Role of Colour Doppler and Spectral Flow Analysis in Pregnancy Induced Hypertension

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Abstract

Background: The main purpose of providing antenatal care is to identify women at risk of complications as a result of impaired uteroplacental circulation such as Pregnancy induced hyper tension (PIH) and Preeclampsia.

Objective: To evaluate the role of Color Doppler in predicting the fetal outcome in cases of pregnancy induced hypertension (PIH).

Materials & Methods: A total of 60 cases of PIH with gestational age beyond 30 weeks were studied over a period of 12 months between April 2012 and March 2013 and subjected to color Doppler ultrasonography for studying uterine, umbilical & fetal middle cerebral arteries. We used S/D ratio of more than 2.6, RI more than 0.58, persistent early diastolic notch in uterine artery; S/D ratio of more than 3, RI more than 0.7, AEDV, REDV in umbilical artery; RI less than 0.7, PI less than 1.3 in middle cerebral artery were considered abnormal. The results were correlated with parameters of fetal outcome.

Results: In our study of 60 hypertensive cases 35(58%) had abnormal indices and the rest 25 (42%) cases were normal.   30 (85%) out of 35 abnormal cases had umbilical artery S/D ratio of more than 3.   Among abnormal cases, 26 babies (74%) had Apgar score <7 compared to 5 babies (20%) in normal cases (p<0.001). 22 babies (63%) with abnormal Doppler had NICU stay, out of which 14 (64%) had stay for more than 1 week. Out of six patients with AEDV, there were two still born, two neonatal deaths and another two recovered in NICU accounting to 66.6% mortality in AEDV cases.

Conclusion: Doppler velocimetry is a primary tool for fetomaternal surveilance and indispensable for the management of pregnancy induced hypertension patients. It helps to identify the fetuses at risk & predict perinatal morbidity &mortality.

Keywords: Pregnancy induced hypertension, color Doppler ultrasonography , perinatal outcome.

Introduction

Hypertension is one of the commonest medical complications during pregnancy and a leading cause of maternal and perinatal mortality. Hypertensive disorders complicate 5 to 10% of all pregnancies and form one member of the deadly triad of maternal mortality contributing to 16% of maternal mortality in developed countries. The main goals of prenatal testing are to identify fetuses at increased risk for perinatal morbidity & mortality. In general population two large prospective

studies failed to show significant improvement in neonatal performance associated with Doppler technology[1]. Among high risk patients several studies suggested a significant decrease in neonatal morbidity& mortality when Doppler evaluation was a part of fetal surveillance[2]. Hypertensive disorder of pregnancy is one of the most common complications that effect human pregnancy. It is one of the leading causes of maternal & fetal mortality & morbidity[3]. The principal problem in PIH is poor placental perfusion attributable to the abnormal implantation or underlying maternal vascular diseases. Reduced placental perfusion in PIH is thought to be result from failure of trophoblast to invade maternal spiral arteries in first half of the pregnancy lead to development of IUGR[4]. Doppler is useful in selecting the patients for induction and trial of labour, also helps in making decisions when to intervene without increasing fetal risk. This in its effect contributes to lowering maternal morbidity and also neonatal morbidity and lowers the incidence of caesarean sections and admission to NICU care, and incidence of prematurity. Among high risk patient, several studies suggested a significant decrease in neonatal morbidity and mortality when Doppler evaluation was a part of fetal surveillancce[5]. The purpose of our study was to assess the blood flow in uterine artery, umbilical artery and middle cerebral artery by using Doppler ultrasound in a group of pregnant women with PIH with reference to flow velocity wave form.

1. S/D ratio
2. Pulsatality index
3. Resistance index

And to evaluate the role of these blood indices in the prediction of adverse fetal outcome.

Methods:

This study was conducted on sixty patients with clinically diagnosed pregnancy induced hypertension in the department of obstetrics and gynaecology, at a tertiary care hospital during period of April 2012 to March 2013. The following were the inclusion and exclusion criteria.

Inclusion criteria:

1. Gestational age beyond 30 weeks
2. Singleton pregnancy

Exclusion criteria:

1. All patients of gestational age below 30 weeks
2. Multiple pregnancies
3. Medical diseases complicating pregnancy.

The first scan was performed in each case, as soon as patient was registered in order to avoid any influence of treatment on Doppler sonogram. The gestational age was confirmed by menstrual history and ultrasound examination and was followed by colour Doppler examination. Consent was taken from the patient or the guardian.

