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Original Research Article

Role of Uterine Artery Doppler in the Second Trimester for Predicting IUGR in High-Risk Pregnancies

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Conflict of interest: Nil

Abstract:

Background: Intrauterine growth restriction (IUGR) remains one of the major challenges in obstetrics, carrying a high risk of perinatal illness and death. To improve early detection, uterine artery Doppler studies during the second trimester are now widely used, as they provide valuable insight into placental blood flow and help identify pregnancies at risk for adverse outcomes.

Aim and Objective: The aim of this study is to assess how well second-trimester uterine artery Doppler indices can predict intrauterine growth restriction (IUGR) in high-risk pregnancies, and to compare neonatal outcomes between those with normal versus abnormal Doppler findings.

Materials and Methods: Between March 2023 and February 2024, we conducted a prospective observational study at a tertiary-level teaching hospital. The study population included 120 pregnant women identified as high risk and presenting between 20 and 24 weeks of gestation. Women were categorized as high risk if they had conditions such as prior intrauterine growth restriction, preeclampsia, chronic hypertension, or gestational diabetes. Each participant underwent uterine artery Doppler assessment with a high-resolution ultrasound system. The evaluation focused on calculating the mean pulsatility index (PI) and checking for the persistence of an early diastolic notch. Doppler findings were classified as abnormal when the mean PI exceeded 1.45 and/or bilateral notching was observed. All women were followed until delivery, and pregnancy outcomes including the occurrence of IUGR, neonatal birth weight, requirement for NICU care, and perinatal mortality—were systematically recorded.

Results: Out of the 120 women studied, abnormal uterine artery Doppler findings were observed in 38 cases (31.7%). Among these, more than half [22 women (57.9%)] subsequently developed IUGR, whereas only 10 women (12.2%) with normal Doppler readings were affected, a difference that was highly significant ($p < 0.001$). When assessed as a screening tool, abnormal Doppler demonstrated a sensitivity of 68.8% and a specificity of 81.8% for predicting IUGR. Infants diagnosed with IUGR had notably poorer outcomes, with mean birth weights markedly lower than those without growth restriction (2.14 ± 0.28 kg vs. 2.87 ± 0.36 kg, $p < 0.001$), along with a substantially higher likelihood of requiring NICU admission (43.8% compared with 10.2%, $p < 0.001$).

Conclusion: Uterine artery Doppler assessment during the second trimester serves as an effective, non-invasive approach for identifying high-risk pregnancies likely to develop intrauterine growth restriction. Integrating this technique into routine evaluation can facilitate earlier recognition of compromised fetal growth and enable timely management strategies, ultimately improving neonatal outcomes.

Keywords: Intrauterine Growth Restriction, Uterine Artery Doppler, High-Risk Pregnancy, Pulsatility Index, Diastolic Notch, Second Trimester, Placental Insufficiency.

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Introduction

Intrauterine growth restriction (IUGR) remains one of the leading contributors to perinatal illness and death, affecting an estimated 5–10% of pregnancies globally, with a disproportionately higher burden reported in low- and middle-income countries [1]. The condition is defined by the inability of the fetus to attain its genetic growth potential, most often as a consequence of placental dysfunction [2]. Detecting pregnancies at risk early is essential to optimize

surveillance, guide management, and ultimately improve neonatal outcomes.

Over the past two decades, uterine artery Doppler velocimetry has gained prominence as a non-invasive technique for evaluating uteroplacental circulation and anticipating complications in high-risk pregnancies. Abnormal Doppler patterns—such as elevated pulsatility or resistance indices and the persistence of an early diastolic notch—suggest increased vascular resistance, reflecting impaired trophoblastic invasion and reduced placental perfusion [3,4]. When performed between 20 and 24 weeks of gestation, this assessment allows for the identification of women at increased risk of IUGR well before clinical features become evident [5].

Evidence from multiple studies supports the usefulness of uterine artery Doppler in women with conditions such as prior IUGR, chronic hypertension, or preeclampsia. While it demonstrates moderate predictive accuracy for placental insufficiency and related adverse outcomes [6,7], its performance is influenced by factors including timing of assessment, Doppler indices applied, and population characteristics. These variations highlight the need for context-specific research to establish its reliability in different clinical settings [8].

