

Uterine artery Doppler screening in 18 to 24 weeks of pregnancy for prediction of adverse maternal outcome

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ABSTRACT

Background: Uterine artery Doppler velocimetry (UADV) analysis has been extensively studied in the second trimester of pregnancy as a predictive investigation for the future development of adverse fetomaternal outcome. This study was designed to assess the association between findings of uterine artery Doppler velocimetry with maternal outcome.

Methods: This was a prospective observational study among the pregnant women attending the inpatient and outpatient departments of Obstetrics and Gynecology, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Segunbagicha, Dhaka, 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. After obtaining informed written consent, data were collected from patients on variables of interest using a semi-structured questionnaire. All the respondents underwent uterine artery Doppler velocimetry at 18 to and 24 weeks of gestation and were followed up to observe its relationship with fetomaternal outcome. Descriptive and inferential analyses were done using SPSS v.21.

Results: More than half (51.6%) of the subjects belonged to 30 years and above. The mean age was found 29.71 ± 4.8 years with ranged from 21 to 40 years. Most (96.8%) of the subjects had diabetes mellitus and only 32.3% subjects had hypertension. More than half (54.8%) had adequate diastolic flow and 32.3% subjects had diastolic notch. Majority (64.3%) of the respondents with decreased diastolic flow had preeclampsia. Majority (70.0%) of the respondents with diastolic notch also developed preeclampsia. All these findings were statistically significant ($p < 0.05$).

Conclusion: In conclusion, pregnant women who have normal UADV finding at their 2nd trimester possess less chance of development of adverse maternal outcome.

Key words: Preeclampsia, UADV, pregnancy induced hypertension

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INTRODUCTION

Doppler ultrasound has been used in almost every medical discipline to study blood flow in diseases where an alteration of this dynamic system is anticipated. The first Doppler ultrasound report using continuous-wave assessment of umbilical artery flow was published in 1977.¹ Doppler flow studies of maternal and fetal arteries have been included as a technique for evaluating the physiology of the maternal-fetal unit. The relationship between abnormal uterine artery Doppler velocimetry and adverse pregnancy outcomes is well established. Maternal hypertensive disorders are often associated with inadequate blood supply to the placenta.² An increased risk of maternal and fetal complications has

been reported in women showing an increased resistance in the uterine arteries. Abnormal uterine artery Doppler findings also have shown a significant correlation with the risk of adverse perinatal outcomes such as small for gestational age and admission to Neonatal Intensive Care Units (NICU).³

An estimated 2.6 million stillbirths occur every year worldwide, 98% of which occur in low- and middle-income countries (LMICs). Nearly 20% pregnancies in low- and middle-income countries are complicated with small-for-gestational-age, many of whom are growth restricted. Intrauterine growth restriction (IUGR) describes a pathological inhibition of fetal growth that prevents the fetus from attaining its growth potential. It is a well-established risk factor for stillbirth, and can increase the risk of stillbirth by up to eightfold. IUGR is also associated with higher rates of neonatal death, perinatal morbidity and non-communicable diseases (such as diabetes) into adulthood. Placental insufficiency is the leading cause of IUGR, mostly due to poor utero-placental blood flow, placental thrombi and infarctions. Despite the high prevalence of IUGR in many LMICs, it is often not detected during routine antenatal care.⁴

Pregnancies that are destined to result in normal term deliveries show increased diastolic blood flow velocity and loss of the early diastolic notch by 22 weeks of gestation, while pregnancies that show persistent high resistance waveforms with early diastolic notches are at risk of preterm delivery, due to pre-eclampsia, abruption, and intrauterine growth restriction (IUGR). It must be presumed that a reduction in uteroplacental blood flow alone, does not result in placental insufficiency, and therefore, does not necessarily trigger pre-eclampsia or reduce fetal growth. Women whose uterine artery blood flow has failed to modify by 20 weeks, represent one of the highest risk groups in pregnancy, particularly for the development of preterm delivery, IUGR, and early onset of pregnancy induced hypertension, pre-eclampsia. Perhaps, the potential for stratifying care is the greatest benefit of mid-trimester uterine artery Doppler screening.⁵ Udenze et al., has demonstrated that changes occur in the maternal circulation as early as the first trimester in women who develop pre-eclampsia, IUGR or FGR, IUD, still birth, and NICU admission of the newborn baby.⁶ Second trimester uterine artery pulsatility index (PI) may add

