

Doppler Velocimetry In Normal And Hypertensive Pregnancy

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Abstract

Objectives: This study was conducted to find doppler velocimetric indices of the uterine and umbilical artery in normotensive and hypertensive pregnancy and to detect SGA fetuses with abnormal velocimetric index. **Study design:** Two hundred women of third trimester in antenatal clinic were studied: hypertensive and normotensive 100 each. Baseline investigations and doppler velocimetry of both the uterine arteries and umbilical artery was done. Statistical analysis of data was done using the EPI-info 6 (CDC (US) / WHO). **Result:** The mean SD ratio of Uterine Artery decreased from 6.15 at 32-34 weeks to 3.06 at 38-40 weeks in the hypertensive group. Abnormal uterine artery doppler findings were reported in 55% of hypertensives. In the hypertensive group 92.10% of cases with SGA babies and 32.25% of cases with AGA babies had abnormal uterine artery Doppler findings. **Conclusion:** Abnormal doppler findings of the uterine and umbilical are more common in SGA fetuses.

INTRODUCTION

The essence of the capacity of a pregnancy to develop normally is that there should be adequate supply of nutrients and oxygen. The principal supply lines are the uterine and umbilical arteries. The utero-placental blood flow has been found to be decreased in hypertensive pregnancies and fetal growth restriction (1), where instead of the low resistance and high flow state which is seen in normal pregnancies, there is decreased umbilical and uterine blood flow (2).

In antenatal period these small babies can be identified on clinical examination and ultrasonography, but the normal small fetus cannot be distinguished from the compromised small fetus. The Doppler Velocimetry has become an important tool in the evaluation and management of high-risk pregnancies. The umbilical and uterine Doppler abnormalities have been documented in pregnancy complicated by hypertension and fetal growth restriction (3,4). As it can detect abnormal fetoplacental circulation, it can be used to differentiate between normal and compromised small fetuses that are at risk of adverse perinatal outcome (5).

The study was conducted with the aims and objectives to study the doppler velocimetric indices of the uterine and umbilical artery in normotensive and hypertensive pregnancy in the third trimester; to detect the number of

small for gestational age fetuses with abnormal velocimetric study in each group & correlate the relation of birth weight and Doppler velocimetric findings with perinatal outcome in both the groups.

MATERIAL AND METHODS

The present study was conducted in the Department of Obstetrics and Gynaecology, in collaboration with the Department of Radiology of Mahatma Gandhi Institute of Medical Sciences, Sevagram. A total of 200 cases from the women attending the antenatal outpatient department were included in the study of which 100 were hypertensive and 100 normotensive. All the women had a singleton pregnancy of >32 weeks gestation and vertex presentation and did not have any history of medical disorder. Both primigravida and multigravida were selected for the study. Among the hypertensive group the women who had recorded blood pressure of >140 / 90 on two or more occasions six hours apart after adequate rest were selected. Baseline investigations and Doppler velocimetry of both the uterine arteries and umbilical artery was performed in both the groups. The patients were followed up till delivery. The perinatal outcome were noted and compared with the results of the Doppler velocimetry.

EQUIPMENT

The GE, LOGIC 500 MD, MR3 Colour Doppler machine

was used to conduct the Doppler velocimetric study with the probe frequency of 3-5 MHz. The wall filter was kept at a minimum and the images were recorded on an online computer.

The peak systolic velocity (Vs) and end diastolic velocity (Vd) was measured. From these the Systolic diastolic (SD) ratio Resistance Index (RI) and Pulsatility Index (PI) were recorded using the following formulae.

$$SD \text{ ratio} = (Vs) / (Vd)$$

$$RI = (Vs) - (Vd) / (Vs)$$

$$PI = (Vs) - (Vd) / \text{Mean Velocity}$$

Statistical analysis of data was done using the EPI-info 6 (CDC (US) / WHO). Where ever appropriate the Chi2 test and Fishers Exact Test were used.

