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# PREDICTING ADVERSE OUTCOMES IN PREGNANCY USING FIRST TRIMESTER AND SECOND TRIMESTER UTERINE ARTERY DOPPLER

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**ABSTRACT** **BACKGROUND-** Doppler assessment of the placental circulation plays an important role in screening for impaired placentation and its complications like pre-eclampsia and intrauterine growth restriction. **AIM**-To predict adverse pregnancy outcomes like pre-eclampsia and FGR by first trimester and second trimester uterine artery doppler. **STUDY DESIGN-**Hospital based prospective cohort study **MATERIALS AND METHODS-**120 antenatal patients with singleton pregnancy at 10-14 weeks gestation attending ANOPD of Guahati Medical College and Hospital, with no prior history of any medical conditions, irrespective of parity were followed up till delivery and early neonatal period for adverse pregnancy outcomes by uterine artery doppler at first and second trimester. **RESULTS-**In our study comprising of 120 antenatal patients,10(8.3%) patients developed pre-eclampsia and 15(12.5%) patients developed FGR . Bilateral uterine artery notching in first and second trimesters could predict 90% pre-eclampsia cases($p<0.0001$).First trimester notching could predict 87%($p<0.0001$) of FGR cases,while in second trimester it could predict 67%($p<0.0001$) FGR. RI>95 percentile in first trimester could predict 50%($p<0.0001$)of pre-eclampsia and 40%($p<0.0001$) of FGR.While in second trimester it could predict 40%($p<0.0001$) of pre-eclampsia and 40%($p<0.0001$) of FGR. PI>95 percentile in first trimester could predict 20%($p<0.0001$)of pre-eclampsia and 27%($p<0.0001$) of FGR.While in second trimester it could predict 20%($p<0.0001$) of pre-eclampsia and 13%($p=0.0003$) of FGR. **CONCLUSION-**Our study found doppler study of uterine artery as a very promising non-invasive tool for early identification of pregnancies with placental insufficiency.

**KEYWORDS :**

## INTRODUCTION

Doppler assessment of the placental circulation plays an important role in screening for impaired placentation and its complications like pre-eclampsia,intrauterine growth restriction,preterm labour ,IUFD,abruptio placenta and perinatal death.Assessment of the fetal circulation is essential in the better understanding of the pathophysiology of a wide range of pathological pregnancies and their clinical management.

Pregnancies affected by impaired placentation have been shown to demonstrate increased impedance in spiral artery .The spiral artery, the major continuation of the uterine artery undergoes trophoblastic invasion during pregnancy.This physiological process is characterized by loss of the musculoelastic properties and its conversion to the uteroplacental arteries,which allows an increased blood flow to the placenta and fetus.This process commences in the first and ends in early second trimester .

The impairment or complete absence of this physiological process is associated with increased vascular resistance and increased impedance to blood flow and ultimately affect blood flow into the placenta .These sequences of events precedes the onset of complications .The effect of abnormal trophoblastic invasion is derived from studies on uterine artery,because the uterine artery provides a good representation of the sum of resistances of placental bed and placental perfusion .Doppler flow studies of uterine artery therefore provides an accurate means of assessing uteroplacental resistance to blood flow and a good method of assessing impairment or absence of uteroplacental blood flow.

Doppler is a non-invasive method for evaluation of feto-placental circulation without any disturbance to human pregnancy. A high Resistance Index, Pulsatility Index and persistent uterine artery notching in uterine artery Doppler wave form has been shown as the best screening test.

Thus, we have conducted this study to find out the predictive value of uterine artery Doppler in first and second trimesters for the prediction of adverse outcomes in pregnancy (preeclampsia,IUGR,IUFD) and subsequent perinatal outcome as it is cheaper,easier and needs lesser expertise. High risk population can be identified very early and thus early intervention with lifestyle modifications and drugs like aspirin can be started.

## MATERIALS AND METHODS

An observational study was done over a period of one year among women attending the antenatal OPD of Obstetrics and Gynaecology department at Guahati Medical College and Hospital during the period of April 2020 to March 2021.

