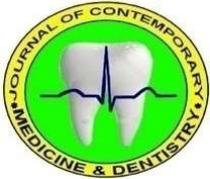


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## Uterine Artery Doppler as a Predictor of Pre-Eclampsia at 18-28 Weeks of Gestational Age

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### Abstract

**Background:** The doppler is a non-invasive method for the evaluation of fetoplacental circulation. A high resistance index and pulsatility index and persistence of uterine notching in uterine Doppler waveforms have been shown to predict pre-eclampsia. We in the current study tried to evaluate whether Abnormal Uterine Artery Doppler Velocimetry Can be used as an effective screening test to predict preeclampsia? **Methods:** Doppler study after routine fetal anomaly scan. After assessment of inclusion and exclusion criteria, n=60 high-risk antenatal women were selected for the study in the department of Obstetrics and Gynaecology of Prathima Institute of Medical sciences. Women booking for antenatal care were examined and investigated. The women were subjected to Doppler ultrasound. At 18-28 weeks, a Doppler ultrasound (with 3.5 MHZ curvilinear probes) of uterine artery waveform was performed on women using an ultra-sound. **Results:** The uterine artery doppler study indicated the presence of doppler diastolic notching at 18 – 28 weeks. The notching was found to be present in n=22(36.7%) cases and absent in n=38(63.3%) cases. A comparison of uterine artery notching alone and uterine notch with RI >0.65 with development of preeclampsia revealed uterine artery notch was found in n=22 cases out of which n=6 cases were preeclampsia. Not with RI > 0.65 was found in n=11 cases with preeclampsia. Uterine Artery Notch has 35.29% sensitivity, specificity is 62.71% Uterine Artery Notch+0.65 64.71% sensitivity, specificity is 72.09%. **Conclusion:** Uterine artery Doppler is a non-invasive method for evaluation of Fetoplacental circulation without any disturbance to pregnancy. Uterine Doppler at 18-28 weeks of Gestation can be used as a reliable screening test for the prediction of Preeclampsia and intrauterine growth restriction and in cases where the test proves to be abnormal increased surveillance and delivery in a well-equipped set up is necessary to reduce the maternal and fetal complications.

**Keywords:** Uterine Artery Doppler, Pre-Eclampsia, Resistance Index, Uterine artery notch

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### Introduction

Preeclampsia and intrauterine growth restriction are important causes of Maternal morbidity and mortality. [1, 2] According to the National center for health statistics in 1998, hypertension Associated with pregnancy was a common medical risk factor. Preeclampsia was Identified in 1,46,320 women or 3.7% of all pregnancies

that ended in live births. [3] Berg and colleagues (1996) reported almost 18% of 1450 maternal deaths in the United States from 1987 to 1990 were complications of pregnancy-related hypertension. [4] Hypertension in pregnancy is also responsible for fetal (more than 19 Weeks of gestation) and infant mortality as well as 46% of infants born small for gestation. [2] It has been estimated that 3 – 10% of infants are growth

restricted. Fetal growth restriction is associated with substantive perinatal morbidity and mortality true in cases of preterm and post-term infants. [6-8] Pre-eclampsia is a disorder that can be prevented by evidence-based interventions in the early antenatal period. The study of literature shows that prevention and prediction of preeclampsia are complementary to each other. Uterine artery Doppler done in the late second trimester may be a predictive factor for Preeclampsia. The abnormal vascular patterns noted in the Uterine artery Doppler need to be studied in detail for the likelihood of Preeclampsia. The basis for this basic investigation the First and Second wave of decidual invasion which occurs between 10 to 12 weeks and 16 to 18 weeks which establishes the placental circulation and makes it a low resistance flow with vasodilatation. The absence of the decidual invasions by the trophoblasts lead to the accumulation of vasospastic substances (Thromboxane A<sub>2</sub>, PGF<sub>2A</sub>alpha) which causes endothelial damage, exudation of plasma into the extravascular compartment, and platelet aggregation and activation with added vasospasm which is the cellular and biochemical basis for the pathogenesis of Pre-eclampsia. Early screening for preeclampsia may allow vigilant antenatal surveillance and appropriate timing of fetal delivery to avoid serious sequel. Various hemodynamic and biochemical measures have been found to have limited accuracy as screening measures for this condition. [9, 10] Preeclampsia is characterized by an imbalance between Prostacycline and thromboxane A<sub>2</sub> production as well as the failure of the second wave trophoblastic invasion of the endometrial-myometrial vasculature. [11] The result is abnormal uteroplacental blood flow, and this leads to an idea of using Doppler assessment of uterine artery velocimetry wave forms as the method of screening for antenatal complications. [12] In recent years, ultrasonography is commonly used in the measurement of Fetal biometry and diagnosis of congenital anomalies and intrauterine growth restriction. The problem which still Exists is the identification of those pregnancies which are at risk of increased maternal and fetal morbidity as in pregnancy-induced hypertension.[2] The Uterine artery Doppler detects the abnormal vascular pattern