more information to the prediction process of pre-eclampsia.⁵

Doppler ultrasound can be used during pregnancy to detect blood flow within the blood vessels of the umbilical cord as a proxy measure of placental function. When blood flow is absent (i.e. absent end diastolic flow, AEDF) or reversed (i.e. reverse end diastolic flow, REDF), urgent referral for specialist care is needed to prevent a perinatal death. The use of Doppler ultrasound to assess umbilical blood flow in women with high-risk pregnancies has been shown to prevent perinatal deaths.⁴ If we can identify the 'at-risk' fetus with the use of a Doppler and apply clinical interventions, it may result in reduced perinatal deaths and unnecessary obstetric interventions. Therefore, this study was carried out for the prediction of adverse pregnancy outcomes using Doppler study of uterine artery.

METHODS

Study design

This prospective observational study was conducted on pregnant women in their second trimester attending for antenatal checkup in the outpatient and inpatient departments of the Department of Obstetrics and Gynecology, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Segunbagicha, Dhaka from July 2021 to December 2021. The purpose and procedure of the study were discussed, and 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 upon fulfilling the inclusion and exclusion criteria. Enrolled patients were followed up to their delivery of baby and maternal and fetal outcomes were noted. Proper antenatal check-up was given to the study population. The inclusion criteria of the study population were women with singleton pregnancy during their 18 to 24 weeks of gestation. Along with their scheduled routine congenital anomaly scan, Doppler velocimetry of both the uterine arteries was performed in all the study subjects. Exclusion criteria included multiple pregnancies, pregnant women with chronic liver disease, heart disease, chronic renal disease and connective tissue disorder. Purposive random sampling was done. Abnormal uterine artery Doppler flow velocimetry is defined as a mean pulsatility index (PI) of more than 1.45 or/and the presence of bilateral

early diastolic notches.⁵ The participants were examined for various 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 LUCS, frequency of ANC, perinatal outcome such as AGA, SGA, IUD, APGAR score of neonates at 1st min and at 5th min, mean birth weight, mean gestational age, postnatal death), (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, observation, clinical examination, antenatal checkup records and reports of Doppler uterine artery ultrasound in the second trimester of pregnancy. Blood pressure and participants’ height-weight were measured and recorded in the checklist.

Statistical analysis

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

RESULTS

A total of 31 cases were enrolled in this study. Table I demonstrates the socio-demographic characteristics of the study population where the majority of the participatory women belonged to the 30 years and above of age group. The mean age was found 29.71±4.8 years with range from 21 to 40 years. It was observed that more than half (51.6%) of the subjects belonged to 30 years and above. Most (96.8%) of the subjects had diabetes mellitus and only 32.3% subjects had hypertension.

Table I. Socio-demographic characteristics and medical condition of study population

Age (In year)	Number of subjects N (%)	Mean ±SD	Range (min, max)
<30	15 (48.4)	29.71±4.8	21-40
≥30	16 (51.6)		
Presence of diabetes mellitus			
Yes	30 (96.8)		
No	1 (3.8)		
Presence of hypertension			
Yes	10 (32.3)		
No	21 (67.7)		

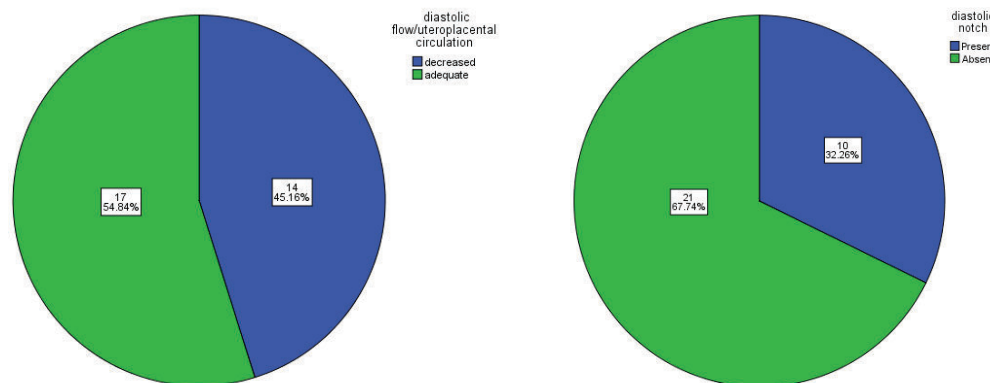


Figure 1. Doppler findings of the study subjects

Doppler findings of the study subjects revealed that more than half (54.8%) had adequate diastolic flow. It was also observed that only 32.3% subjects had diastolic notch.

