOR, DEPARTMENT OF RADIODIAGNOSIS, BJGMC AND SGH, PUNE.
3: DR PRIYA S BAGALE, MD ASSOCIATE PROFESSOR, PATHOLOGY BAVMC PUNE

CORRESPONDING AUTHOR:DR. SATHYA NARAYANA S. SENIOR RESIDENT, DEPARTMENT OF RADIODIAGNOSIS, BJGMC AND SGH, PUNE.

ABSTRACT:

INTRODUCTION: Pregnancy represents a significant phase for both the mother and foetus, influenced by various factors. In India, 20-30% of pregnancies are classified as high-risk, accounting for perinatal morbidity and mortality. Primary contributors to this is hypertensive disorders during pregnancy, which are responsible for 18.35% of maternal morbidity and 0.96% of maternal mortality in the country. **AIM:** To assess the role of uterine artery doppler pulsatile index study between 11 to 14 weeks as predictor of preeclampsia • To assess the sensitivity, specificity, positive predictive value and negative value of first trimester screening with uterine artery doppler for predicting pre eclampsia as evidenced by clinical and biochemical parameters. **MATERIALS AND METHODS:** Data: Department of Radiodiagnosis in a tertiary care centre. • Study Duration: 18 months. (October 2022 to February 2024) • Cases: Patients coming to obstetric OPD for regular first trimester scan meeting inclusion and exclusion criteria**.** **RESULTS :** Among the study population(105), 12(11.4%) had gestational hypertension, 6(5.7%) had Preeclampsia.The cut off of Mean Pulsatility Index (PI) for predicting Gestational hypertension is 2.075 which had a sensitivity of 83.3%, specificity of 87.1%, positive predictive value of 45.45%, negative predictive value of 97.59% and a diagnostic accuracy of 86.67%. The cut off of Mean Pulsatility Index (PI) for predicting Pre-eclampsia is 2.3 having a sensitivity of 83.3%, specificity of 95.5%, positive predictive value of 55.6%, negative predictive value of 98.95% and a diagnostic accuracy of 94.28% **CONCLUSION:** In our study, uterine artery pulsatility index indicate impedance to uteroplacental circulation, and has demonstrated statistical significance.

KEY WORDS: Mean Pulsatility Index, Pregnancy, Preeclampsia, Uterine artery doppler.

INTRODUCTION:

One of the primary contributors to high risk pregnancy is hypertensive disorders[(1)]. The prevalence of preeclampsia in India is estimated to be around 5.4% [(2)]. During the first trimester, the placenta undergoes stress when trophoblast-uterine interactions are inadequate. This can hinder the growth and development of the villous tree, subsequently diminishing the oxygen and nutrient supply to the foetus. These factors disrupt the homeostatic processes of the maternal endothelium, which include the regulation of blood pressure, fluid transport, and coagulation, ultimately resulting in a systemic inflammatory response [(3)].

Preeclampsia is characterized not only by hypertension accompanied by proteinuria but also by complications such as fetal growth restriction, pulmonary edema, hemolysis, thrombocytopenia, abnormal liver function, and sudden maternal renal impairment [(4)].Timely identification of pregnancy-related preeclampsia is crucial for formulating an effective treatment plan and monitoring the patient's condition. The global impact of preeclampsia and its associated risks on maternal and neonatal health is significant, affecting morbidity and mortality rates. With prompt and effective management, the outcomes for women experiencing preeclampsia can be substantially improved[(5)].

Numerous screening tests are available to detect Pre-eclampsia based on maternal factors, which include [(6)]: Guidelines from NICE and PRECOG, A previous occurrence of pre-eclampsia, Mean Arterial Pressure and Various biomarkers

Ultrasound Parameters :

Pre-eclampsia, which is marked by defective placentation, is associated with heightened resistance in the uteroplacental circulation. The detection of a diastolic 'notch' in the Doppler waveform of the uterine artery, along with an elevation in the pulsatility index (PI) or resistive index (RI) of that vessel, is significant. Research indicates that uterine artery indices measured during the first trimester can effectively predict abnormal uterine outcomes [(7)].

