

# Diagnostic Accuracy of Uterine Artery Doppler and Umbilical Artery Doppler Flow studies for Predicting IUGR

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## ABSTRACT

**Objective:** To determine the diagnostic accuracy of Uterine artery and Umbilical artery Doppler flow studies in predicting Intrauterine growth restriction taking birth weight as gold standard.

**Patients and methods:** It was a Cross Sectional validation Study conducted at Department of Obstetrics and Gynaecology, Lady Willingdon Hospital, Lahore from 1<sup>st</sup> January 2021 to 30<sup>th</sup> April 2022. The uterine and umbilical arteries were analysed using Doppler. The newborn's weight in grammes was recorded right after birth.

**Results:** In the diagnosis of intrauterine growth restriction, uterine artery Doppler has showed a sensitivity of 66%, specificity of 96.4%, diagnostic accuracy of 89%, PPV of 84.6%, and NPV of 90.4%.

**Conclusion:** Uterine and umbilical arteries combined the greatest sign for predicting IUGR is Doppler.

**Keywords:** Uterine artery Doppler, Intrauterine growth restriction, Diagnostic accuracy, Umbilical artery Doppler,

## INTRODUCTION

When a fetus's development rate falls short of what would be considered normal for its genetic makeup or its environment, this is known as intrauterine growth restriction (IUGR). Fetal growth restriction has been defined as a decrease in the foetal growth rate that would otherwise be predicted, and it causes a variety of negative outcomes. A "normal" newborn is one whose birth weight falls within the 10th to 90th percentile for their gestational age, gender, and race, without showing signs of starvation or growth retardation.<sup>1, 2</sup>

It is possible for IUGR to occur from a combination of maternal, placental, foetal, and genetic causes. Causes of intrauterine growth restriction (IUGR) include maternal age, interpregnancy gap (less than 6 or more than 120 months), and illnesses affecting maternal health. Inadequate placental nutrition, in which the placenta fails to provide the fetus's nutritional needs, also causes IUGR. Some occurrences of IUGR can be traced back to foetal deformities, inherited metabolic disorders, or chromosomal abnormalities. Recent progress in genetics and molecular biology has led to the possibility that polymorphisms in genes from the mother, the foetus, and the placenta all play a role in causing IUGR.<sup>3, 4</sup>

Since Fitzgerald and Drumm first reported on signals from the Umbilical artery, researchers have been exploring the use of Doppler techniques in obstetrics. Doppler velocimetry was initially reported to have been used in obstetrics by Fitzgerald, Drumm, McCallum, and co-authors. Doppler ultrasonography has long been used to confirm the long-held belief that poor uterine, placental, and foetal circulations cause negative pregnancy outcomes. Pregnancies affected by hypertension and intrauterine growth restriction have reduced blood supply to the uterus and placenta (IUGR).<sup>5, 6</sup>

Uterine artery Doppler had a sensitive of 62.5%, a specificity of 90.22%, a PPV of 35.71 %, and a NPV of 96.5 %, according to a study by Nagar T. et al., while umbilical artery Doppler had a sensitivity of 37.5%, a specificity of 92.39%, a PPV of 30 %, and a NPV of.<sup>7</sup>

No similar research has ever been conducted on our community previously. Since the condition was first discovered, screening for IUGR has been an important clinical and research problem despite the lack of any medication that may reverse the IUGR process once it has begun. Therefore, I intend to evaluate the diagnostic accuracy of Doppler flow investigations of the uterine artery and the Umbilical artery in predicting intrauterine growth restriction using birth weight as the gold standard. The findings from my research will help inform decisions on how best to

use Doppler ultrasound to predict intrauterine growth restriction in our community.

## PATIENTS AND METHODS

It was a Cross Sectional Validation Study conducted at Department of Obstetrics and Gynaecology, Lady Willingdon Hospital, from 1<sup>st</sup> January 2020 to 30<sup>th</sup> April 2021. Sample Size of 217 patients was calculated taking Sensitivity (62.5%), Specificity (90.22%)<sup>[7]</sup>, Prevalence (25%)<sup>[8]</sup>, Confidence interval (95%) and taking precision for Sensitivity to be 13%, for Specificity to be 13%. Non-probability consecutive sampling was used. Those women having age 18-40 years, Singleton pregnancy on ultrasound, Gestational age 26 to 30 weeks on LMP, Parity 1-4, Hypertension (systolic blood pressure  $\geq$ 140mmHg, measured at two different intervals (4 hours apart)) and H/o IUGR in previous pregnancy on medical record were involved. Those patients with congenital anomaly of fetus, unbooked patients and those with unreliable LMP details on history were excluded from the study.

The uterine and umbilical arteries were examined using a Doppler ultrasonography equipment with 3–5 MHz transducers while the patient was lying supine with their head slightly elevated or laterally reclined. The ultrasound was carried out under the supervision of consultant gynecologist with 3 years of post-fellowship experience. The infant's weight, in grammes, was recorded right after birth. Researchers used a custom-made proforma to record all of the information they gathered from Doppler flow scans of blood flow in the umbilical artery and the uterine artery can be used to predict IUGR and BW.

IBM-SPSS version 22 was used for data entry and analysis. All numerical factors, including as age were subjected to a mean standard deviation analysis. Umbilical artery/uterine artery diagnostic specificity sensitivity, PPV, NPV and accuracy were calculated in relation to birth weight using a 2X2 model. Age, gestational age, and parity, all of which can have a significant impact on results, were managed through stratification. When determining the results of the post-stratification using diagnostic accuracy.