### INCLUSION CRITERIA

1. All antenatal women with singleton pregnancy irrespective of parity.
2. No previous history of pre-eclampsia,IUGR,abruption,preterm delivery or any other adverse pregnancy outcomes.

### EXCLUSION CRITERIA

1.Multiple gestation.
2.Patient with congenital anomaly of fetus
3.Chronic hypertension
4. Renal disease
5. Cardiac disease
6.Molar pregnancy
7.Overt diabetes mellitus
8.Maternal autoimmune disease

**SAMPLE SIZE**: 120

**STUDY DESIGN**: HOSPITAL BASED PROSPECTIVE COHORT STUDY

### METHODOLOGY

After assessment of inclusion and exclusion criteria, 120 antenatal women (of 10-14 weeks singleton gestation) attending Antenatal OPD of Guahati Medical college and Hospital were selected for the study . Women booking for antenatal care were examined and investigated. After a written informed consent, the women were subjected to transabdominal ultrasound for dating and Uterine artery doppler screening scan.

Doppler ultrasound assessments of both UA were performed by radiology staff using a Samsung RS80A machine .Patient was kept in semi recumbent position,gel was applied over the abdomen to get a good acoustic coupling. Mid-sagittal section of uterus was obtained ,and cervical canal was identified.The probe was then moved laterally until paracervical vascular plexus was seen .Color Doppler was turned

on and the uterine artery was identified as it turns cranially,to make its ascent to the uterine body.Using pulsed-wave Doppler,3 or 4 waves of equal height were seen, the image was frozen and values were obtained from the machine. Same procedure was repeated on contralateral side. These patients were again reviewed at 20-24 weeks .Along with routine anomaly scan,bilateral uterine artery doppler was performed.

These patients were followed up till delivery and early neonatal period. Uterine artery Doppler assessment for presence of bilateral diastolic notch, mean RI,mean PI values, both at 10-14 weeks and 20-24 weeks were studied.Adverse pregnancy events like pre-eclampsia and IUGR were noted.Perinatal outcome in terms of IUFD,low birth weight,NICU admission,APGAR score and early neonatal death were recorded.

Mean PI>95 percentile,Mean RI>95 percentile and presence of bilateral uterine artery diastolic notching were considered abnormal.
Data were collected, revised,coded and entered to the Statistical Package for Social Science(IBM SPSS) version 20.
Cut off values(>95 percentile) in our study for RI1-0.83±0.04

RI2-0.75±0.02
PI1-2.34±0.06
PI2-2.03±0.11

For each index, statistical analysis was done and sensitivity, specificity, PPV, NPV was calculated.

## RESULTS

In our study, 20%(24) belong to teenage group ,39.16%(47) belong to 21-25 years,31.66%(38) belongs to 26-30years,6.66%(8) belongs to 31-35 years and 2.5% (3)belongs to 36-40 years.

52.5%(63) of patients were primigravida and 47.5%(57) were multigravida in our study.

Mean gestational age at first trimester ultrasound was $11^{+}5$weeks and second trimester was 22 weeks.