Procedure

The patient was explained about the non invasive / a traumatic nature of the procedure. Examination was performed with the patient in supine position with slight left lateral tilt. Synthetic ultra gel was applied liberally over the abdomen to get a good acoustic coupling. Initially routine scan was performed using 2D real time ultrasound with 3.5 MHZ convex sector transducer. Machine used in radiology department is ESOATE MEGAS GPS. Doppler wave form was obtained after localizing the vessels by B-mode real time scanner. Pulsed Doppler was used to get Doppler signals after localizing the vessels. The maximum Doppler shift frequencies were obtained and various ratios were calculated from each vessel. Doppler examination was done when the fetus was in apneic state to avoid the influence of fetal respiration on Doppler signals.

Identification of various arteries and their criteria:

1. **Uterine artery:** colour Doppler facilitates identification of uterine artery substantially. The uterine signals were obtained per abdomen by pointing the probe in the iliac fossa towards the lower para-cervical area. In the colour mode uterine artery is seen to cross the external iliac artery, just after its origin from the internal iliac artery and this point was taken as sampling point. S/D ratio more than 2.6, RI more than 0.58 and persistent early diastolic notch is considered abnormal.

2. **Umbilical artery:** Flow velocity wave forms from umbilical artery can be easily obtained, for this colour flow is not usually needed. Doppler signals can be acquired from different points in cord usually from mid portion of card. S/D ratio of umbilical artery more than 3, RI more than 0.7, presence of absent end diastolic velocity (AEDV) and reversal end diastolic velocity (REDV) were considered abnormal.

3. **Middle cerebral artery (MCA):** MCA was visualized in transverse axial view of fetal head at a slightly more caudal plane than the one used for BPD. PI less than 1.3 and RI less than 0.7 were considered abnormal.

The statistical chi-square test was done between Doppler study result and Outcome of pregnancy and percentage was used to discreet variable and continuous variable and mean of maternal age was calculated using MS Excel and online software.

Results

Hypothesis

H_0: All the new born babies born to pregnant women with PIH is Healthy

H_1: All the new born babies born to pregnant women with PIH is not healthy

Table 1: Doppler Study and Outcome of pregnancy.

Doppler	Healthy Baby born	Not healthy Baby born	Total
Abnormal	9	26	35
Normal	17	8	25
Total	26	34	60

The chi-square statistic is 10.6193. The p-value is 0.00119. This result is significant at p-value <0.05. There exist an association between Doppler result and outcome of pregnancy.

Result: The null hypothesis may be rejected and the alternate hypothesis can be accepted that all the new born babies born to pregnant women with PIH are not healthy since chi-square statistic is 10.6193 which is higher than the chi-square table value of 3.84 at (0.05) l.o.s. with d.f.=1. The p-value is 0.00119. The result was statistically significant at p-value is <0.05.

Table 2: Distribution of cases of Normal and Abnormal Doppler

Doppler	Number	Percentage
Normal	25	41.67
Abnormal	35	58.33
Total	60	100.0

The table 2 narrate that after studying three arteries, patients were classified in to normal and abnormal based on their colour Doppler indices. Normal was those with no abnormality in any of the arteries. Cases that had any of the following criteria were considered abnormal.

a) S/D ratio more than 2.6 or RI more than 0.58 of uterine artery.

b) Presence of persistent early diastolic notch in uterine artery.

c) S/D ratio of more than 3 or RI more than 0.7 of umbilical artery.

d) Presence of absent end diastolic velocity (AEDV) and reversed end diastolic velocity(REDV).

e) PI less than 1.3 and RI less than 0.7 of middle cerebral artery.

Table 3: Age distribution of cases

Age group (years)	No. of cases	Percentage
< 20	7	11.66
20-24	31	51.66
25-29	19	31.66
$\geq$ 30	3	5.02
Total	60	100.0

The table 3 shows that age group 20-24 years was the common group and the mean maternal age was 23.1 years.

