

Uterine Artery Doppler Screening in Prediction of Adverse Perinatal Outcome

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Abstract

Background: Uterine artery Doppler velocimetry (UADV) can detect any pathological increase in placental vascular resistance, and thus can detect women at risk for developing adverse perinatal outcome. **Materials and method:** This prospective observational study was carried out in the department of Obstetrics and Gynecology, BIRDEM General Hospital (Women and Children), Segunbagicha, Dhaka, Bangladesh, from July 2021 to December 2021. A total of 31 women with singleton pregnancy were enrolled in this study at their 18-24 weeks of gestation and uterine artery Doppler velocimetry was done to observe its relationship with adverse perinatal outcome. Data were collected using a semi-structured questionnaire. Relevant statistical analyses were done using SPSS v.21. **Results:** The mean age was found 29.71 ± 4.8 years with a range from 21 to 40 years. Most (96.8%) of the subjects had diabetes mellitus and only 32.3% had hypertension. Diastolic flow of the uterine arteries was reduced in 45.16% subjects and 32.3% had diastolic notch. Majority (64.3%) of the babies of the respondents with decreased diastolic flow developed fetal growth retardation (FGR) and fetal distress (57.1%) and 85.7% babies needed neonatal intensive care unit (NICU) admission. Majority of the respondents with diastolic notch also developed FGR (60.0%) and 80.0% babies needed NICU admission. All these findings were statistically significant ($p < 0.05$). **Conclusion:** Abnormal uterine artery Doppler velocimetry findings in 2nd trimester of pregnancy may predict adverse perinatal outcome.

Keywords: Doppler velocimetry; Uterine artery; UADV; Perinatal outcome.

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Introduction

The smooth muscle walls of radial and spiral artery, the major continuation of the uterine artery, are invaded by trophoblastic cells during pregnancy and become large-caliber vessels. For

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successful placental implantation and normal placental function, this physiological transformation of uteroplacental spiral arteries or spiral artery remodeling is critical. This process commences in the first and ends in early second trimester.^{1,2} Proper placentation is very much crucial for a normal pregnancy outcome. The complications of impaired placentation are significant contributors to maternal and perinatal morbidity and mortality.² There is failure of trophoblast invasion of the uterine vasculature in pregnancies subsequently complicated by preeclampsia, intrauterine fetal growth restriction and preterm birth. Doppler flow studies of the maternal uterine vessels can detect any pathological increase in placental vascular resistance, and this could offer the potential to detect women at risk for such complications.³

The majority of researches has centered on an elevation in the resistance index (RI) or pulsatility index (PI), or the persistence of a uterine artery diastolic notch to detect the presence of increased uteroplacental vascular resistance.³ Recent studies of the entire pathophysiology of the abnormal implantation proved association between the impaired placental performance and the reduced uteroplacental circulation.⁴ Assessment of placental circulation by Doppler velocimetry is performed in the second trimester between 18th and 24th weeks of pregnancy, when it is expected that the physiologic process would have been completed.²⁻¹¹ The effect of abnormal trophoblastic invasion is derived from studies on the uterine artery, because the uterine artery provides a good representation of the sum of resistances of the placental bed and of the placental perfusion.^{12,13} Doppler flow studies of the 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.¹³

A large number of researches have investigated the potentials of second trimester uterine artery Doppler studies as a screening tool for these

complications and concluded that Doppler examination of uterine blood flow may provide the early recognition of high-risk pregnancies complicated by maternal hypertension and fetal intrauterine growth retardation.⁴⁻⁷ The use of Doppler ultrasound to assess umbilical blood flow in women with high-risk pregnancies has been shown to prevent perinatal deaths.¹⁴ If we can identify the 'at-risk' fetus with the use of a Doppler, appropriate clinical interventions can be applied and it may result in reduced perinatal morbidity and mortality, and unnecessary obstetric interventions can be avoided. Therefore, this study was carried for the prediction of adverse perinatal outcomes.