### Prediction of adverse pregnancy outcomes with uterine artery doppler

| ADVERSE PREGNANCY EFFECTS | PRE-ECLAMPSIA | | | Sensitivity | Specificity | PPV | NPV | p value |
|---|---|---|---|---|---|---|---|---|
| N1 | PRESENT | | ABSENT | | | | | |
| | COUNT(%) | | COUNT(%) | | | | | |
| N2 | ABSENT | 1(10) | 89(80.91) | 90 | 80.9 | 30 | 99 | <0.0001 |
| | PRESENT | 9(90) | 21(19.09) | | | | | |
| | ABSENT | 1(10) | 106(96.36) | 90 | 96.4 | 69.2 | 99 | <0.0001 |
| | PRESENT | 9(90) | 4(3.64) | | | | | |
| RI 1 | <95 PERCENTILE | 5(50) | 107(97.27) | 50 | 97.3 | 62.5 | 96 | <0.0001 |
| | ≥95 PERCENTILE | 5(50) | 3(2.73) | | | | | |
| RI 2 | < 95 PERCENTILE | 6(60) | 107(97.27) | 40 | 97.3 | 57.1 | 95 | < 0.0001 |
| | ≥95 PERCENTILE | 4(40) | 3(2.73) | | | | | |
| PI 1 | <95 PERCENTILE | 8(80) | 107(97.27) | 20 | 97.3 | 40 | 93 | < 0.0001 |
| | ≥95 PERCENTILE | 2(20) | 3(2.73) | | | | | |
| PI 2 | <95 PERCENTILE | 8(80) | 108(98.18) | 20 | 98.2 | 50 | 93 | < 0.0001 |
| | ≥95 PERCENTILE | 2(20) | 2(1.82) | | | | | |

N1-Notching in first trimester
N2-Notching in second trimester
RI1-Resistance index in first trimester
RI2- Resistance index in second trimester
PI1-Pulsatality index in first trimester
PI2- Pulsatality index in second trimester

| ADVERSE PREGNANCY EFFECTS | IUGR | | | Sensitivity | Specificity | PPV | NPV | p value |
|---|---|---|---|---|---|---|---|---|
| | PRESENT | ABSENT | | | | | | |
| | COUNT(%) | COUNT(%) | | | | | | |
| N1 | ABSENT | 2(13.3) | 88(83.81) | 86.7 | 83.8 | 43.3 | 97.8 | <0.0001 |
| | PRESENT | 13(86.67) | 17(16.19) | | | | | |
| N2 | ABSENT | 5(33.33) | 102(97.14) | 66.7 | 97.1 | 76.9 | 95.3 | <0.0001 |
| | PRESENT | 10(66.67) | 3(2.86) | | | | | |
| RI 1 | <95 PERCENTILE | 9(60) | 103(98.1) | 40 | 98.1 | 75 | 92 | <0.0001 |
| | ≥95 PERCENTILE | 6(40) | 2(1.9) | | | | | |
| RI 2 | <95 PERCENTILE | 9(60) | 104(99.05) | 40 | 99.1 | 85.7 | 92 | <0.0001 |
| | ≥95 PERCENTILE | 6(40) | 1(0.95) | | | | | |
| PI 1 | <95 PERCENTILE | 11(73.33) | 104(99.05) | 26.7 | 99.1 | 80 | 90.4 | <0.0001 |
| | ≥95 PERCENTILE | 4(26.67) | 1(0.95) | | | | | |
| PI 2 | <95 PERCENTILE | 13(86.67) | 103(98.1) | 13.3 | 98.1 | 50 | 88.8 | 0.0003 |
| | ≥95 PERCENTILE | 2(13.33) | 2(1.9) | | | | | |

Uterine artery notching in first trimester had sensitivity of 90%,specificity of 80.9%,PPV of 30% and NPV of 98.9% in prediction of preeclampsia.In second trimester it had sensitivity of 90%,specificity of 96.4%,PPV of 69.2% and NPV of 99.1% in prediction of preeclampsia.

Uterine artery notching in first trimester had sensitivity of 86.7%,specificity of 83.8%,PPV of 43.3% and NPV of 97.8% in prediction of IUGR.In second trimester it had sensitivity of 66.7%,specificity of 97.1%,PPV of 76.9% and NPV of 95.3% in prediction of IUGR.

RI in first trimester had sensitivity of 50%,specificity of 97.27%,PPV of 62.50% and NPV of 95.54% in predicting Pre-eclampsia.RI in second trimester had sensitivity of 40%,specificity of 97.27%,PPV of 57.14% and NPV of 94.69% in predicting Pre-eclampsia.

PI in first trimester had sensitivity of 20%,specificity of 97.27%,PPV of 40% and NPV of 93.04% in predicting Pre-eclampsia.PI in second trimester had sensitivity of 20%,specificity of 98.18%,PPV of 50% and NPV of 93.10% in predicting Pre-eclampsia.