AIMS AND OBJECTIVES OF THE STUDY:

- To assess the role of uterine artery doppler pulsatile index study between 11 to 14 weeks as predictor of preeclampsia

- To assess the sensitivity, specificity, positive predictive value and negative value of first trimester screening with uterine artery Doppler for predicting pre eclampsia as evidenced by clinical and biochemical parameters

MATERIALS AND METHODS:

- **Institution**: Department of Radiodiagnosis in the tertiary care centre.
- **Duration of study:** 18 months. From october 2022 to February 2024
- **Source of cases**: Patients presenting to the obstetric OPD of tertiary care centre for regular first trimester scan
- **Sample size**: 105

Inclusion Criteria:

✓ Antenatal mothers with computed Gestational age and scan Gestational age between 11 to 14 weeks irrespective of their previous history of pregnancy induced hypertension/ pre-eclampsia status.

Exclusion Criteria:

✓ Patients with known chronic hypertension
✓ Multiple gestation

Study design: This is a Prospective study.

Ethical clearance:

✓ This study obtained ethical approval from the Institutional ethical committee.
✓ First written informed consent was taken from patients included in the study.

Materials and Techniques:

- ✓ Maternal demographic data were gathered.
- ✓ Participants underwent uterine artery Doppler assessment utilizing a 2D Philips Affinity 70 ultrasound device.
- ✓ A sagittal view of the uterus was obtained, ensuring the identification of the cervical canal and internal cervical os.
- ✓ The transducer was carefully tilted laterally, employing color flow mapping to locate each uterine artery adjacent to the cervix and uterus at the level of the internal os.
- ✓ Pulsed wave Doppler was utilized with a sampling gate set to 2 mm to encompass the entire vessel, ensuring that the angle of insonation remained below 30 degrees.
- ✓ Upon acquiring three consecutive similar waveforms, the Pulsatility Index (PI) and peak Systolic Velocity (PSV) were recorded, and the mean PI for both the left and right arteries was calculated.
- ✓ The pregnancy outcomes of patients with normal pregnancies were compared to those who developed pre-eclampsia.
- ✓ Receiver-operating characteristic curves were generated to assess the accuracy of the Pulsatility Index (PI).

OBSERVATION AND RESULTS :

Table 1: Distribution of Gestational hypertension among study population.

Gestational Hypertension	No.	Percent
Yes	12	11.4
No	93	88.6

Among the study population, 12(11.4%) had gestational hypertension

Table 2: Distribution of Pre-eclampsia among study population**.**

Preeclampsia	No.	Percent
Yes	6	5.7

No	99	94.3

Among the study population, 6(5.7%) had Preeclampsia

Table 3: Mean pulsatility index(PI) and Gestational hypertension.

Gestational HTN	Mean (SD)
Yes	2.216 (0.384)
No	1.678 (0.296)
Unpaired t test, P Value <0.001, Significant	

The mean PI among the study population was higher among those with gestational hypertension patients of about 2.216(0.384) and it was statistically significant (p<0.001)

Table 4: Mean pulsatility index(PI) and Pre-eclampsia.

Preeclampsia	Mean (SD)
Yes	2.308 (0.410)
No	1.705 (0.317)
Unpaired t test, P Value <0.001, Significant	

The mean PI among the study population was higher among those with Pre-eclampsia patients of about 2.308(0.410) and it was statistically significant (p<0.001)

Table 5: Sensitivity, specificity, and predictive accuracy of mean PI for the prediction of Gestational hypertension.

AUC	SE	P Value	95% Confidence Interval	
			Lower Bound	Upper Bound
0.864	0.104	0.003*	0.000	1.000

Mean PI (Cut-off = 2.075)	**Gestational Hypertension**		**Total**
	Present	**Absent**	
Elevated	10	12	22
Normal	2	81	83
Total	12	93	
Chi-Square Test, P Value <0.001, Significant			
Odds Ratio = 33.75 (21.88-37.01)			
Sensitivity = 83.3%			
Specificity = 87.1%			
Positive Predictive Value = 45.45%			
Negative Predictive Value = 97.59%			
Diagnostic Accuracy = 86.67%			

The area under the curve for Mean Pulsatility Index (PI) in predicting Gestational Hypertension is 0.864.The cut off of Mean Pulsatility Index (PI) for predicting Gestational hypertension is 2.075 which had a sensitivity of 83.3%, specificity of 87.1%, positive predictive value of 45.45%, negative predictive value of 97.59% and a diagnostic accuracy of 86.67%

Table 6: Sensitivity, specificity, and predictive accuracy of mean PI for the prediction of Pre-eclampsia.