OBSERVATIONS

The mean age in hypertensive was 23.53 years and in normotensive was 23.61 years. The mean gestation age in hypertensive group was 37.26 weeks and in normotensive group was 37.72 weeks.

The mean values of Uterine Artery Doppler Velocimetric Indices i.e. S/D ratio, RI and PI were higher in the hypertensive cases than normotensive cases of the same gestational age. The values in both the groups gradually decreased with increase in the gestational age. The mean SD ratio decreased from 6.15 at 32-34 weeks to 3.06 at 38-40 weeks in the hypertensive group and from 2.04 at 32-34 weeks to 1.64 at 38-40 weeks in the normotensive group. The difference in the values of the indices in the hypertensive and normotensive group was very significant at 38-40 weeks gestation (p value of SD ratio = 0.0000, p value of RI = 0.000, p value of PI =0.0000).

The mean values of Umbilical Artery Doppler Velocimetric Indices were higher in hypertensive than in normotensive group of the same gestation. The values in both the groups gradually decreased with increase in gestation. The mean SD ratio decreased from 4.74 at 32-34 weeks to 3.09 at 38-40 weeks in the hypertensive group and from 2.92 at 32-34 weeks to 2.23 at 38-40 weeks in the normotensive group. The difference between the values was significant at 35-37 weeks (p value SD ratio = 0.021, p value of RI = 0.005, p value of PI = 0.009) and at 38 – 40 weeks (p value SD ratio = 0.0000, p value of RI = 0.000 and p value of PI = 0.000) (Table 1).

Figure 1

Table 1. Mean values of Doppler Indices of Umbilical Artery

Gestation (Weeks)	Hypertensive			Normotensive		
	S/D	RI	PI	S/D	RI	PI
32-34	4.74 ± 1.78	0.94 ± 0.26	2.0 ± 0.82	2.92 ± 0.06	0.65 ± 0.02	1.1 ± 0.14
35-37	3.54 ± 0.97	0.78 ± 0.12	1.27 ± 0.32	2.36 ± 0.09	0.56 ± 0.03	0.77 ± 0.05
38-40	3.09 ± 0.76	0.72 ± 0.11	0.99 ± 0.23	2.23 ± 0.13	0.55 ± 0.02	0.74 ± 0.06

Abnormal uterine artery doppler findings were reported in 55% hypertensive and 4% normotensive cases ; abnormal umbilical artery doppler waveforms were found in higher number of hypertensive as compared to normotensive cases (39% vs. 19%)(Table 2).

Relationship between Perinatal Outcome, Birth Weight and Doppler study in Hypertensive group is shown in Table 3. In the hypertensive cases, abnormal uterine Doppler findings were present in all cases of IUD and

Figure 2

Table 2 Uterine Artery & Umbilical; Artery Doppler - subsequent Birth Weight

Ut. artery Doppler findings	Hypertensive				Normotensive			
	SGA (%)	AGA (%)	Total (%)	p-value	SGA (%)	AGA (%)	Total (%)	p-value
Abnormal	35 (92.10)	20 (32.25)	55 (55)	0.000	4 (19)	0 (0)	4 (4)	0.001
Normal	3 (7.8)	42 (67.74)	45 (45)		17 (80.9)	79 (100)	96 (96)	
Total	38 (100)	62 (100)	100 (100)		21 (100)	79 (100)	100 (100)	
Umb. artery Doppler findings				0.000				0.000
Abnormal	26 (68.42)	13 (20.96)	39 (39)		13 (61.90)	6 (7.5)	19 (19)	
Normal	12 (31.5)	49 (79.13)	61 (61)		8 (38.08)	73 (92.42)	81 (81)	
Total	38 (100)	62 (100)	100 (100)		21 (100)	79 (100)	100 (100)	

Figures in parenthesis indicate percentage, both vertically and horizontally

NND and in (82.7%) cases of NICU admissions. Abnormal umbilical Doppler findings were seen in all cases of IUD, in 83.33% cases of NND and 55.1% cases of NICU admission.