In light of the continuing challenges posed by IUGR, the present study was designed to investigate the predictive value of second-trimester uterine artery Doppler in high-risk pregnancies. By establishing its role in early detection, this work aims to support timely intervention strategies that may improve perinatal outcomes.

Materials and Methods

After receiving approval from the Institutional Ethics Committee, we carried out a prospective observational study in the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital in India. The study spanned 12 months, from March 2023 to February 2024.

Study Population: The study enrolled pregnant women attending the antenatal clinic who were considered to be at high risk for adverse perinatal outcomes. Women were classified as high risk if they had one or more clinical factors such as a previous history of intrauterine growth restriction (IUGR), preeclampsia, chronic hypertension, or gestational diabetes. Additional risk criteria included maternal age over 35 years and a poor obstetric history, such as recurrent pregnancy loss or stillbirth.

Inclusion Criteria

- Singleton pregnancies
- Only women with a gestational age of 20 to 24 weeks, confirmed by a dating ultrasound
- Presence of one or more high-risk factors for placental insufficiency
- Willingness to participate and provide informed written consent

Exclusion Criteria

- Multiple gestation pregnancies
- Major fetal anomalies detected on anomaly scan
- Pregnant women with known renal, cardiac, or autoimmune disorders
- Poor visualization of uterine arteries on Doppler study

Uterine Artery Doppler Examination: Each enrolled woman underwent a uterine artery Doppler examination between 20 and 24 weeks of gestation. The scans were carried out using a high-resolution Doppler ultrasound system fitted with a 3.5–5 MHz curvilinear probe. Using a transabdominal approach, the uterine arteries were visualized at the point where they cross the external iliac artery, usually close to the level of the internal os.

Doppler assessment was performed on both the right and left uterine arteries to measure the pulsatility index (PI), resistance index (RI), and to check for the presence of an early diastolic notch. The mean PI was calculated from the two sides, and findings were classified as abnormal when the mean PI exceeded 1.45 and/or bilateral early diastolic notching was observed, indicating impaired placental perfusion.

Follow-Up and Outcome Assessment: All participants were monitored throughout their pregnancy until delivery. The main outcome evaluated was the occurrence of intrauterine growth restriction (IUGR). IUGR was defined as an estimated fetal weight below the 10th percentile for gestational age, confirmed through serial ultrasound growth assessments and subsequently by the birth weight recorded at delivery.

Neonatal outcomes such as birth weight, NICU admission, and perinatal mortality were also recorded.

Data Collection: Data were recorded in a predesigned proforma and included demographic details, obstetric history, clinical risk factors, Doppler indices, and pregnancy outcomes. All ultrasound and Doppler assessments were performed by experienced radiologists blinded to clinical history.

Statistical Analysis: Data entry was performed in Microsoft Excel, and all statistical analyses were carried out using SPSS software version 27.0 (IBM Corp., Armonk, NY). Baseline maternal and fetal characteristics were described using descriptive statistics. Continuous variables were expressed as mean with standard deviation, whereas categorical variables were summarized as counts and percentages. For comparisons between the IUGR

and non-IUGR groups, the independent t-test was applied to continuous data, while categorical variables were analyzed using either the Chi-square test or Fisher's exact test, depending on applicability. The diagnostic utility of second-trimester uterine artery Doppler was further assessed by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Statistical significance was determined at a threshold of $p < 0.05$.

In total, 120 women identified as high risk were included and underwent uterine artery Doppler evaluation during the second trimester, between 20 and 24 weeks of gestation. The study population comprised women with risk factors such as chronic hypertension, gestational diabetes, a history of preeclampsia, or prior IUGR. The average maternal age was 29.4 ± 4.2 years. Of the enrolled participants, 62 (51.7%) were primigravida and 58 (48.3%) were multigravida.