Table 4: Cases with Doppler Abnormality

Parameters	S/D UA		S/D UT		Notch		ADEV	
	No.	%	No.	%	No.	%	No.	%
Abnormality Present	30	85.7	20	57.1	24	68.6	6	17.1
Abnormality Absent	5	14.3	15	42.9	11	31.4	29	82.9
Total	35	100	35	100	35	100	35	100

The table 4 shows the abnormality parameters that present and absent in S/D UA (umbilical artery) and in UT (uterine artery). Presence or absence of Notch and similarly it was in ADEV. It was seen that more than 50% cases with elevated S /D ratio in uterine artery and maximum number of cases (85.71%) were in abnormal umbilical artery S/D ratio. It also revealed that the number of cases with uterine artery notch was more than those without notch and 17% cases showed absent end diastolic velocity in umbilical artery.

Table 5: Resistance index of Uterine and Umbilical Artery

DOPPLER	RI (Uterine artery)	RI (Umbilical artery)
Normal	9 (25.72%)	12 (34.28%)
Abnormal	26 (74.28%)	23 (65.72%)
Total	35 (100%)	35 (100%)

The table 5 stated that the RI was 74.28% in abnormal uterine artery and it was 65.72% in abnormal umbilical artery.

Table 6: Sensitivity of various vessels studied

Parameters	No. of cases	Percentage
Uterine artery	24/35	68.57
Umbilical artery	30/35	85.71
Fetal MCA	15/35	42.85

The table 6 shows the sensitivity of various parameters studied. It revealed that Doppler study of umbilical artery was most sensitivity of all vessels under study.

Table 7: Doppler study and Peri natal Outcome

Doppler	Healthy Baby		NICU		Stillbirth		Total	
	No.	%	No.	%	No.	%	No.	%
Abnormal	9	25.7	22	62.9	4	11.4	35	58.33
Normal	17	68.0	8	32.0	0	0	25	41.67
Total	26	43.34	30	50.0	4	6.6	60	100.0

The table 7 shows that Doppler study and perinatal outcome. It shows that babies of 22 (63%) with abnormal Doppler indices had NICU stay and 4 babies (11.4%) were still born, which indicates adverse perinatal outcome

with abnormal Doppler compared to normal Doppler. It was also noted that 32% of the babies born to cases with normal Doppler indices had NICU stay.

Table 8: Perinatal Mortality wise Distribution of cases

Perinatal Outcome	Abnormal	Normal
Still born	4	0
Neo natal death	4	0
Total	8	0

The table 8 shows that there were 8 perinatal deaths in abnormal Doppler indices group, out of which 4 were still born and another 4 were neonatal deaths.

Discussion

In the present study out of sixty pregnancies induced hypertension cases 35 showed positive Doppler indices in any of the three vessels studied the remaining 25 cases showed normal Doppler indices in all the three vessels studied. In the present study mean maternal age was 23.1 years which is comparable with other studies conducted by U.Gupta et al[6] and in accordance with normal reproductive age group (18-28) years of Indian woman. As compared with other studies conducted by U. Gupta et al[6] and Bhatt CJ et al[7] present study also had majority of cases with abnormal Doppler. Present study had shown majority of cases (85.71%) with abnormal umbilical artery S/D ratio, which is comparable to the study conducted by Khalid et al[8]. In the present study, majority of cases (63%) with abnormal Doppler indices had NICU stay were as Cutis L Lowery Jr[9] study showed 86% of NICU admissions with abnormal Doppler indices. In the present study perinatal morbidity in abnormal uterine artery S/D and abnormal umbilical artery S/D are 70% and 63.33% respectively. Similarly it is 82.7% and 55.1% in the study conducted by U. Gupta et al[6]. In the present study, there were 2 still born, 2 neonatal deaths and 2 recovered in NICU. Perinatal mortality in AEDU group

was found to be 66.66% in our study whereas it is each 50% in the study conducted by Bhatt CJ et al[7] and Battaglia et al[10].

Conclusion

Thus we conclude that the Doppler velocimetry is primary tool for fetomaternal surveillance in hypertensive pregnancies because the changes in umbilical & uterine circulation strongly correlate with pregnancy outcome. It helps us to take timely action, plan the treatment & also counsel the patients in their future pregnancies. We strongly recommend the use of Color Doppler examination in all cases of PIH.

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