



DIAGNOSTIC ACCURACY OF UTERINE ARTERY DOPPLER ULTRASOUND TO PREDICT PREECLAMPSIA IN PRIMIPAROUS WOMEN

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ABSTRACT

Objective – Efficacy of uterine artery Doppler ultrasound in early detection of pre-eclampsia in primiparous women. **Material & Method** - This study, includes 102 primiparous women, aged 20-35 years with gestational ages between 10-20 weeks. Inclusion required a blood pressure > 140/100 mmHg and a persistent early diastolic notch in uterine arteries with a resistance index (RI) > 0.7 in the first trimester. Excluded were those with fetal congenital anomalies or pre-existing renal, diabetes, or cardiovascular conditions. Uterine artery Doppler ultrasound was performed by measuring RI in both trimesters. Participants with high-risk indicators (BP > 140/100 mmHg and RI > 0.7) were monitored and managed according to protocol until 20 weeks to track and address potential pre-eclampsia. **Results** - In this study, we performed transabdominal ultrasound examinations of the uterine arteries between 10 to 12 weeks of gestation in a high-risk population. A total of 102 patients were selected based on elevated blood pressure and a diastolic notch in at least one uterine artery. In the second trimester, Doppler ultrasound re-evaluated these patients, revealing that 54 had a resistance index (RI) > 0.7, and 48 had an RI < 0.7. Of those with RI > 0.7, 74.07% developed preeclampsia, compared to 22.92% of those with RI < 0.7. This indicates a strong correlation between a higher RI and the likelihood of developing preeclampsia. **Conclusion** – In conclusion, the uterine artery Doppler ultrasonography screening in targeted as well as in non-targeted population proves to be a valuable. It can lead to improved maternal and fetal outcomes by enabling proactive management strategies.

KEYWORDS : preeclampsia , resistance index, Color doppler.

INTRODUCTION

Preeclampsia affects 2-6% of pregnant females; it is the major cause of maternal and perinatal mortality and morbidity worldwide¹. In India the reported incidence is notably higher, at around 10.3%². Primiparous women represent as a unique population with a higher risk of developing preeclampsia, compared to multiparous³. Current literature suggests the exact cause of preeclampsia remains uncertain, however current research suggests, it is mainly seen due to failure of trophoblastic invasion of the maternal spiral arteries, this leads to increased vasculature resistance of the uterine arteries and decreased utero-placental blood flow³. Early detection is crucial for managing preeclampsia effectively, as it poses significant risks to both maternal and fetal health. Common indicators include elevated blood pressure, protein in the urine, swelling, and rapid weight gain³.

One promising approach for early prediction of preeclampsia is uterine artery color Doppler. This noninvasive and cost-effective method evaluates blood flow in the uterine arteries. Abnormalities in the Doppler waveforms, such as high resistance to blood flow, can signal an increased risk of preeclampsia, enabling timely medical intervention and management.

MATERIAL & METHOD

This study was conducted at our institute from January 2024 to April 2024. It includes 102 patients who had a Blood pressure reading more than 140/100mmHg and displayed a persistent early diastolic notch in any uterine artery during the first trimester, with a resistance index (RI) greater than 0.7.

The inclusion criteria of this study were primiparous women aged 20-35yrs with gestational age of 10-20weeks. Based on the history given, patients excluded if they had a fetus with congenital anomalies or if they had renal diseases, diabetes mellitus, or cardiovascular diseases. Demographics like name, age, gestational age were recorded. Uterine artery Doppler ultrasound was performed using a LOGIC GE ultrasound machine with a convex probe. The resistance

index (RI) values were measured in both the first and second trimesters using color Doppler imaging. The Doppler parameters, including RI, were calculated by the machine's software, which averaged at least two waveforms for accuracy.

Patients were classified as positive for high risk if their blood pressure reading was more than 140/100mmg along RI above 0.7 in the first trimester. These women were monitored throughout their pregnancy according to established protocols and were followed up until 20 weeks. Those identified as likely to develop preeclampsia were managed according to protocol to ensure timely and appropriate care.

RESULTS

In this study, we performed transabdominal ultrasound examinations of the uterine arteries between 10 to 12 weeks of gestation in a high-risk population. A total of 102 patients were recruited, with a mean age of 28 years. These patients were selected based on elevated blood pressure and the presence of a diastolic notch in at least one of the uterine arteries during first trimester. Among these 102 patients, proteinuria was assessed using the dipstick method. Of these, 23 patients had no detectable proteinuria, 30 patients had proteinuria measured as +1, 39 had proteinuria at +2, and 10 had proteinuria at +3.

