

## Utilization Of Uterine Artery Doppler In Second Trimester To Predict Adverse Perinatal Outcomes -A Prospective Observational Study

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### Abstract-

**Background:** Complications during pregnancy frequently result in adverse events impacting both the mother and the fetus. Hemodynamic changes characteristic of pregnancy typically involve a decline in uterine artery flow resistance, accompanied by increased blood flow as gestational age progresses. While these changes are a natural part of pregnancy, pathological alterations marked by high-resistant circulation can pose significant risks for adverse pregnancy outcomes. The uterine artery Doppler has been utilized largely in the first and second trimesters to screen high risk pregnancies in relation to the development of subsequent complications. Second trimester screening can be still of value for late scheduled and those with unplanned pregnancies who require closer antenatal monitoring. The aim of this study was to determine the sensitivity, specificity, positive and negative predictive value of the uterine artery Doppler parameters in the prediction of adverse pregnancy outcomes in our population.

**Methods:** This was a hospital-based, time-bound and prospective study, conducted in the Department of Radiodiagnosis of Mahatma Gandhi Memorial Medical College & M.Y. Hospital, Indore, Madhya Pradesh, India, after getting approval by the Institutional Scientific and Ethical Committee. The duration of this study was from Sept. 2022 to Sept. 2023. A total of 150 pregnant women in 2nd trimester (22-24 weeks), referred to the Department of Radiodiagnosis were included in the study according to the inclusion and exclusion criteria, after enrolling PCPNDT registration and after obtaining written informed consent.

**Results:** In our study, 20.7% women delivered babies before gestational age of 37 weeks, also 15.3% underwent LSCS and 6% had assisted delivery. 28 out of 63 women with high mean PI gave birth to babies with adverse perinatal outcomes, while rest 35 women gave birth to babies with no adverse perinatal outcomes, giving sensitivity of 44.4% and specificity of 81.6%. 23 out of 53 women with high mean RI gave birth to babies with adverse perinatal outcomes, while rest 30 women gave birth to babies with no adverse perinatal outcomes, giving sensitivity of 43.4% and specificity of 77.3%.

**Conclusion:** In second trimester, high mean uterine artery PI has higher specificity for adverse perinatal outcomes than high mean uterine artery RI.

**Keywords:** Uterine artery Doppler ultrasound, second trimester, adverse perinatal outcomes.

### INTRODUCTION

Complications during pregnancy frequently result in adverse events impacting both the mother and the fetus. These complications may arise from various sources, ranging from preexisting maternal conditions to previous obstetric complications. Additionally, maternal, social and anthropometric characteristics, including age and obesity, can play pivotal roles. Hemodynamic changes characteristic of pregnancy typically involve a decline in uterine artery flow resistance, accompanied by increased blood flow as gestational age progresses. While these changes are a natural part of pregnancy, pathological alterations marked by high-resistant circulation can pose significant risks for adverse pregnancy outcomes<sup>1</sup>. Studies have associated pathological circulatory changes during pregnancy with an elevated risk of adverse complications, emphasizing the importance of vigilance in prenatal care<sup>2</sup>. Uterine artery Doppler

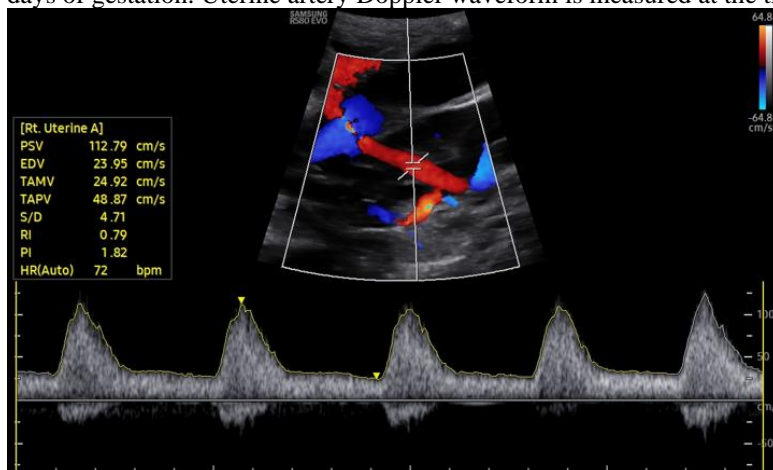
ultrasound constitute a useful non-invasive method to assess uteroplacental perfusion and to predict further development of preeclampsia, fetal growth restrictions and stillbirth. Pregnancy-related hypertensive disorders are thought to be a consequence of impaired trophoblastic invasion of the maternal spiral arteries, that results in high resistance in maintenance vessels, inadequate placental perfusion, tissue injury and increased production of vasoconstrictive substances. The result is abnormal uteroplacental blood flow which led to the idea of uterine artery Doppler as screening method. The principle is that impedance to uterine artery flow velocimetry increases as pregnancy progresses probably due to abnormal placentation. It is a reliable, safe, rapid and easily reproducible tool<sup>3</sup>.

