

## ORIGINAL RESEARCH

# Prediction of preeclampsia using uterine artery Doppler pulsatility index between 11-14 weeks

<sup>1</sup>Dr. Tamana, <sup>2</sup>Dr. Nidhi Thakur, <sup>3</sup>Dr. Preeti Chouhan, <sup>4</sup>Dr. Swaran Gupta, <sup>5</sup>Dr. Akshi Gupta, <sup>6</sup>Dr. Deepali Bhat

<sup>1-6</sup>Department of Obstetrics & Gynaecology, SMGS Hospital, Government Medical College, Jammu, Jammu and Kashmir, India

### Corresponding author

Dr. Preeti Chouhan

Department of Obstetrics & Gynaecology, SMGS Hospital, Government Medical College, Jammu, Jammu and Kashmir, India

Received: 07 June, 2023

Accepted: 09 July, 2023

### ABSTRACT

**Background:** This study was conducted for the Prediction of preeclampsia using uterine artery Doppler pulsatility index between 11-14 weeks. **Material and methods:** All subjects were informed about the study and informed consent was taken before they were enrolled in the study. Women were subjected to detailed history and gestational age was calculated from reliable last menstrual history and early ultrasound. Family history, past medical history, smoking habits, medical histories of first degree family members was taken. Systemic examination with special reference to edema, blood pressure and gestational week was carried out. **Results:** A total of 62% of women were 18-25 years of age, 34% were 26-30 years of age and only 4% were more than 30 years of age. Mean age was 24.6 years with youngest women was 19 years of age and oldest 32 years of age. **Conclusion:** Thus we can conclude that Pre-eclampsia is believed to develop from inadequate trophoblast invasion of the maternal spiral arteries and Doppler ultrasound is a reliable, noninvasive method of examining uteroplacental perfusion. Abnormal UA Doppler ultrasonography (elevated PI) in 11-14 weeks' gestation can predict pre-eclampsia. It is recommended to follow-up cases presenting with a high PI at the 11-14 weeks' scan for development of Pre-eclampsia. Doppler imaging permits non-invasive evaluation of the uteroplacental circulation, thus enabling further earlier prevention and therapeutic interventions to improve maternal and neonatal health.

**Keywords:** Doppler, uteroplacental circulation, Pre-eclampsia

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

### INTRODUCTION

Hypertensive disorders during pregnancy remain amongst the most significant and intriguing unsolved problems in obstetrics.<sup>1</sup> Hypertensive disorders of pregnancy constitute one of the leading causes of maternal and perinatal mortality world wide.<sup>2</sup> Gestational hypertension along with its sequelae that is preeclampsia and eclampsia can be best described as human pregnancy-specific syndrome. It affects virtually every organ system and widely varies in its clinical phenotypic expression.<sup>3</sup>

According to World health organization, in developing countries with limited access to health care, preeclampsia is estimated to be responsible for more than 60000 maternal deaths per year, whereas in the developed countries the burden of this disease falls on the neonates. This is because the high rate of iatrogenic preterm deliveries performed to preserve the maternal health.<sup>4</sup>

Infants of women with preeclampsia have a fivefold

increase in mortality compared with infants without the disorder. Approximately 10% of preeclampsia occurs before 34 weeks of gestation, and induced premature delivery resulting from preeclampsia is responsible for approximately 15% of all preterm births.<sup>5</sup> The perinatal and neonatal mortality rate due to preeclampsia is about 10% worldwide (**Daskalakis G et al. 2015**).<sup>6</sup> According to the National High Blood Pressure Education Program Working Group Report (2000), hypertensive disorders of pregnancy is classified as: (**Williams Obstetrics. 24 edition**)<sup>1</sup>

### MATERIAL AND METHODS

The Prospective observational study was under taken in the Department of Obstetrics and Gynecology of SMGS Hospital Jammu, over a period of one year after proper institutional and ethical approval. The informed written consent from each participant was taken for the study.

STUDY DESIGN: Prospective Observational Study

**STUDY DURATION:** 1 year

**Study Tool:** Proforma and Uterine artery doppler pulsatility index performed at 11- 14weeks of gestation

#### **INCLUSION CRITERIA FOR STUDY GROUP**

- 11 -14 WEEKS OF PREGNANCY
- Primigravida
- Spontaneous pregnancy
- No history of infertility
- No history of medical disorders

#### **EXCLUSION CRITERIA FOR STUDY GROUP:**

- Multigravida women;
- Women with multiple pregnancies
- Smokers
- Routine prophylaxis with aspirin was not undertaken during this period of this study
- History of essential hypertension
- History of preeclampsia in previous pregnancy
- History of treatment with aspirin and heparin
- History of anti-hypertensive drugs
- Incomplete Data

#### **METHODOLOGY**

All subjects were informed about the study and informed consent was taken before they were enrolled in the study.