due to the above pathogenesis and we can objectively predict Preeclampsia. Therefore, this study is needed.

## Materials and Methods

This cross-sectional study was done over a period of 2 years, among high-risk pregnant women attending the outpatient Department for antenatal care at Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Institutional Ethical committee permission was obtained for the study. Written permission was obtained from all the participants of the study.

### *Inclusion criteria*

1. All pregnant women between 18 to 28 weeks of gestational age with
2. singleton pregnancy, having any of the risk factors,
3. Teenage pregnancy
4. Elderly primi
5. Increased BMI >35kg/m<sup>2</sup>
6. Previous history of Preeclampsia in the first pregnancy
7. History of Chronic hypertension
8. History of Diabetes mellitus
9. Conceived after ART procedures
10. Recurrent Pregnancy Loss/ BOH

### *Exclusion criteria*

1. Multiple gestations
2. Congenital anomalies of the fetus

When the above criteria were met study, the group was subjected to the Uterine artery. Doppler study after routine Fetal anomaly scan. After assessment of inclusion and exclusion criteria, 60 high-risk antenatal women were selected for the study in the department of Obstetrics and Gynaecology of Prathima Institute of Medical sciences. women booking for antenatal care were examined and investigated. The women were subjected to a Doppler ultrasound. At 18-28 weeks, a Doppler ultrasound (with 3.5 MHZ curvilinear probes) of uterine artery waveform was performed on women using an ultra-sound machine (M/S Shimadzu India LTD). The women were examined in a semi-recumbent position after 10 minutes of bed rest. Under real-time ultrasonography uterine artery of each side was identified at the uterocervical junction where it appeared to cross the external iliac artery using color Doppler imaging flow velocity waveforms

of both uterine arteries were recorded. Persistence of an early diastolic notch unilateral and bilateral in the main uterine artery and Elevated RI >0.65 or both were considered as abnormal. An early diastolic notch was defined as a V-shaped deflection towards the baseline early diastole.  $RI = \frac{\text{Systolic peak velocity} - \text{diastolic peak velocity}}{\text{Systolic peak velocity}}$ . *Follow-up.* All pregnant women were followed up till delivery and details of pregnancy events, delivery, and neonatal outcome were noted. The abnormal pregnancy outcomes considered are preeclampsia. Perinatal outcomes are considered are IUFD, Apgar at 5 minutes, birth weight, and NICU admission.

**Statistical analysis:**

Statistical analysis was done using descriptive statistical methods mean, percentages, and proportions, Chi-square test was used to find the association between two attributes, and an unpaired t-test was used to find the association between two variables. A p-value of less than 0.05 was statistically significant.

**Results**

Out of the total n=60 cases, n=30(50%) of cases were between 18-25 years. The youngest case was 18.5 years and the mean age group was  $23.5 \pm 2.5$  years. The other details of distribution are depicted in table 1.

**Table 1:** Age distribution in years of the patients included in the study

Age group in years	Frequency	Percentage
< 20	8	13.33
21 – 25	22	36.67
26 – 30	20	33.33
> 30	10	16.67
Total	60	100.0

In the study, most of the cases were gravida 1 n=39(65%). The minimum gestation age at scan ranged from 18 – 28 weeks. The minimum was 18 weeks and the maximum was 26 weeks with a mean age of gestation at scan was  $23 \pm 1.0$  week.