Figure 3

Table 3. Perinatal Outcome, Birth Weight and Doppler study in Hypertensives

	Birth wt.	Uterine			Umbilical		
		N	Ab.	Total	N	Ab	Total
IUD	AGA	-	2 (25)	2 (25)	-	2 (25)	2 (25)
	SGA	-	6 (75)	6 (75)	-	6 (75)	6 (75)
Total		-	8 (100)	8 (100)	-	8 (100)	8 (100)
NND	AGA	-	3 (50)	3 (50)	1 (100)	2 (40)	3 (50)
	SGA	-	3 (50)	3 (50)	-	3 (60)	3 (50)
Total			6 (100)	6 (100)	1 (16.6)	5 (83.3)	6 (100)
NICU	AGA	4 (80)	9 (37.5)	13 (44.8)	8 (61.5)	5 (31.2)	13 (44.8)
	SGA	1 (20)	15 (62.5)	16 (55.1)	5 (38.4)	11 (68.7)	16 (55.1)
Total		5 (100) (17.2)	24 (100) (82.7)	29 (100) (100)	13 (100) (44.8)	16 (100) (55.1)	29 (100) (100)
Healthy	AGA	38 (95)	6 (35.2)	44 (77.1)	40 (85.1)	4 (40)	44 (77.1)
	SGA	2 (5)	11 (64)	13 (22.8)	7 (14.8)	6 (60)	13 (22.8)
Total		40 (100) (70.1)	17 (100) (29.8)	57 (100) (100)	47 (100) (82.4)	10 (100) (17.5)	57 (100) (100)

Figures in parenthesis indicate percentage, both vertically and horizontally

As more than one artery was studied the number of findings is more in each group.

Figure 4

Table 4 Perinatal Outcome, Birth Weight and Doppler study in Normotensive

Out Come	Birth wt.	Uterine			Umbilical		
		N	Ab.	Total	N	Ab	Total
NND	AGA	1 (25)	0	1 (20)	1 (100)	0	1 (20)
	SGA	3 (75)	1 (100)	4 (80)	0	4 (100)	4 (80)
tOTAL		4 (100) (80)	1 (100) (20)	5 (100) (100)	1 (100) (20)	4 (100) (80)	5 (100) (100)
NICU	AGA	2 (40)	0	2 (25)	1 (33.3)	1 (20)	2 (25)
	SGA	3 (60)	3 (100)	6 (75)	2 (66.6)	4 (80)	6 (75)
tOTAL		5 (100) (62.5)	3 (100) (37.5)	8 (100) (100)	3 (100) (37.5)	5 (100) (62.5)	8 (100) (100)
Healthy		76 (87.3)	0	76 (87.3)	71 (92.2)	5 (50)	76 (87.3)
	SGA	11 (12.6)	0	11 (12.6)	6 (7.7)	5 (50)	11 (12.6)
tOTAL		87 (100) (100)	0	87 (100) (100)	77 (100) (88.5)	10 (100) (11.4)	87 (100) (100)

Figures in parenthesis indicate percentage, both vertically and horizontally

As more than one artery was studied the number of findings is more in each group.

Relationship between Perinatal Outcome, Birth Weight and Doppler study in Normotensive group is depicted in Table 4. In the normotensive group 20% of the NND and 37.5% NICU admissions had abnormal uterine artery findings. Abnormal umbilical Doppler findings were seen in 80% of NND and 62.5% cases of NICU admission.

DISCUSSION

The total Obstetrics admissions during the study time were 9471. Of these, hypertensive disorders in pregnancy were found in 20.5% women.