Table II shows the development of maternal and fetal adverse outcome among the study subjects and it was observed that more than half (54.8%) of the respondents had adverse pregnancy outcome. In regards of pregnancy outcome of mother majority (67.7%) had pregnancy induced hypertension followed by preeclampsia (32.3%) and preterm Delivery (9.7%).

Table III shows the comparison of Doppler findings with pregnancy outcome of mother. A significant difference was observed in regards of maternal outcome with Doppler findings where majority with abnormal Doppler findings had adverse maternal outcome ($p < 0.05$). Majority (64.3%) of the respondents with preeclampsia had decreased diastolic flow. This finding was

statistically significant ($p < 0.05$). (Table IV). Majority (70.0%) of the respondents with preeclampsia had diastolic notch. This finding was statistically significant ($p < 0.05$). (Table V)

Table II. Development of maternal adverse outcome among the study subjects

Pregnancy outcome	Frequency	Percentage
	(N)	(%)
Normal	14	45.2
Adverse	17	54.8
Pregnancy outcome of mother		
Preterm Delivery	03	9.7
Preeclampsia	10	32.3
Pregnancy induced hypertension	21	67.7

Table III. Comparison of Doppler findings with development of pregnancy outcome of mother

Diastolic flow	Maternal outcome		p-value
	Adverse outcome	Normal outcome	
Decreased	12 (70.6)	2 (14.3)	0.002 ^a
Adequate	05 (29.4)	12 (85.7)	
Diastolic notch			
Present	9 (52.9)	1 (7.1)	0.007 ^a
Absent	8 (47.1)	13 (92.9)	

Table IV. Comparison of diastolic flow with development of pregnancy outcome

Maternal outcome	Diastolic flow		p-value
	Decreased	Adequate	
Preterm delivery			
Yes	02 (14.3)	01 (5.9)	0.576 ^a
No	12 (85.7)	16 (94.1)	
Preeclampsia			
Yes	09 (64.3)	01 (5.9)	0.001 ^a
No	05 (35.7)	16 (94.1)	
Pregnancy induced hypertension			
Yes	01 (7.1)	03 (17.6)	0.385 ^a
No	13 (92.9)	14 (82.4)	

Table V. Comparison of diastolic notch with development of pregnancy outcome

Maternal outcome	Diastolic notch		p-value
	Present	Absent	
Preterm delivery			
Yes	01(10.0)	02 (9.5)	0.100 ^a
No	09(90.0)	19(90.5)	
Preeclampsia			
Yes	07(70.0)	03 (14.3)	0.002 ^a
No	03(30.0)	18 (85.7)	
Pregnancy induced hypertension			
Yes	01(10.0)	03 (14.3)	0.100 ^a
No	09(90.0)	18 (85.7)	

DISCUSSION

This prospective observational study was carried out to predict the probability of developing adverse pregnancy outcome of mother and fetus in relation with normal and abnormal Doppler velocimetry of uterine artery at 2nd trimester of pregnancy. Based on the results of this study, the mean age was found 29.71±4.8 years with range from 21 to 40 years. Similarly, in our country Akbari et al. found the mean age was 25.46±3.5 years.⁷ Most (96.8%) of the subjects had diabetes mellitus and only 3 2.3% subjects had hypertension. More than half (54.8%) of the study subjects had adequate diastolic flow. It was also observed that only 32.3% subjects had diastolic notch. More than half (54.8%) of the respondents had adverse pregnancy outcome. In regards of pregnancy outcome of mother majority (67.7%) developed pregnancy induced hypertension followed by preeclampsia (32.3%) and preterm delivery (9.7%). A significant difference was observed in regards of maternal outcome with Doppler findings where majority with abnormal Doppler findings had adverse maternal outcome ($p < 0.05$). A similar study supports these findings where the mean age was found 23.4±3.4 years with range from 18 to 33 years. 12(12.4%) patients had diastolic notch in 2nd UADV.⁸

In this study, majority (64.3%) of the respondents with preeclampsia had decreased diastolic flow. In a study Yeasmin and Uddin showed that an elevated uterine resistance index and a uterine artery notch both were associated with increased relative risk of pre-eclampsia.⁹