RI in first trimester had sensitivity of 40%,specificity of 98.10%,PPV of 75% and NPV of 91.96% in predicting IUGR.RI in second trimester had sensitivity of 40%,specificity of 99.05%,PPV of 85.71% and NPV of 92.04% in predicting IUGR.

PI in first trimester had sensitivity of 26.67%,specificity of 99.05%,PPV of 80% and NPV of 90.43% in predicting IUGR.PI in second trimester had sensitivity of 13.33%,specificity of 98.10%,PPV of 50% and NPV of 88.79% in predicting IUGR.

NICU-Admission in NICU
IUGR-Intrauterine growth restriction
IUFD-Intrauterine fetal death
AP1-Apgar score at 1 minute

AP2-Apgar score at 5 minute Babies born to pre-eclampsia mothers had high chances of NICU admission($p<0.0001$),IUGR($p<0.0001$),IUFD(0.0026) and lower APGAR scores at one and five minutes($p<0.0001$). 10%(12) of study population had preterm delivery(less than 37 weeks). 55.83%(67) of study population had full term vaginal delivery , 35.83%(43) had LSCS,4.17%(5) had preterm vaginal delivery,2.5%(3) had forceps assisted delivery and 1.67% (2)had vaccum assisted delivery.

Relation of pre-eclampsia with adverse neonatal outcomes

| ADVERSE PREGNANCY EFFECTS | IUGR | | | Sensitivity | Specificity | PPV | NPV | p value |
|---|---|---|---|---|---|---|---|---|
| | PRESENT | ABSENT | | | | | | |
| | COUNT(%) | COUNT(%) | | | | | | |
| N1 | ABSENT | 2(13.3) | 88(83.81) | 86.7 | 83.8 | 43.3 | 97.8 | <0.0001 |
| | PRESENT | 13(86.67) | 17(16.19) | | | | | |
| N2 | ABSENT | 5(33.33) | 102(97.14) | 66.7 | 97.1 | 76.9 | 95.3 | <0.0001 |
| | PRESENT | 10(66.67) | 3(2.86) | | | | | |
| RI 1 | <95 PERCENTILE | 9(60) | 103(98.1) | 40 | 98.1 | 75 | 92 | <0.0001 |
| | ≥95ERCENTILE | 6(40) | 2(1.9) | | | | | |
| RI 2 | <95 PERCENTILE | 9(60) | 104(99.05) | 40 | 99.1 | 85.7 | 92 | <0.0001 |
| | ≥95 PERCENTILE | 6(40) | 1(0.95) | | | | | |
| PI 1 | <95 PERCENTILE | 11(73.33) | 104(99.05) | 26.7 | 99.1 | 80 | 90.4 | <0.0001 |
| | ≥95 PERCENTILE | 4(26.67) | 1(0.95) | | | | | |
| PI 2 | <95 PERCENTILE | 13(86.67) | 103(98.1) | 13.3 | 98.1 | 50 | 88.8 | 0.0003 |
| | ≥95 PERCENTILE | 2(13.33) | 2(1.9) | | | | | |

## DISCUSSION

Preeclampsia was noted in 8.3% of our study population,which was lesser when compared with Gupta Shashi et al [1](20%).IUGR was noted in 12.5% of our study population which was higher when compared to Harrington K et al [2](9.6%).

In our study ,bilateral uterine artery notching in first trimester had sensitivity of 90%,specificity of 89.9%,PPV of 30% and NPV of 98.9% in predicting pre-eclampsia.These values are higher when compared to study conducted by Gupta Shashi et al [1] where sensitivity was 68.75,specificity was 66.6%,PPV was 31.42% and NPV was 90.5%.

In our study ,bilateral uterine artery notching in second trimester had sensitivity of 90%,specificity of 96.4%,PPV of 69.2% and NPV of 99.1% in predicting pre-eclampsia. In a study conducted by Densak pongrojpaw et al [3] sensitivity was 62.96%,specificity was 65.34%,PPV was 13.43% and NPV was 95.19%.