The uterine artery Doppler has been utilized largely in the first and second trimesters to screen high risk pregnancies in relation to the development of subsequent complications. There are various kind of opinions on the best time during pregnancy to perform a Doppler scan to predict adverse pregnancy outcomes. While some studies suggest that a combination of second and third-trimester Doppler scans is effective, others propose that Doppler ultrasound is useful across all trimesters<sup>4</sup>.

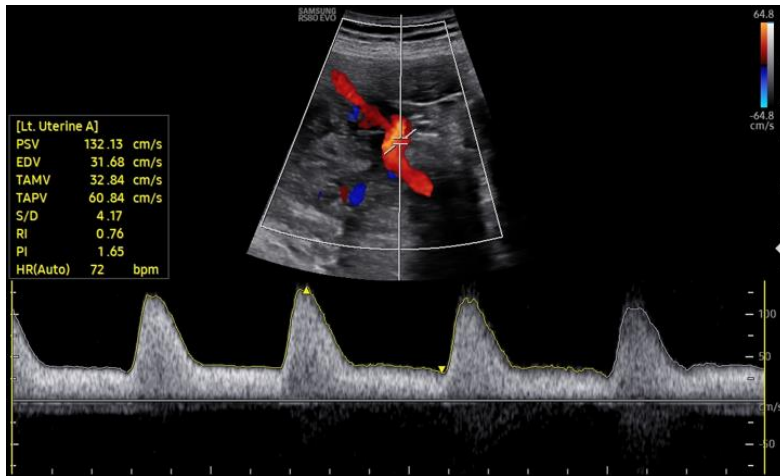
## METHODS

This was a hospital-based, time-bound and prospective study, conducted in the Department of Radiodiagnosis of Mahatma Gandhi Memorial Medical College & M.Y. Hospital, Indore, Madhya Pradesh, India, after getting approval by the Institutional Scientific and Ethical Committee. The duration of this study was from Sept. 2022 to Sept. 2023. A total of 150 pregnant women in 2nd trimester (22-24 weeks), referred to the Department of Radiodiagnosis were included in the study according to the inclusion and exclusion criteria, after enrolling PCPNDT registration and after obtaining written informed consent. **INCLUSION CRITERIA:** All Singleton pregnancy with gestational age between 22-24 weeks. **EXCLUSION CRITERIA:** Patients with multiple pregnancies, gross fetal anomalies, in active labor or with major complications presenting as an emergency, with gestational age < 22 weeks, who plan delivery at other hospitals, with preexisting systemic diseases, like hypertension, diabetes, systemic lupus erythematosus, hemoglobinopathy, etc. **STUDY PROTOCOL:** 150 in 2nd trimester (22-24 weeks) were selected according to inclusion and exclusion criteria. A detailed history was taken. Ultrasonography of pelvis was done with ultrasound equipment, using curvilinear trans-abdominal probe. The pulsatility index (PI) and resistance index (RI) were measured bilaterally and the mean PI and RI of the uterine arteries were calculated. The patients were followed up till delivery of the baby. **PERINATAL OUTCOME ASSESEMENT:** Mode of delivery, gestational age at delivery, preterm birth, stillbirth, low birth weight and NICU admissions if any were recorded.

**CASE 1:** A 20 year old pregnant female with G2P1L1A0 gravidity came to OPD for routine check-up at 22 weeks 3 days of gestation. Uterine artery Doppler waveform is measured at the time of scan.



a) Right uterine artery



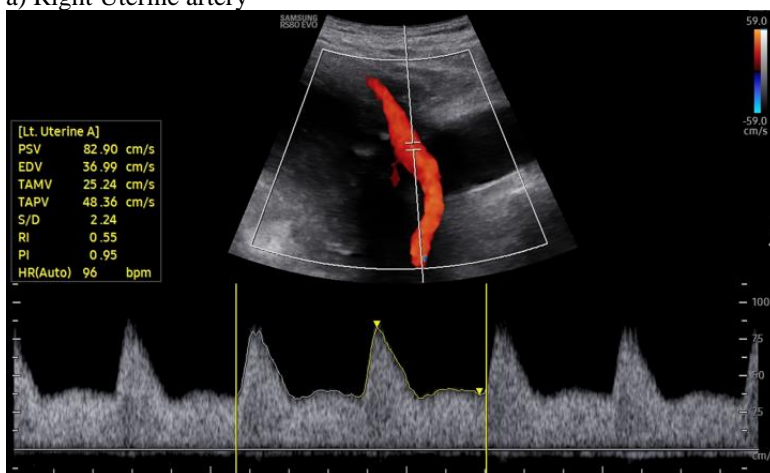
b) Left uterine artery

Bilateral Uterine artery Doppler waveform is assessed, PI and RI values are measured with mean PI value of 1.74 and mean RI value of 0.78. On follow up, female developed preeclampsia on 29 weeks of gestation.