Materials and method

Study design

This prospective observational study was conducted on pregnant women in their second trimester attending the antenatal checkup in the outpatient and inpatient departments of the department of Obstetrics and Gynaecology, BIRDEM General Hospital (Women and Children), Segunbagicha, Dhaka, Bangladesh, from July 2021 to December 2021. Informed written consent was taken from those who agreed to participate in the study. A total of 31 pregnant women during their 18 to 24 weeks of pregnancy were enrolled purposively. The inclusion criteria of the study population were women with singleton pregnancy during their 18 to 24 weeks of gestation. Exclusion criteria included multiple pregnancy, pregnant women with chronic liver disease, heart disease, chronic renal disease and connective tissue disorder. Doppler velocimetry of the maternal uterine arteries was done in all the selected patients. The participants were examined for variables including (a) independent variables (findings of uterine artery velocimetry at 18 to 24 weeks of pregnancy), (b) dependent variables (mode of delivery, indications for Cesarean section, frequency of ante natal care, perinatal

outcome such as average for gestational age, small for gestational age, intrauterine death, APGAR score of neonates at 1st min and at 5th min, mean birth weight, mean gestational age, postnatal death), and (c) confounding variables or demographic variables (age, parity, educational status, occupation, socioeconomic status, residence).

Data collection

Data were collected from the patients on variables of interest using the semi-structured questionnaire designed for interview.

Statistical analysis

Collected data were analyzed and compared using SPSS software version 21.0 for Windows. For qualitative variables, distribution was expressed in frequency and percentage. Chi-square tests were done to determine the association between maternal abnormal Doppler findings and adverse perinatal outcome. The strength of association was determined by estimating the odds ratio (OR) and their 95% confidence interval (CI). A p value of <0.05 was considered as significant.

Results

The socio-demographic characteristics of the study population are presented in Table I. A slightly higher proportion of the participatory women belonged to the 30 years and above age group. The mean age was found 29.71 ± 4.8 years with a range from 21 to 40 years.

Table I: Socio-demographic characteristics of study population (N=31)

Age (in year)	Number of subjects (%)	Mean \pm SD	Range
<30	15 (48.4)	29.71 ± 4.8	21-40
>30	16 (51.6)		

Most (96.8%) of the subjects had diabetes mellitus (DM) and 32.3% subjects had hypertension (HTN). Figure 1 shows the Doppler velocimetry findings of the study subjects where 45.2% had reduced diastolic flow and 32.3% subjects had diastolic notch.

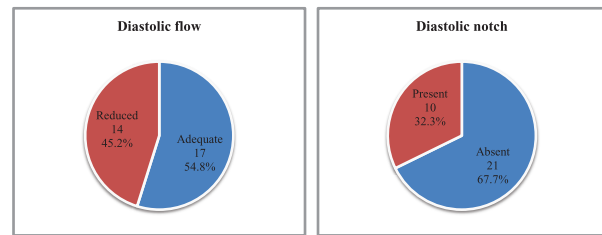


Fig. 1: Uterine artery Doppler velocimetry findings of the study subjects

Table II shows the development of perinatal adverse outcome among the study subjects and it was observed that majority needed NICU admission (45.2%) followed by development of fetal growth restriction (FGR) (32.3%), fetal distress (32.3%) and still birth (3.2%).

Table II: Development of fetal adverse outcome among the study subjects (N=31)

Perinatal outcome	Frequency	Percentage (%)
Fetal growth restriction (FGR)	10	32.3
Fetal distress	10	32.3
Neonatal ICU (NICU) admission	14	45.2
Still birth	1	3.2

Among the 14 study subjects with reduced uterine artery Doppler flow, 13(92.9%) and all of the subjects with a diastolic notch experienced adverse perinatal outcome. A significant difference was observed in regards of perinatal outcome where majority of the patients with abnormal Doppler findings had adverse outcome ($p \leq 0.001$). (Table III)

Table III: Comparison of Doppler findings with perinatal outcome (N=31)

Diastolic flow	Perinatal outcome		p-value
	Adverse outcome	Normal outcome	
Reduced (n=14)	13(92.9%)	01(7.1%)	<0.001 ^a
Adequate (n=17)	04(23.5%)	13 (76.5%)	
Diastolic notch			
Present (n=10)	10(100.0%)	00(0.0%)	<0.001 ^a
Absent (n=21)	07(33.3%)	14(66.7%)	

a = Statistically significant

Babies of most of the respondents with decreased diastolic flow needed NICU admission (85.7%),

and developed FGR (64.3%) and fetal distress (57.1%) and these findings were statistically significant ($p<0.05$). (Table IV)