In our study ,bilateral uterine artery notching in second trimester had sensitivity of 66.7%,specificity of 97.1%,PPV of 76.9% and NPV of 95.3% in predicting IUGR. In a study conducted by Densak pongrojpaw et al [3] sensitivity was 56.25%,specificity was 64%,PPV was 7.37% and NPV was 96.63%, and this is comparable with ours.

In our study,PI>95 percentile was found to be 2.34 in first trimester. PI1 had sensitivity of 20%,specificity of 97.27%,PPV of 40% and NPV of 93.04% in predicting pre-eclampsia.This is comparable with study conducted by A M Martin [4] ,where PI>95 percentile was 2.35.Their PI value had sensitivity of 27%,specificity of 95.4%,PPV of 11% and NPV of 98.4% in predicting pre-eclampsia. Gomez et al [5] conducted a study where PI had sensitivity of 24%,specificity of 95.1%,PPV of 11.3% and NPV of 97.9% in predicting pre-eclampsia.

Our study showed sensitivity of 20%,specificity of 98.18%,PPV of 50% and NPV of 93.10% in predicting pre-eclampsia in second trimester.PI2>95 percentile was noted to be 2.03. Albaiges [6] conducted a study where PI>1.45 was taken as cutoff ,and had sensitivity of 35.3%,specificity of 96%,PPV of 25.8% and NPV of 97.5% in predicting pre-eclampsia in second trimester.

In our study,PI1>95 percentile was found to be 2.34.PI1 had sensitivity of 26.67%,specificity of 99.05%,PPV of 80% and NPV of 90.43% in predicting IUGR in first trimester.This is comparable to a study conducted by Gomez et al [5] where PI had sensitivity of 24.3%,specificity of 95.4%,PPV of 16.9% and NPV of 97% in predicting IUGR.

Our study showed sensitivity of 13.33%,specificity of 98.10%,PPV of 50% and NPV of 88.79% in predicting IUGR in second trimester.PI2>95 percentile was noted to be 2.03. Albaiges [6] conducted a study where PI>1.45 was taken as cutoff, and had sensitivity of 21%,specificity of 96.3%,PPV of 33.7% and NPV of 93.2% in predicting IUGR in second trimester.

In our study with RI>95 percentile(0.83) in first trimester,sensitivity was noted to be 50%,specificity 97.27%,PPV of 62.5% and NPV of 95.54%. Melchiorre et al [7] conducted a study where RI>90 percentile was taken as cutoff.The sensitivity was 48.5,specificity was 91.8,PPV was 6.2 and NPV was 99.4 in predicting preterm pre-eclampsia.

In our study RI2>95 percentile(0.75) was taken as cut off .Its sensitivity was 40%,specificity of 97.27%,PPV of 57.14% and NPV of 94.69% in predicting pre-eclampsia in second trimester.Our study is comparable with Bewley et al [8] where RI>95 percentile was taken as cut off.The sensitivity was 24%,specificity of 95%,PPV of 20% and NPV of 96% in predicting pre-eclampsia in second trimester.

Our study showed sensitivity of 40%,specificity of 99.05%.PPV of 85.71% and NPV of 92.04%, when RI>95 percentile was taken as cutoff, in predicting IUGR in second trimester.Bower S et al [9] showed sensitivity of 46% and specificity of 86%,when RI>95 percentile+/- bilateral notch were taken as cutoff.

## CONCLUSION

Pre-eclampsia is a complex clinical syndrome involving multiorgan systems and causes maternal and perinatal mortality and morbidity. The research for ideal predictive tests and preventive measures remains challenging. Doppler is a non-invasive method for evaluation of feto-placental circulation without any disturbance to human pregnancy.

Thus uterine artery doppler can safely be incorporated to routine ultrasound in first and second trimester for early prediction of pre-eclampsia and IUGR .It helps in early identification of high risk population and preventive measures like lifestyle modifications, nutritional supplementation and drugs like aspirin can be started.

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