## RESULTS

In this study mean age was 27.281 $\pm$ 3.17 years, mean gestational age 28.023 $\pm$ 1.18 weeks and mean parity was 1.792 $\pm$ 0.77 as shown in Table-I. Uterine Artery Doppler diagnosed 39(18%), Umbilical Artery Doppler 23(10.6%) and On Birth Weight 50(23%) with intrauterine growth restriction as shown in Table-II. As can be shown in Table-IV, the sensitivity and specificity of uterine artery Doppler for the diagnosis of intrauterine growth restriction are 66%

and 96.4%, respectively, while the PPV and NPV are 89% and 90.4%, respectively. Tables IV reveal that the sensitivity and specificity of umbilical artery Doppler for the diagnosis of intrauterine growth restriction are 36% and 97%, respectively. The test also has a PPV of 78% and an NPV of 83%.

Table 1: Mean ±SD of patient's age, gestational age and parity

Demographics	Mean +SD
Age in yrs	27.281±3.17
Gestational age in weeks	28.023±1.18
Parity	1.792±0.77

Table 2: Results overall for the diagnosis of intrauterine growth restriction using uterine artery doppler, umbilical artery doppler, and birth weight

IUGR	Uterine Artery Doppler	Umbilical Artery Doppler	On Birth Weight
Yes	39(18%)	23(10.6%)	50 (23%)
No	178(82%)	194(89.4%)	167(77%)
Total	217 (100%)	217 (100%)	217 (100%)

Table 3: Diagnosis of intrauterine growth restriction: a comparison of uterine artery doppler and birth weight

Parameter	On Birth Weight		Total	P-value
	Yes	No		
Uterine Artery Doppler	33 (TP)	6 (FP)	39	0.000
	17 (FN)	161 (TN)		
Total	50	167	217	
Umbilical Artery Doppler	18 (TP)	5 (FP)	23	0.000
	32 (FN)	162 (TN)		
Total	50	167	217	

Table 4: Sensitivity, Specificity and Diagnostic Accuracy of Uterine Artery Doppler and Umbilical Artery Doppler for Intrauterine growth restriction

Parameter	Sensitivity	Specificity	Diagnostic Accuracy	PPV	NPV
Uterine Artery Doppler	66.0%	96.4%	89%	84.6%	90.4%
Umbilical Artery Doppler	36%	97%	83%	78.3%	83.5%

## DISCUSSION

When a fetus's development rate falls below what's considered normal for its race and gender, this is known as (IUGR). Fetal growth restriction has been defined as a decrease in the foetal growth rate that is expected given the mother's age and the father's height and weight.<sup>8,9</sup>

Twenty-three percent of pregnant women with foetal growth restriction who were considered to be at risk for IUGR. This study's increased IUGR prevalence may be explained by the fact that all of the pregnant women included had a preexisting diagnosis of clinically suspicious IUGR, although IUGR affects just 3% to 10% of normal pregnancies. The research confirms and reports a significant prevalence of IUGR among patients with clinical suspicion of the condition.<sup>9</sup>

We used a similar study design as Chanprapaph et al., who found a prevalence of IUGR of 50.9%. Diagnostic accuracy was 83%, PPV was 78.3%, and NPV was 83.5% for the diagnosis of IUGR using the umbilical artery in the current investigation.<sup>10</sup> Gudmundsson's conceptual framework is supported by these data; however, Dhand et al. found the same findings.<sup>11</sup> The fact that Dhand et al. (2011) have a pro effectiveness of Umbilical artery might account for this discrepancy.<sup>12</sup> Studies indicate varying values for PI, most likely due to differences in study design or estimation methodology; for instance, Using a combination of Umbilical artery indicators, Narula et al. found a sensitivity of 94%.<sup>13</sup> PI in the umbilical artery is more of a specific criterion than a sensitive one. It has been observed in the literature that the pulsatility index drops in the first trimester and subsequently increases, making the criterion more stringent by the third visit (late in the third trimester). Lower diastolic flow causes a greater PI value in pregnancies complicated by placental insufficiency.<sup>10,11,12,13</sup>

Multiple studies have shown that the sensitivity of RI in the umbilical artery is poor but the specificity is good. On the other

hand, a RI of the umbilical artery was reported by Lakhkar et al. to have a sensitivity of 58%, specificity of 71.7%, PPV of 35%, and NPV of 86.8%.<sup>14</sup> In the examination of pregnancy issues, including preeclampsia, Umbilical artery RI was found to be 100% sensitive at a cut-off value of 0.64 but only 44% specific at a higher cut-off value of 0.81.<sup>15</sup> The Umbilical artery S/D ratio had a poorer discriminant value in predicting IUGR, as was also shown in the current investigation by Chanprapaph et al. 10 In contrast to the current study, Wang et al. observed that the Umbilical artery S/D ratio at 24-30 weeks gestation period had significantly higher sensitivity (80%), specificity (83.7%), and positive predictive value (50%).<sup>16</sup>

Kofnias et al. (1990) conducted a study with same results. It's worth noting that pregnant women in their third trimester participated in Kofnias et al study's.<sup>17</sup> Accordingly, it appears that the S/D ratio of the Umbilical artery becomes a valuable tool for predicting IUGR as pregnancy progresses. With regard to diagnosing IGR, the current study found that Doppler imaging of the uterine artery had a sensitivity of 66%, specificity of 96.4%, diagnostic accuracy of 89%, PPV of 84.6%, and NPV of 90.4%.<sup>7,17</sup>

## CONCLUSION

Uterine and umbilical arteries combined The best indicator for IUGR prediction is Doppler. Individual uterine artery Doppler indices are inferior to the diastolic notch as a single measure.

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