Table IV: Comparison of diastolic flow with perinatal outcome

Outcome of baby	Diastolic flow		p-value
	Reduced (n=14)	Adequate (n=17)	
FGR			
Yes	9(64.3%)	01(5.9%)	0.001 ^a
No	5(35.7%)	16(94.1%)	
Fetal distress			
Yes	8(57.1%)	02(11.8%)	0.007 ^a
No	6(42.9%)	15(88.2%)	
NICU admission			
Yes	12(85.7%)	2(11.8%)	<0.001 ^a
No	2(14.3%)	15(88.2%)	
Still birth			
Yes	00(0.0%)	1(5.9%)	1.000 ^a
No	14(100.0%)	16(94.1%)	

FGR=Fetal growth restriction

a = Statistically significant

Babies of most of the respondents with diastolic notch needed NICU admission (80.0%) and developed FGR (60.0%) and these findings were statistically significant ($p<0.05$). (Table V)

Table V: Comparison of diastolic notch with perinatal outcome

Outcome of baby	Diastolic notch		p-value
	Present (n=10)	Absent (n=21)	
FGR			
Yes	6(60.0%)	4(19.0%)	0.023 ^a
No	4(40.0%)	17(81.0%)	
Fetal distress			
Yes	5(50.0%)	5(23.80%)	0.007 ^a
No	5(50.0%)	16(76.2%)	
NICU admission			
Yes	8(80.07%)	6(28.68%)	<0.001 ^a
No	2(20.0%)	15(71.4%)	
Still birth			
Yes	1(10.0%)	00(00.0%)	1.000 ^a
No	9(90.0%)	21(100.0%)	

FGR= Fetal growth restriction

a = Statistically significant

Discussion

This prospective observational study was carried out to predict the probability of developing adverse perinatal outcome in relation with normal and abnormal Doppler velocimetry of uterine artery at 2nd trimester of pregnancy. In this study, the mean age of the study subjects was found 29.71 ± 4.8 years with a range from 21 to 40 years. Akbari et al. found the mean age was 25.46 ± 3.5 years and in another similar study the mean age was found 23.4 ± 3.4 years.¹⁵ Uterine artery diastolic flow was reduced in 45.2% of the subjects and 32.3% had uterine artery diastolic notch on Doppler velocimetry. Majority of the babies with adverse outcome needed NICU admission (45.2%) followed by development of FGR (32.3%), fetal distress (32.3%) and still birth (3.2%). The development of adverse perinatal outcome was statistically significant in patients with abnormal uterine artery Doppler velocimetry findings ($p\leq 0.001$).

In this study most of the respondents with decreased diastolic flow needed NICU admission (85.7%), and developed FGR (64.3%) and Fetal distress (57.1%) and these findings were statistically significant ($p<0.05$). Most of the respondents with diastolic notch needed NICU admission (80.0%) and developed FGR (60.0%) and these findings were statistically significant ($p<0.05$). In a study by Ghosh and Gudmundsson, they showed a statistically significant correlation for adverse outcome of pregnancy with abnormal uterine artery Doppler findings and concluded that uterine artery Doppler in the surveillance of growth-restricted fetuses might detect a group of pregnancies at high risk.¹⁶

Kurdi et al. noted the presence or absence of uterine artery notching and resistance index (RI). They concluded that women with high resistance in both uterine arteries or bilateral notches have an increased risk of the subsequent development of complications like preeclampsia, FGR, abruption and stillbirth.⁸ Todros et al. studied the S/D ratios

of the uterine and umbilical arteries at 19 to 24 weeks and concluded that Doppler examinations of the uterine and umbilical arteries at mid pregnancy can detect the severe forms of pregnancy-induced hypertension and small for gestational age fetuses.⁹ In a prospective cross-sectional trial by Zimmermann et al.¹¹, FGR was found in 58.3% patients with abnormal uterine artery waveforms, compared to 8.3% if Doppler results were normal. In another study, Coleman et al. concluded that in high-risk women, uterine artery Doppler waveform analysis performed best in the prediction of severe adverse outcome and was better than clinical risk assessment in the prediction of FGR babies.¹⁷

Conclusion

Though an effective intervention to avoid complications has not been identified for high risk women with an abnormal uterine artery Doppler study, the patient with a negative study could then undergo fewer evaluations during the pregnancy, with a reduction in health care costs and time lost. On the other hand, abnormal uterine artery Doppler studies could lead to increased surveillance like earlier and more frequent assessment of fetal growth and maternal clinical condition and interventions that might improve clinical outcomes.

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