Results

Table 1: Demographic and clinical characteristics of the study population (n = 120)

Parameter	Value
Maternal age (years)	29.4 ± 4.2
Gestational age at scan (weeks)	21.6 ± 1.1
Primigravida	62 (51.7%)
Multigravida	58 (48.3%)
History of previous IUGR	22 (18.3%)
Chronic hypertension	25 (20.8%)
Gestational diabetes	19 (15.8%)
History of preeclampsia	14 (11.7%)

Doppler assessment revealed abnormal results in 38 women (31.7%), characterized by a mean pulsatility index (PI) greater than 1.45 and/or the presence of an early diastolic notch. The remaining 82 participants (68.3%) demonstrated normal Doppler findings.

Table 2: Uterine Artery Doppler Findings

Doppler Finding	Number (%)
Abnormal PI (>1.45)	30 (25.0%)
Bilateral early diastolic notch	20 (16.7%)
Any abnormal Doppler	38 (31.7%)
Normal Doppler	82 (68.3%)

Among the 38 women with abnormal Doppler findings, 22 (57.9%) developed intrauterine growth restriction (IUGR), whereas only 10 cases (12.2%) were observed in the 82 women with normal Doppler values. The difference between the two groups was statistically highly significant ($p < 0.001$), underscoring the strong association between abnormal uterine artery Doppler and subsequent IUGR.

Table 3: Incidence of IUGR in Relation to Doppler Findings

Doppler Group	IUGR (n, %)	No IUGR (n, %)
Abnormal (n = 38)	22 (57.9%)	16 (42.1%)
Normal (n = 82)	10 (12.2%)	72 (87.8%)
p-value	< 0.001	

Neonatal outcomes showed marked differences between the IUGR and non-IUGR groups. Babies affected by IUGR had substantially lower birth weights and required NICU admission more frequently than those without growth restriction.

Table 4: Neonatal Outcomes in IUGR vs. Non-IUGR Groups

Outcome	IUGR (n = 32)	Non-IUGR (n = 88)	p-value
Mean birth weight (kg)	2.14 ± 0.28	2.87 ± 0.36	<0.001
NICU admission	14 (43.8%)	9 (10.2%)	<0.001
Perinatal death	2 (6.3%)	1 (1.1%)	0.09

Finally, the diagnostic performance of uterine artery Doppler for predicting IUGR was calculated. The test showed good specificity and negative predictive value.

Table 5: Predictive accuracy of uterine artery Doppler in detecting IUGR

Parameter	Value (%)
Sensitivity	68.8
Specificity	81.8
Positive Predictive Value (PPV)	57.9
Negative Predictive Value (NPV)	87.8
Overall Accuracy	78.3

Discussion

Intrauterine growth restriction (IUGR) remains a pressing concern in obstetrics because of its strong association with perinatal illness and mortality. The present study explored whether uterine artery Doppler performed in the second trimester (20–24 weeks) could reliably predict IUGR in a cohort of high-risk pregnancies. The results highlight its usefulness as a screening tool, particularly in low-resource settings where timely recognition of at-risk pregnancies is vital for improving outcomes.

In this study, abnormal Doppler waveforms were identified in 31.7% of participants, and more than half of these women (57.9%) subsequently developed IUGR. By contrast, the frequency of IUGR among women with normal Doppler indices was only 12.2%. This marked difference underscores the value of Doppler assessment for early risk stratification. Similar trends have been described by Khalil et al. [6], who in a systematic review and meta-analysis demonstrated that mid-pregnancy uterine artery Doppler abnormalities were linked to an increased likelihood of delivering small-for-gestational-age infants and other adverse perinatal events.

The predictive ability of abnormal Doppler in our cohort showed a sensitivity of 68.8% and specificity of 81.8%. These figures closely parallel those reported by Papageorghiou et al. [3], who observed that a mean uterine artery PI greater than 1.45 yielded a sensitivity of 65% and specificity of 84% for detecting IUGR in high-risk pregnancies. Likewise, Gomez et al. [4] have emphasized that predictive performance improves further when raised PI is combined with the presence of bilateral early diastolic notching, reflecting impaired placental function more accurately.

The relatively high proportion of IUGR cases in women with abnormal Doppler findings in our study echoes the observations of Audette and Kingdom [7], who suggested that second-trimester abnormalities in uterine artery flow reflect inadequate trophoblastic invasion and consequent placental underperfusion, both of which are central to the pathophysiology of fetal growth restriction.