AUC	SE	P Value	95% Confidence Interval	
			Lower Bound	Upper Bound
0.853	0.072	<0.001*	0.712	0.994

Mean PI (Cut-off = 2.3)	**Preeclampsia**		**Total**
	Present	**Absent**	
Elevated	5	4	9
Normal	1	95	96
Total	6	99	
Chi-Square Test, P Value <0.001, Significant			
Odds Ratio = 118.75 (93.45-134.92)			
Sensitivity = 83.3%			
Specificity = 95.95%			
Positive Predictive Value = 55.6%			
Negative Predictive Value = 98.95%			
Diagnostic Accuracy = 94.28%			

The area under the curve for Mean Pulsatility Index (PI) in predicting Pre-eclampsia is 0.853.The cut off of Mean Pulsatility Index (PI) for predicting Pre-eclampsia is 2.3 which

had a sensitivity of 83.3%, specificity of 95.5%, positive predictive value of 55.6%, negative predictive value of 98.95% and a diagnostic accuracy of 94.28%

DISCUSSION:

Most of these studies primarily analyzed the indices as averages of the right and left side values, neglecting the potential discordance in blood flow between the two sides. Bellamy et al.[8] suggested that a screening test capable of identifying women at risk of developing preeclampsia in the latter stages of pregnancy would facilitate enhanced monitoring for those at risk while reducing unnecessary surveillance for those unlikely to experience the syndrome.
The maternal age of participants varied from 18 to 33 years. A significant portion of the study cohort, specifically 60% of the women, fell within the age range of 21 to 25 years. The average age was calculated to be 24.07 ± 3.1 years, indicating that the majority of the women involved in this research were relatively young.

In terms of obstetric history, the predominant group among the women was gravida 1, accounting for 58.1%, followed by gravida 2 at 40%, gravida 3 at 1.9%.
The primary aim of this research is to evaluate the sensitivity, specificity, positive predictive value, and negative predictive value of first trimester screening utilizing uterine artery Doppler in predicting pre-eclampsia, as indicated by clinical and biochemical parameters.

The average Pulsatility Index (PI) for the right uterine artery among participants was 1.732 , with values ranging from 1.1 to 2.7. For the left side, the mean Pulsatility Index (PI) was 1.747 , with a range from 1.2 to 2.6. Overall, the mean Pulsatility Index (PI) across all subjects was 1.740 , with a range from 1.15 to 2.65.

The average Pulsatility Index (PI) recorded at 11 weeks was 1.845, which exceeds the average of 1.737 observed at 12 weeks, and is followed by a mean of 1.650 at 13 weeks. This difference was statistically not significant ($p \sim 0.084$).

In our study, the mean PI values were 1.845, 1.737, and 1.650 at 11, 12, and 13 weeks, respectively. In comparison, the research conducted by Gomez et al. reported mean (SD) values of 1.96, 1.83, and 1.71 for the same weeks. The threshold for the Mean Pulsatility Index (PI) to predict Preeclampsia is established at 2.3, demonstrating a sensitivity of 83.3%, specificity of 95.5%, positive predictive value of 55.6%, negative predictive value of 98.95%, and an overall diagnostic accuracy of 94.28% (Area under the curve -0.853).

The threshold for the Mean Pulsatility Index (PI) in forecasting Gestational Hypertension is established at 2.075. This threshold demonstrates a sensitivity of 83.3%, a specificity of

87.1%, a positive predictive value of 45.45%, a negative predictive value of 97.59%, and an overall diagnostic accuracy of 86.67%, with an area under the curve measuring 0.864.

In our study, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for predicting preeclampsia using the mean pulsatility index (PI) were found to be 83.3%, 95.95%, 55.6%, and 98.95%, respectively. This contrasts with the findings of Khanam, Mittal, and Suri, who reported sensitivity, specificity, PPV, and NPV values of 77.8%, 98.9%, 97.8%, and 87.5% when utilizing mean PI for the same purpose. Additionally, a study conducted by Oancea revealed sensitivity and specificity rates of 61.5% and 63.8%, indicating that our study demonstrated a higher sensitivity rate for the detection of preeclampsia compared to other research.

Furthermore, Moeity et al. (2016) indicated that the uterine artery PI had the highest sensitivity (100%) but the lowest specificity (56%) in predicting preeclampsia. The specificity rates associated with mean PI as an indicator for detecting preeclampsia show a positive correlation with the results from Khanam, Mittal, and Suri, while also presenting significantly higher outcomes compared to the studies conducted by Oancea et al. and Moeity et al[(9).]