The analysis of mean values of the Doppler indices of

uterine artery in relation to gestation showed that there is gradual decline in the values with advancing gestation. The mean values in the hypertensive group were higher than the normotensive group stressing the fact that there is increased uteroplacental resistance in this group. The mean SD ratio decreased from 6.15 to 3.06 in hypertensive and 2.04 to 1.64 in normotensive cases.

In normal pregnancy there is reduction the values of various Doppler indices due to the invasion of cytotrophoblast into the spiral arteries leading to the loss of the muscular component, dilatation and uncoiling of these ‘uteroplacental’ vessels. This results in progressive loss of vascular impedance and increase in end diastolic flow in later half of pregnancy (6). In pregnancies complicated by hypertension or fetal growth restriction this does not occur and therefore the Doppler indices are higher. Decrease in the diastolic flow in uterine arteries has been reported in hypertensive pregnancies (3). Schulman et al (7) reported progressive fall in the uterine artery S/D ratio from second trimester till term in normal pregnancy. However, Rajan (8) reported no decrease in SD ratio from 21-40 weeks. Saxena et al (9) reported decline in the values of Doppler indices with advancing gestation but the values were higher in hypertensive group than in normotensive group. They opined that due to abundant diastolic flow in normal pregnancy there is decrease in uterine SD ratio, which reflects the adequacy of uteroplacental circulation. A high ratio indicates that normal adaptation to pregnancy has not occurred, which is true in hypertensive cases. Our observations are with the findings of Saxena et al (9).

Stuart and Drumm (10) first reported a progressive fall in the values of Doppler indices of the Umbilical artery with increasing gestation, this decrease in the values with advancing gestation occurs due to decreased placental vascular resistance. This decrease does not occur in hypertensive pregnancies, which therefore have high values of Doppler indices (3). Similar findings have been reported by several authors (8,9,11,12). UA Doppler reflects disease severity but is not independently associated with neonatal outcome. The mean PI in UA was 1.210 Standard deviations higher in SGA group than normal two weeks before delivery(13).

Abnormal uterine artery Doppler findings were reported in 55% hypertensive and 4% normotensive cases. Trudinger et al (1985) reported 47.3% cases of abnormal uterine artery Doppler in the study of hypertensive cases. Saxena et al (9) in their study have reported 77% and 18% of abnormal

uterine Doppler findings in hypertensive and normotensive cases respectively. This number is higher than the present study. This difference could be due to less number of cases in their study.

In the present study abnormal umbilical artery Doppler waveforms were found in higher number of hypertensive as compared to normotensive cases (39% vs. 19%). Several other authors have reported the association of abnormal umbilical artery Doppler with high risk pregnancy (8, 9, and 12). The findings of the present study in hypertensive are more or less similar to Saxena et al (9).

Correlation of perinatal outcome birth weight and Doppler findings in hypertensive and normotensive group. Abnormal uterine artery Doppler findings were found in 55% hypertensive and 4% normotensive cases. In the hypertensive group 92.10% cases with SGA babies and 32.25% cases with AGA babies had abnormal uterine artery Doppler findings as compared to 19% cases with SGA babies in normotensive group. Abnormal umbilical artery Doppler findings were seen more in hypertensive than normotensive cases (39% vs. 19%). The abnormality in UA Doppler findings was found in 68.42% SGA babies in hypertensive and 61.9% SGA babies in normotensive group respectively (Table 2). Jain et al (14) noted adverse perinatal outcome in 70% considering UA Doppler alone in high risk pregnancy. The findings of the present study are more or less similar to those of Ducey et al and others (14, 15, 16,).

CONCLUSIONS

Abnormal Doppler findings of the uterine and umbilical are more common in SGA fetuses. While abnormal uterine and umbilical Doppler findings are more frequently seen in hypertensive cases, many normotensive cases also show abnormal umbilical Doppler. By detecting decreased uteroplacental and feto-placental blood flow it can identify a hypoxic fetus. Doppler velocimetric study is a valuable tool for evaluation of high risk pregnancies.

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