Women were subjected to detailed history and gestational age was calculated from reliable last menstrual history and early ultrasound.

Family history, past medical history, smoking habits, medical histories of first degree family members was taken.

Systemic examination with special reference to edema, blood pressure and gestational week was carried out.

Routine antenatal investigations were done which include: Blood group, Haemoglobin Platelet count

Coagulation profile, Urine routine examination Blood sugar, HIV, HbsAg and VDRL Thyroid function tests DIPSI, Urine for albumin.

Liver function test Renal function test Special investigation:

Uterine artery Pulsatility index at 11-14 weeks of gestation.

All patients were subjected to ultrasound at 11-14 weeks of gestation and uterine artery Doppler pulsatility index was measured and cut off of  $PI > 1.71$  was considered abnormal and  $PI < 1.71$  was considered normal. All patients were followed up in antenatal clinic and examined 4 weekly till 28 weeks, fortnightly upto 34 weeks and thereafter weekly till delivery and were observed for development of Preeclampsia.

At each antenatal visit, blood pressure, Pedal edema were noted and urine for albumin was performed. All subjects were followed up till delivery and following facts were noted:

Mode of delivery: Vaginal or LSCS.

Baby status: Live/stillbirth/FGR Maternal outcome: eventful/uneventful

Maternal outcome: eventful/uneventful

#### **STATISTICAL ANALYSIS**

All data were compiled, analysed and conclusion drawn in correlation of uterine artery Doppler pulsatility index and subsequent development of Preeclampsia. The analysis was carried out by computer software SPSS version 21.0. All quantitative variables were presented as Mean+SD and percentage. All qualitative variables were presented in terms of percentage. Univariate analysis was conducted to evaluate the relationship of hypertension in pregnancy with other variables. Chi-square/Fishers test was used to evaluate the statistical significance of the relationship.

#### **RESULTS**

**Table1: Age distribution among the study groups**

Age Group (in years)	N	%
18-25	62	62
26-30	34	34
>30	4	4
Total	100	100
Mean±SD	24.60±3.41	

A total of 62% of women were 18-25 years of age, 34% were 26-30 years of age and only 4% were more than 30 years of age. Mean age was 24.6 years with youngest women was 19 years of age and oldest 32 years of age. Majority of women were urban dwellers (53%) while 47% lived in rural areas.

**Table2: Distribution of study subjects according to residence**

Residence	N	%
Rural	47	47
Urban	53	53
Total	100	100

**Table3: Education status among study participants**

Educational status	N	%
Postgraduate	8	8
Graduate	18	18
Highersecondary	18	18
Secondary	42	42
Primary	14	14

**Table 4: Descriptive analysis of SBP and DBP at 11-14 weeks of gestation.**

Variables	Minimum	Maximum	Mean	SD
SBPat11-14	100	130	117.52	7.265
DBPat11-14wks	66	88	78.97	7.769

The mean SBP at 11-14 weeks was 117.52mmHg and mean DBP at 11-14weekswas78.97.

## DISCUSSION

Hypertensive disorders of pregnancy is one of the greatest and dangerous complication causing premature delivery, fetal growth restriction, abruption placenta, Still births and maternal morbidity and mortality. Pre-eclampsia is a complex condition, which cannot be attributed to any single cause. Many workers have studied the association between uterine artery pulsatility index and hypertensive disorders of pregnancy. Present study was conducted to analyse relationship of uterine artery pulsatility index at 1st trimester and subsequent development of Pre-eclampsia.

In the present study, a total of 100 antenatal, primigravida, normotensive, non-proteinuric women between 11-14 weeks of pregnancy were recruited and selected randomly from antenatal outpatient department of SMGS Hospital, Jammu, over a period of one year. Their uterine artery pulsatility index was measured at the time of recruitment.

Most of the patients in our study were in the age group of 18-25 years i.e. 62(62%), 34% were 26-30 years of age and only 4% were more than 30 years of age. Mean age was 24.6 years among those who remained Normotensive and the Mean age of women developing Pre-eclampsia was 27.8 years in our study. In a study conducted by Wahid DHA et al., (2021) mean age among normotensive was 26.61 years which was consistent with our study, and those who developed Pre-eclampsia was 27.3 years.<sup>7</sup>

Our results are consistent with findings of Arpana et al., (2018) in which mean age among Normotensive was 26.8 years and among hypertensive group was 27.08 years. There was no significant difference between both groups.<sup>8</sup>

In a study conducted by Yousefnejad et al., (2008), there was no significant difference between the Preeclamptic group and normotensive group, the mean age was 27.27 years among those who had Pre-eclampsia and 27.6 among those who remained normotensive.<sup>9</sup>