Patients were categorized based on their blood pressure, Doppler study results, and dipstick proteinuria reports from the first trimester. Color Doppler ultrasound study in these high risk patients were then performed during the second trimester to further assess the chance of developing preeclampsia.

In the second trimester, Doppler ultrasound examinations were repeated for the 102 high-risk patients previously identified and categorized in the first trimester. Measurements revealed that 54 patients had a resistance index (RI) greater than 0.7, while 48 patients had an RI less than 0.7. Among the 54 patients with an RI greater than 0.7, 40 (74.07%)

subsequently developed preeclampsia, while 14 (25.93%) did not develop preeclampsia and remained normal. In contrast, of the 48 patients with an RI less than 0.7, only 11 (22.92%) developed preeclampsia, whereas 37 (77.08%) did not develop preeclampsia and had normal outcomes.

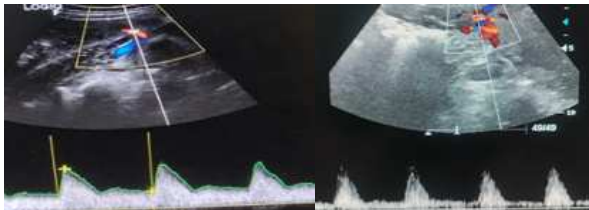
Thus, the Doppler ultrasound findings reveal a strong correlation between a higher resistance index (RI) and the subsequent development of preeclampsia.

Case1



(a) First and (b) second trimester color doppler ultrasound image of a same patient showing persistent diastolic flow notching within the left uterine arterial waveform.

CASE 2



(a) An ultrasound image of the same patient shows early diastolic flow notching in the right uterine artery waveform during the first trimester, (b) but subsequent screening Doppler study in the second trimester was normal.

Comparison Of Resistive Index On Doppler Ultrasound And Development Of Preeclampsia (n= 102)

RI	Preeclampsia		TOTAL
	YES	NO	
RI >0.7	40 (74.07%)	14 (25.9%)	54
RI <0.7	11 (22.9%)	37 (77.08%)	48

DISCUSSION

Preeclampsia is one of a leading cause of maternal morbidity and mortality worldwide^{4,5}. It is primarily characterized by the new onset of hypertension and proteinuria, typically occurring after 20 weeks of gestation in women who were previously normotensive⁷. Identifying the targeted populations and then routinely screening them with color Doppler ultrasound can significantly decrease the incidence of preeclampsia, eclampsia, and related maternal mortality, particularly in developed countries⁵.

Preeclampsia is often associated with abnormal placentation, which results in inadequate utero-placental blood flow³. This has led to the use of Doppler ultrasonography to evaluate uterine artery blood flow velocity as part of routine screening. The presence of an early diastolic notch in uterine artery waveforms during the first trimester can indicate inadequate trophoblastic invasion, which is strongly associated with preeclampsia¹⁰.

In our study, out of 102 patients, 54 had a resistance index (RI) greater than 0.7 at the time of presentation, and 40 of these patients subsequently developed preeclampsia. Among the 48 patients with an RI less than 0.7, 11 developed preeclampsia.

uterine artery Doppler screening meets all the essential criteria for an effective screening program for predicting preeclampsia.^{12,13} They reported that the sensitivity of this screening method for early detection of preeclampsia ranges between 80% and 90%, with a false positive rate between 5% and 7%. In terms of timing, uterine artery Doppler screening performed between 18 and 22 weeks of gestation is considered more effective and beneficial than first-trimester screening¹³.

Similarly, Harrington et al. reports, bilateral notching of the uterine arteries at 20 to 22 weeks identified 55% of women who later developed preeclampsia. The predictive value increased to 81% for cases of preeclampsia that required delivery before 34 weeks of gestation.

These findings support the use of Doppler ultrasound as a reliable and effective tool for the early prediction of preeclampsia, particularly in primigravida patients. The high sensitivity and specificity of this method make it a valuable component of routinely screening programs, which aims for reducing the incidence and complications associated with preeclampsia⁷.

CONCLUSION

This study confirms that uterine artery Doppler ultrasound is highly an effective radiological modality for predicting preeclampsia in primiparous women. A higher resistance index (RI) in the first trimester was strongly associated with the development of preeclampsia, with 74.07% of patients with RI >0.7 developing the condition, compared to 22.92% with RI <0.7. Routine Doppler screening in both the first and second trimesters enhances early detection and allows for timely management, potentially improving maternal and fetal outcomes.

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Antsaklis and Daskalakis in his study, highlighted that