**Table 2:** Showing the Parity Distribution

Gravida	Frequency	Percentage
1	39	65.0
2	18	30.0
3	2	3.3
4	1	1.7
Total	60	100.0

The uterine artery doppler study indicated the presence of doppler diastolic notching at 18 – 28 weeks. The notching was found to be present in n=22(36.7%) cases and absent in n=38(63.3%) cases. The systolic blood pressure was below 130 mmHg in n=44(73.3%) cases and > 150 mmHg were found in n=11(18.3%) cases shown in table 3. The Diastolic blood pressure was below 80 mmHg in n=23(38.3%) cases and > 110 mmHg were found in n=2(3.3%) cases shown in table 4.

**Table 3:** Systolic blood Pressure in Study group in the third trimester

SBP in mmHg	Frequency	Percentage
<130	44	73.3
130-139	2	3.0
140-149	3	5.0
>150	11	18.3
TOTAL	60	100.0

**Table 4:** Diastolic Blood Pressure in Study group in the third trimester

BP in mmHg	Frequency	Percentage
<80	23	38.3
80-89	21	35.0
90-100	14	23.4
>110	2	3.3
TOTAL	60	100.0

The measurement of resistance index and pulsatility index in the group revealed out of n=60 cases resistance index was minimum 0.42 and maximum was 0.68 with the mean value of 0.49. The pulsatility index of the patients revealed a minimum index of 0.57 and a maximum of 1.06 with a mean value of 0.59. The association of resistance index at 18 – 28 weeks of gestation by uterine artery Doppler indices in preeclamptic and normal pregnant women has been shown in table 5.

**Table 5:** Resistance index in preeclampsia and normal pregnancy

Gestational age	Pre-eclampsia women		Non-preeclampsia women	
	mean	Standard deviation	Mean	Standard deviation
18 – 28 weeks	0.624	0.07	0.535	0.09

A comparison of uterine artery notching alone and uterine notch with RI >0.65 with development of preeclampsia revealed uterine artery notch was found in n=22 cases out of which n=6 cases were preeclampsia. Not with RI>0.65 was found in n=11 cases with preeclampsia. Uterine Artery Notch has 35.29%

sensitivity, specificity is 62.71% Uterine Artery Notch+0.65 64.71% sensitivity, specificity is 72.09%. Pregnancy outcome in Study Group 23.4% of pregnant women had preterm delivery. 63.3% had Normal pregnancy outcome (Table 6).

**Table 6:** Pregnancy outcome in preeclampsia and Non-preeclampsia

Outcome of the Pregnancy	Frequency	Percentage
Normal	38	63.3
Oligoamnios	4	6.7
IUGR	2	3.3
Preterm birth	14	23.4
IUFD	2	3.3
TOTAL	60	100.0

The mode of delivery was full-term normal delivery in n=21(35%) of cases with preterm vaginal delivery in n=15(25%) of cases and LSCS in n=24(40%) of cases. The neonatal birth weight in kgs ranged from 1.2 to 3.5 with a mean weight of 2.8 Kgs. APGAR scores at 1-minute mean values were found to 8.36 and APGAR at 5 minutes mean values were 8.36. The mean duration of NICU stay was 1.25 days.

## Discussion

In the current study, we analyzed for Doppler changes in the Uterine artery at 18-28 weeks of gestation after a routine anomaly scan. These patients were followed up till delivery and details of pregnancy events, delivery, and neonatal outcome were noted. Preeclampsia is a pregnancy-specific syndrome of reduced organ perfusion secondary to vasospasm and endothelial activation. The minimum criteria for preeclampsia are BP 140/90 mm Hg after 20 weeks gestation and proteinuria 300 mg/24 hours or 1+ dipstick.<sup>[13]</sup> The syndrome complex of Preeclampsia and fetal growth restriction have similar pathology of placental insufficiency. Here the blood supply to the fetuses inadequate because of defective placentation which can be part of the syndrome of preeclampsia Impaired uteroplacental blood flow as reflected by abnormal uterine Doppler flow velocities remains the important cause for severe pregnancy complications like Preeclampsia and Intrauterine growth restriction.<sup>[14]</sup> Uterine artery Doppler assessment for the presence of Diastolic notch, Resistance index, Pulsatility Index values at 18-