In a study conducted by Das E et al., 38.8% of the women were 18-25 years of age, 37% of women were 26-30 years of age, 24.4% of women were >30 years of age. The youngest woman was 19 years of age, and the oldest woman was 38 years of age.<sup>10</sup>

In a study conducted by Gokdeniz et al., in which 13 pregnant women with Pre-eclampsia were matched with singleton Pregnancies. It was found that there was no significant difference between study group and control with mean age of 20.7years and 21.3 years respectively.<sup>11</sup>

Among the 100 women who completed the study, 80 women remained normotensive whereas 20 patients developed hypertension. This gives the incidence rate of 20%. Among 20 women who became hypertensive, 14(14%) developed gestational hypertension whereas 6(6%) developed Pre- eclampsia in our study.

Similar study conducted by Harrington et al., found that Preeclampsia developed in 2.2% of women.<sup>12</sup>

In the study done by Das E et al., (2022), 142 women at 11- 14 weeks of gestation completed the study, among whom, 18 (12.7%) developed Pre- eclampsia and 7 (4.9%) developed gestational hypertension.<sup>10</sup>

In a similar study conducted by Bindal J et al., Out of total 100 women, Pre- eclampsia was seen in 22% of women.<sup>13</sup>

Another study was done by Oancea M et al., (2020), out of total 120 pregnant women included in the study, 26 (21.6%) developed Pre-eclampsia during pregnancy.<sup>14</sup>

In a study conducted by Salem MAA et al., (2018) 300 women were included in the final analysis, of them 30 patients (10%) suffered from preeclampsia.<sup>15</sup>

In a study conducted by Wahid DHA et al., Pre-eclampsia was seen in 9.4% of women.<sup>7</sup>

In a study conducted by Martin et al., Preeclampsia was seen in 2.1% of women.<sup>16</sup>

So we can conclude by saying that the incidence of Pre-eclampsia ranges between 2-7%, which was consistent in our study and in most of the other studies.

The prediction of patients at high risk for PE has been a focus of research and, at present, the first trimester is considered to be the preferred gestational period for PE screening. Resistance to blood flow within the uteroplacental circulation is transmitted upstream to the uterine arteries and can be measured as an increased pulsatility index (PI) or resistance index (RI). Uterine artery PI and RI values decrease with increasing gestational age, a change that is thought to be secondary to a fall in impedance in uterine vessels

following trophoblastic invasion. Although no single efficient screening procedure for predicting PE has been adopted in clinical practice, uterine artery Doppler is the most widely studied clinical test available for this particular purpose, becoming a useful method for the indirect assessment of uteroplacental circulation in early pregnancy (11–14 weeks).

In the present study uterine artery Doppler pulsatility index measured among 100 women at 11-14 weeks of gestation and value  $>1.71$  was considered abnormal and value  $<1.71$  was considered normal. Out of the total 100 patients 73 had pulsatility index  $<1.71$  and 27 had pulsatility index  $>1.71$ . Mean PI among 100 study participants was 1.56 in our study.

Out of the total 73 who had normal pulsatility index, 71(97.3%) remained normotensive and 2(2.7%) developed gestational hypertension and none developed Pre-eclampsia.

Out of 27 women who had pulsatility index  $>1.71$ , 9(33.3%) remained normotensive, 12(44.5%) developed gestational hypertension and 6(22.2%) developed Pre-eclampsia. So, we can conclude that all patient in our study 100% women who had Pre-eclampsia, had  $PI > 1.71$ .

The patients with abnormal high PI at 11-13 weeks has significantly increase in risk of development of preeclampsia over the course of pregnancy when compared to patients with normal PI (p value  $<0.01$ ).

In our study mean uterine artery PI values of those developing preeclampsia (2.02) is significantly higher ( $p < 0.01$ ) than the mean uterine PI of those who remained normotensive (1.49). The mean of uterine artery PI values of those developing gestational hypertension (1.80) is significantly higher ( $p = 0.002$ ) than the mean uterine PI of those who remained normotensive (1.49).

In a study conducted by Salem MAA et al., (2018) they found value of  $PI \geq 1.7$  using the ROC curve gave sensitivity of 100%, specificity of 84.4%, PPV of 41.7%, NPV 100% and an accuracy of 94.3% which was consistent with our study. Out of Total 300 patients in a study, 30(10%) developed preeclampsia and all 30 women i.e. 100% had a pulsatility index of  $>1.7$ . The findings were consistent with our study.<sup>15</sup>

Similar study conducted by Handa S et al., (2019) found positive association between preeclampsia and uterine artery pulsatility index in first trimester. Among women with  $PI > 1.71$ , 41.6% developed Pre-eclampsia, while in our 22.2% of women with  $PI > 1.71$  developed Pre-eclampsia, which was not consistent with our study.<sup>17</sup>