Majority (70.0%) of the respondents with preeclampsia had diastolic notch. A similar study supports the findings where among 98 high-risk pregnant women, 61 (62.2%) developed preeclampsia and 32 (32.8%) did not have preeclampsia. In the preeclampsia cases, 15 (24.5%) were mild and 46 (74.5%) were severe preeclampsia. The uterine artery PI was significantly associated with preeclampsia. A unit increase in uterine PI in high-risk pregnancies, increases the odd of preeclampsia by 37.3 times. More caesarean section (48.4%) and 69.2% of 45 pre-term deliveries occurred in women with severe preeclampsia. The findings from this study show significantly lower uterine and umbilical arteries PSV and EDV but higher RI, PI and S/D in cases that developed preeclampsia. The uterine artery PI is the best predictor of preeclampsia, whereas the combinations of uterine and umbilical arteries PSV best predict severity of PE among high-risk pregnant Nigerian women.¹⁰ In another study Ghosh and Gudmundsson showed a statistically significant correlation for adverse outcome of pregnancy with abnormal uterine artery Doppler and they suggested that uterine artery Doppler in the surveillance of growth-restricted fetuses might detect a group of pregnancies at high risk.¹¹

Limitation of current study is that it was conducted within a short period of time in a selected tertiary level hospital, and study subjects were selected non-randomly with relatively small sample size.

Conclusion

This study was undertaken to predict the future probability of developing preterm delivery, pre-eclampsia and pregnancy induced hypertension in relation with normal and abnormal Doppler velocimetry of uterine artery at 2nd trimester of pregnancy. The pregnant women who have normal Doppler finding at their 2nd trimester possess less chance of development of adverse maternal outcome. Therefore, it is recommended that uterine artery Doppler velocimetry in early pregnancy can be a good investigating tool for prediction of subsequent development of adverse maternal outcome. Further multi-centric study with a larger sample size could be done to determine the validity of the findings of the present study.

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REFERENCES

- Maulik D, Mundy D, Heitmann E, Maulik D. Evidence-based approach to umbilical artery Doppler fetal surveillance in high-risk pregnancies: an update. *Clinical obstetrics and gynecology*. 2010;53(4):869-78.
- Barbieri C. Doppler ultrasound in high risk pregnancies. Department of ObstetGynecol of the Center for Integral Attention to Women's Health.
- Ghi T, Youssef A, Piva M, Contro E, Segata M, Guasina F, et al. The prognostic role of uterine artery Doppler studies in patients with late-onset preeclampsia. *American journal of obstetrics and gynecology*. 2009;201(1):36. e1-. e5.
- Vogel JP, Vannevel V, Robbers G, Gwako G, Lavin T, Adanikin A, et al. Prevalence of abnormal umbilical arterial flow on Doppler ultrasound in low-risk and unselected pregnant women: a systematic review. *Reproductive health*. 2021;18(1):1-7.
- Toal M, Keating S, Machin G, Dodd J, Adamson SL, Windrim RC, et al. Determinants of adverse perinatal outcome in high-risk women with abnormal uterine artery Doppler images. *American journal of obstetrics and gynecology*. 2008;198(3):330. e1-. e7.
- Udenze I, Arikawe A, Makwe C, Olowoselu O. A prospective cohort study on the clinical utility of second trimester mean arterial blood pressure in the prediction of late-onset preeclampsia among Nigerian women. *Nigerian Journal of Clinical Practice*. 2017;20(6):741-5.
- Akbari S, Vahabi S, Khaksarian M. A study of β -human chorionic gonadotropin level in preeclamptic and normotensive pregnant women. *Research Journal of Biological Sciences*. 2009;4(4):468-71.
- Mariana N, Chowdhury T, Choudhury T. Uterine Artery Doppler Screening in 2nd Trimester of Pregnancy for Prediction of Pre-eclampsia and Fetal Growth Restriction. *Journal of Advances in Medicine and Medical Research*. 2020;20:7-22.
- Yeasmin S, Uddin MJ. Determination of Risk Factors for Pre-Eclampsia in aTertiary Hospital of Bangladesh. *ChattagramMaa-O-Shishu Hospital Medical College Journal*. 2017;16(1):29-32.
- Adekanmi AJ, Roberts A, Akinmoladun JA, Adeyinka AO. Uterine and umbilical artery doppler in women with pre-eclampsia and their pregnancy outcomes. *Nigerian Postgraduate Medical Journal*. 2019;26(2):106.
- Ghosh GS, Gudmundsson S. Uterine and umbilical artery Doppler are comparable in predicting perinatal outcome of growth restricted fetuses. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2009;116(3):424-30.