28 weeks of gestation is studied. The S/D ratio, PI, and RI decrease throughout pregnancy, the most likely explanation is the circulation experience a progressive fall in the impedance with advancing gestation, especially after 20 weeks. The presence of Notching late in pregnancy is an indicator of increased vascular resistance and impaired uterine circulation. Bilateral notching is more concern. Unilateral notching of the uterine artery on the ipsilateral side of the placenta, if the placenta is along on lateral wall carries the same significance as that of bilateral notching below.<sup>[15]</sup> Doppler proved to be more efficient at predicting a complicating pregnancy in those patients who were at high risk. a positive medical history alone was associated with a 3- fold greater risk of developing preeclampsia and intrauterine growth restriction. By Zimmermann et al;<sup>[16]</sup> In this study, screening for Preeclampsia is based on risk factors. n=60 singleton pregnant women satisfying the inclusion criteria are selected and the criteria include, Primigravida of age <20 years and >35 years, H/o preeclampsia in a previous pregnancy, H/o Diabetes mellitus, and chronic hypertension. Increased BMI >35 kg/m<sup>2</sup>, conceived after ART, and past bad obstetric history is included and this screening of preeclampsia based on risk factors is similar to the studies were done by Arduini et al;<sup>[17]</sup> Jacobson et al;<sup>[18]</sup> Zimmermann et al;<sup>[16]</sup>, and Coleman et al;<sup>[19]</sup>. Routine First trimester screening tests for preeclampsia have low predictive value and no data are demonstrating that they lead to improved outcomes of pregnancy. In this Present study for the screening of Preeclampsia, the uterine artery Doppler was done between 18-28 weeks of gestation because the second wave of Trophoblastic invasion occurs by about 16- 18 weeks of gestation, The failure of this second wave trophoblastic invasion will result in preeclampsia and Intrauterine fetal growth restriction, therefore, this study was done after 18 weeks. However, Doppler examination was performed at different ranges of gestational age in the different studies. In this study, 28.33% of high-risk women developed Preeclampsia. The incidence of preeclampsia ranges from 3% to 7% for Nulliparas, and 1% to 3% for Multiparous. The prevalence of hypertensive disorder of pregnancy is different according to

geographic regions of the world and ranges from 1.5% to 7.5% Uzan J et al; [20] High Prevalence is quoted by Gupta Shashi et al; [12] 20%, Zimmermann et al; [16] 18% and low prevalence rates are reported. In this study among 60 women 36.7% had Bilateral/unilateral notching and from them 27.27% women developed pre-eclampsia. Several studies were done only by using early diastolic. Notching (unilateral/Bilateral) in uterine artery Doppler for prediction of preeclampsia. Zimmermann et al; [16] included Bilateral notching stated that it is the most sensitive predictor for detecting Pre-eclampsia. With uterine artery diastolic notch at 18-28 weeks alone is considered 27.27% of women developed preeclampsia. The detection rate has increased up to 47.82%. When RI > 0.65 is also included along with uterine artery Doppler diastolic notching. Hence, prediction of preeclampsia has increased when bilateral uterine artery notching is combined with RI of uterine artery Doppler thus sensitivity increased from 35.29% to 64.71% when RI is included. Similar to the studies were done by Gupta et al; [12] and Bower et al; [6].

## Conclusion

Uterine artery Doppler is a non-invasive method for evaluation of Fetoplacental circulation without any disturbance to pregnancy. Uterine Doppler at 18-28 weeks of Gestation can be used as a reliable screening test for the prediction of Preeclampsia and intrauterine growth restriction and in cases where the test proves to be abnormal increased surveillance and delivery in a well-equipped set up is necessary to reduce the maternal and fetal complications.

**Conflict of Interest:** None declared

**Source of Support:** Nil

**Ethical Permission:** Obtained

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