**CASE 2:** A 30 year old pregnant female with G3P2L2A0 gravidity came to OPD for routine check-up at 23 weeks 5 days of gestation. Uterine artery Doppler waveform is measured at the time of scan.



a) Right Uterine artery



b) Left Uterine artery

Bilateral uterine artery Doppler waveforms were assessed. PI and RI values were measured with mean PI value of 1.2 and mean RI value of 0.63. Diastolic notch is also seen bilaterally. On follow up, this patient developed preeclampsia at 32 weeks and gave birth to an IUGR baby.

## RESULTS

In our study, majority of the women, 63 out of 150 (42.0%), were in the age group of 26-30 years. The mean age is  $26.69 \pm 4.63$  years. Most of the patients in our study were gravida 2 (40.0%) followed by gravida 3 (28.0%).

**Table No.1** Distribution of adverse perinatal outcomes and Sensitivity, specificity, positive predictive value and negative predictive value of mean UT PI (cut-off  $>1.48$ ) against adverse perinatal outcomes 28 out of 63 women with high mean PI gave birth to babies with adverse perinatal outcomes, while rest 35 women gave birth to babies with no adverse perinatal outcomes, giving sensitivity of 44.4% and specificity of 81.6%.

Adverse perinatal outcomes	Mean UT PI		Total
	$<1.48$	$>1.48$	
Low birth weight	2	18	20
Preterm birth	6	21	27
Stillbirth	0	2	2
NICU admission	15	25	40
Total females with adverse perinatal outcomes	16	28	44
Total females with no adverse perinatal outcomes	71	35	106
Total	87	63	150
Sensitivity		44.4%	
Specificity		81.6%	
Positive Predictive Value		63.6%	
Negative Predictive Value		11.8%	

**Table No.2** Distribution of adverse perinatal outcomes and Sensitivity, specificity, positive predictive value and negative predictive value of mean UT RI (cut-off  $>0.66$ ) against adverse perinatal outcomes 23 out of 53 women with high mean RI gave birth to babies with adverse perinatal outcomes, while rest 30 women gave birth to babies with no adverse perinatal outcomes, giving sensitivity of 43.4% and specificity of 77.3%.

Adverse perinatal outcomes	Mean UT RI		Total
	$<0.66$	$>0.66$	
Low birth weight	9	11	20
Preterm birth	13	14	27
Stillbirth	1	1	2
NICU admission	20	20	40
Total females with adverse perinatal outcomes	22	23	45
Total females with no adverse perinatal outcomes	75	30	105
Total	97	53	150
Sensitivity		43.4%	
Specificity		77.3%	
Positive Predictive Value		51.1%	
Negative Predictive Value		71.4%	

**DISCUSSION**

The mean age of the study population was  $26.69 \pm 4.63$  years with majority of the women, 63 out of 150 (42.0%), lying between the age group of 26 to 30 years. The gravid status of most of the females was gravida 2. In our study, 20.7% women delivered babies before gestational age of 37 weeks, 15.3% underwent LSCS and 6% had assisted delivery. Higher number of Caesarian sections were noted in the studies conducted by Prasad et al (2012) (48%)<sup>5</sup> and Scandiuzzi et al (2016) (40%)<sup>6</sup>, the difference could be because of variation in study population and demographics.

In our study, 28 out of 63 women with high mean PI gave birth to babies with adverse perinatal outcomes, while rest 35 women gave birth to babies with no adverse perinatal outcomes, giving sensitivity of 44.4% and specificity of 81.6%. The result is comparable with the study of Cnossen JS et al (2008)<sup>7</sup> in which sensitivity was 42% and specificity was 91%. 23 out of 53 women with high mean RI gave birth to babies with adverse perinatal outcomes, while rest 30 women gave birth to babies with no adverse perinatal outcomes, giving sensitivity of 43.4% and specificity of 77.3%.

On comparison, high mean uterine artery PI has higher specificity for adverse perinatal outcomes than high mean uterine artery RI.

**LIMITATIONS:** Acknowledging the limitations of this study, such as limited field of view and reduced sensitivity in certain populations such as obese patients, ultrasound may be less effective due to poor acoustic window.

**CONCLUSION**

Uterine artery Doppler ultrasound constitute a useful non-invasive method to assess utero-placental perfusion and to predict further development of preeclampsia, fetal growth restrictions and stillbirth. In our study, we examined the effectiveness of using Doppler scans to detect adverse perinatal outcomes. Our study found that uterine artery Doppler indices help in improving fetal surveillance. Therefore, we believe that using an antenatal Doppler scan is beneficial in assisting obstetricians in diagnosing and predicting possible adverse outcomes promptly. On comparison, high mean uterine artery PI has higher specificity for adverse perinatal outcomes than high mean uterine artery RI.

**ABBREVIATIONS:** PCPNDT: Pre-conception and pre-natal diagnostic techniques, PI: Pulsatility Index, RI: Resistive index, USG: Ultrasonography, UtA: Uterine artery.

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