Adverse neonatal outcomes in our study specifically, lower mean birth weights and higher NICU admission rates among IUGR infants—highlight the clinical significance of these Doppler abnormalities. Comparable findings were reported by Melchiorre et al. [5], who demonstrated that abnormal uterine artery Doppler indices were strongly associated with neonatal complications such as low birth weight and increased need for intensive care.

In terms of clinical applicability, our study demonstrates that uterine artery Doppler can serve as an effective non-invasive screening tool in high-risk pregnancies. While it may not be definitive in isolation, it plays a valuable role when used alongside serial growth scans and maternal risk factor profiling. As shown in the ASPRE trial by Rolnik et al. [9], integration of uterine artery Doppler with other biochemical and clinical markers in early pregnancy can further improve risk stratification for IUGR and preeclampsia.

Despite these strengths, our study had certain limitations. The sample size was modest, and the results may not be generalizable to low-risk populations. In addition, we did not assess biochemical markers or use longitudinal Doppler surveillance beyond the second trimester. Future studies with larger cohorts and integration of first-trimester biomarkers may enhance predictive accuracy.

Conclusion

The results of this study are in line with earlier reports and reinforce the value of second-trimester uterine artery Doppler as a practical screening method for detecting pregnancies at risk of IUGR. Recognizing these cases early creates an opportunity for closer monitoring, timely interventions, and ultimately better neonatal outcomes.

References

1. Lee AC, Katz J, Blencowe H, Cousens S, Kozuki N, Vogel JP, et al. National and regional estimates of intrauterine growth restriction in 138 low-income and middle-income countries in 2010. Lancet Glob Health. 2013;1(1):e26-36. https://doi.org/10.1016/S2214-109X(13)70006-8
2. Figueras F, Gratacós E. Update on the diagnosis and classification of fetal growth restriction and proposal of a stage-based management protocol. Fetal Diagn Ther. 2014;36(2):86-98. https://doi.org/10.1159/000357592
3. Papageorghiou AT, Yu CKH, Bindra R, Pandis G, Nicolaides KH. Multicenter screening for pre-eclampsia and fetal growth restriction by transvaginal uterine artery Doppler at 23 weeks

of gestation. Ultrasound Obstet Gynecol. 2001;18(5):441-9. https://doi.org/10.1046/j.0960-7692.2001.00588.x

4. Gómez O, Figueras F, Fernández S, Bennasar M, Martínez JM, Puerto B, et al. Reference ranges for uterine artery mean pulsatility index at 11–41 weeks of gestation. Ultrasound Obstet Gynecol. 2008;32(2):128-32. https://doi.org/10.1002/uog.5335
5. Melchiorre K, Wormald B, Leslie K, Bhide A, Thilaganathan B. First-trimester uterine artery Doppler indices in term and preterm pre-eclampsia. Ultrasound Obstet Gynecol. 2008;32(2):133-7. https://doi.org/10.1002/uog.5346
6. Khalil A, Morales-Roselló J, Townsend R, Gordijn SJ, Rehal A, Papageorghiou A, et al. Value of uterine artery Doppler velocimetry at 20 weeks' gestation in the prediction of small-for-gestational-age infants and adverse perinatal outcome: A systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2020;56(4):524–35. https://doi.org/10.1002/uog.22099
7. Audette MC, Kingdom JC. Uteroplacental vascular development and the pathophysiology of the placental bed disorders. Best Pract Res Clin Obstet Gynaecol. 2018;50:23-39. https://doi.org/10.1016/j.bpobgyn.2018.01.010
8. Bower S, Bewley S, Campbell S. Improved prediction of preeclampsia by two-stage screening of uterine arteries using the early diastolic notch and color Doppler imaging. Obstet Gynecol. 1993;82(1):78-83. https://doi.org/10.1097/00006250-199307000-00012
9. Rolnik DL, Wright D, Poon LC, O'Gorman N, Syngelaki A, et al. ASPRE trial: Aspirin versus placebo in pregnancies at high risk for preterm preeclampsia. N Engl J Med. 2017;377(7):613–22. https://doi.org/10.1056/NEJMoa1704559