In 2021, Khanam, Mittal, and Suri demonstrated that the Uterine Artery Pulsatility Index (UtA-PI) serves as the most effective individual indicator for screening Gestational Hypertension and Pre-eclampsia, achieving a Receiver Operating Characteristic Area Under the Curve (ROC AUC) of 0.934. The study presents comparative results indicating that the Uterine Artery (UtA)-PI not only exhibits superior sensitivity and specificity but also stands out as the most reliable marker for the screening of Gestational Hypertension and Pre-eclampsia[(10).]

CONCLUSION:

The research was conducted as a prospective study involving 105 participants, specifically antenatal mothers with a computed gestational age and scan gestational age ranging from 11 to 14 weeks, who also had a prior history of pre-eclampsia. The primary aim of the study was to evaluate the sensitivity, specificity, positive predictive value, and negative predictive value of first trimester screening utilizing uterine artery Doppler for the prediction of pre-eclampsia, as indicated by clinical and biochemical parameters.

In our study, uterine artery higher pulsatility index indicates impedance to uteroplacental circulation, and has demonstrated statistical significance. Uterine artery Doppler assessments conducted between 11 and 14 weeks of gestation exhibit a high negative predictive value, enabling us to classify patients into low-risk and high-risk categories. This classification allows for enhanced monitoring of high-risk women, along with the implementation of prophylactic aspirin therapy aimed at reducing maternal morbidity and mortality.

Further research is required to evaluate the applicability of these findings across various resource settings, as well as to assess the impact of screening on clinical outcomes.

REFERENCES :

1. Dhinwa M, Gawande K, Jha N, Anjali M, Bhadoria AS, Sinha S. Prevalence of hypertensive disorders of pregnancy in India: A systematic review and meta-analysis. J Med Evid [Internet]. 2021 [cited 2022 Nov 11];2(2):105. Available from: http://www.journaljme.org/article.asp?issn=2667-0720;year=2021;volume=2;issue=2;spage=105;epage=112;aulast= Dhinwa
2. Preeclampsia | National Health Portal Of India [Internet]. [cited 2022 Nov 11]. Available from: https://www.nhp.gov.in/disease/gynaecology-and- obstetrics/preeclampsia

3. Burton GJ, Redman CW, Roberts JM, Moffett A. Pre-eclampsia: pathophysiology and clinical implications. BMJ [Internet]. 2019;366. Available from: https://www.bmj.com/content/366/bmj.l2381

4. Brown MA, Magee LA, Kenny LC, Karumanchi SA, McCarthy FP, Saito S, et al. Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice. Hypertension. 2018;72(1):24–43.

5. Vasapollo B, Novelli GP, Valensise H. Hemodynamic guided treatment of hypertensive disorders in pregnancy: is it time to change our mind? J Matern Neonatal Med Off J Eur Assoc Perinat Med Fed Asia Ocean Perinat Soc Int Soc Perinat Obstet. 2019;1–2.

6. Duhig K, Vandermolen B, Shennan A. Recent advances in the diagnosis and management of pre-eclampsia. F1000Research. 2018;7:242.

7. Parra M, Rodrigo R, Barja P, Bosco C, Fernández V, Muñoz H, et al. Screening test for preeclampsia through assessment of uteroplacental blood flow and biochemical markers of oxidative stress and endothelial dysfunction. Am J Obstet Gynecol. 2005 Oct;193(4):1486–91.

8. McDonald SD, Malinowski A, Zhou Q, Yusuf S, Devereaux PJ. Cardiovascular sequelae of preeclampsia/eclampsia: a systematic review and metaanalyses. Am Heart J. 2008; 156:918-30

9. Papageorghiou AT, Yu CK, Bindra R, Pandis G, Nicolaides KH. Multicenter screening for pre-eclampsia and fetal growth restriction by transvaginal uterine artery Doppler at 23 weeks of gestation. Ultrasound Obstet Gynecol. 2001; 18(5):441-9.

10. Groom KM, North RA, Stone PR, Chan EHY. Patterns of Change in Uterine Artery Doppler Studies between 20 and 24 Weeks of Gestation and Pregnancy Outcomes. Obstet Gynecol. 2009; 113(2 Pt 1):332-8.