## CONCLUSION

Thus we can conclude that Pre-eclampsia is believed to develop from inadequate trophoblast invasion of the maternal spiral arteries and Doppler ultrasound is a reliable, noninvasive method of examining uteroplacental perfusion. Abnormal UA Doppler ultrasonography (elevated PI) in 11–14 weeks'

gestation can predict pre-eclampsia. It is recommended to follow-up cases presenting with a high PI at the 11–14 weeks' scan for development of Pre-eclampsia. Doppler imaging permits non-invasive evaluation of the uteroplacental circulation, thus enabling further earlier prevention and therapeutic interventions to improve maternal and neonatal health.

## REFERENCES

1. Roberge S, Nicolaides K, Demers S, Hyett J, Chaillet N, Bujold E. The role of aspirin dose on the prevention of preeclampsia and fetal growth restriction: systematic review and meta-analysis. *Am J Obstet Gynecol* 2017;216(2):110-20.
2. Rajesh A, Vandana M. Serum Beta hCG in early second trimester as a predictor of gestational hypertension. *Int J Reprod Contracept Obstet Gynecol* 2018;7(6):2355-359.
3. Kulkarni N, Bansal R, Pawar P. Serum Beta HCG and uterine artery Doppler studies in second trimester to predict preeclampsia and eclampsia. *Int J Reprod Contracept Obstet Gynecol* 2018;7(5):1924-928.
4. Verma D, Gupta S. Prediction of adverse pregnancy outcomes using uterine artery Doppler imaging at 22-24 weeks of pregnancy: A North Indian experience. *Turk J Obstet Gynecol* 2016;13(2): 80-84.
5. Walker JJ. Preeclampsia. *Lancet* 2000; 356:1260-265.
6. Daskalakis G and Papapanagiotou A. Serum Markers for the Prediction of Preeclampsia. *J NeurolNeurophysiol* 2015;6:264.
7. Wahid DHA, Mahdy MS, Mowafy HE, Abdelsalam WA. Predicting Adverse Pregnancy Outcomes During the Late First Trimester and Early Second Trimester Using the Uterine Artery Doppler. *The Egyptian Journal of Hospital Medicine* 2021;85(2):3810-815.
8. Akolekar R, Syngelaki A, Sarquis R, Zvanca M, Nicolaides KH. Prediction of early, intermediate and late pre-eclampsia from maternal factors, biophysical and biochemical markers at 11–13 weeks. *PrenatDiagn* 2011;31(1):66-74.
9. Yousefnejad K and Moslemizadeh N. Serum beta HCG levels in diagnosis and management of preeclampsia. *J Med Sci* 2008;8:722-27.
10. Das E, Singh V, Agarwal S, Pati SK. Prediction of Preeclampsia Using First-Trimester Uterine Artery Doppler and Pregnancy-Associated Plasma Protein-A (PAPP-A): A Prospective Study in Chhattisgarh, India. *Cureus* 14(2): e22026. doi:10.7759/cureus.22026
11. Gokdeniz R, Perez R, David M. Elevated serum HCG levels in severe preeclampsia. *Turk J Med Sci* 2000;30:43-45.
12. Hofmeyr GJ, Lawrie TA, Atallah AN, Torloni MR. Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. *Cochrane Database of Systematic Reviews* 2018;10(6):CD001059.
13. Bindal J, Chugh N. Utility of uterine artery Doppler and pulsatility index at 11-14 weeks of normal pregnancy in prediction of preeclampsia in third trimester. *Int J Med Res Rev* 2016;4(3):432-36.
14. Oancea M, Grigore M, Ciortea R, Diculescu D, Bodean D, Bucuri C. Uterine Artery Doppler Ultrasonography for First Trimester Prediction of Preeclampsia in Individuals at Risk from Low-Resource Settings. *Medicina (Kaunas, Lithuania)* 2020;56(9):428.

15. Salem MAA, Ammar IMM. First-Trimester Uterine Artery Pulsatility Index and Maternal Serum PAPP-A and PIGF in Prediction of Preeclampsia in Primigravida. *Journal of obstetrics and gynaecology of India* 2018;68(3):192-96.
16. Martin AM, Bindra R, Curcio P, Cicero S, Nicolaides KH. Screening for pre-eclampsia and fetal growth restriction by uterine artery Doppler at 11-14 weeks of gestation. *Ultrasound Obstet Gynecol* 2001;18(6):583-86.
17. Handa S, Yeshita P. Evaluation of Uterine Artery Doppler at 11– 13+6 Weeks of Gestation for Prediction of Preeclampsia: A Descriptive Observational Study. *J South Asian Feder Obst Gynae* 2019;11(5):305- 08.