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A study on blood flow in uterine artery, umbilical artery and middle cerebral artery using Doppler ultrasound in a group of patients with pregnancy induced hypertension

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Abstract

Doppler ultrasound evaluation of the mother and fetus with the study of blood flow indices provides non-invasive assessment to study uteroplacental circulation and fetoplacental circulation and hemodynamic changes and adaptation in the fetal organs in response to hypoxemia; with this, the degree of placental dysfunction can be studied to know the severity of the disease. The study was conducted on sixty patients with clinically diagnosed pregnancy induced hypertension, who were referred to the Department of Radiodiagnosis. In the present study out of sixty pregnancy 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.

Keywords: uterine artery, doppler ultrasound, pregnancy induced hypertension

Introduction

Pregnancy induced hypertension has been a recognized pathological entity since the time of Hippocrates and ancient Greeks¹. Hypertensive disorders in pregnancy is one of the major causes of maternal and perinatal mortality and morbidity. It is one of the commonest medical disorders diagnosed by obstetricians in clinical practice^[2].

It is said that pregnancy induced hypertension (PIH) contributes to death of a woman every 3 minutes worldwide^[3].

Pre-eclampsia is characterized by an imbalance between prostacycline and thromboxane production^[4], as well as failure of the second wave trophoblastic invasion of the endometrio-myometrial vasculature. The result is abnormal uteroplacental blood flow, and this has led to the idea of using color Doppler in the evaluation and management of PIH patients.

Doppler ultrasound evaluation of the mother and fetus with the study of blood flow indices provides non-invasive assessment to study uteroplacental circulation and fetoplacental circulation and hemodynamic changes and adaptation in the fetal organs in response to hypoxemia; with this, the degree of placental dysfunction can be studied to know the severity of the disease.

Doppler is useful in selecting the patients for induction and trial of labor, 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 patients, several studies suggested a significant decrease in neonatal morbidity and mortality when Doppler evaluation was a part of fetal surveillance.

Methodology

The study was conducted on sixty patients with clinically diagnosed pregnancy induced hypertension, who were referred to the Department of Radiodiagnosis.

Procedure

The patient was explained about the non-invasive/ atraumatic nature of the procedure. Synthetic ultra gel was applied liberally over the abdomen to get a good acoustic coupling.

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The instruments used were Hitachi EUB 5500, Hitachi EUB 7000, Philips Envisor HD C-1.3 Color Doppler ultrasound machine with a convex transducer of 2-5 MHz frequency. Doppler wave form was obtained after localising the vessels by B-mode real time scanner. Pulsed Doppler was used to get the Doppler signals after localising the vessels. The maximum Doppler shift frequencies were obtained and various ratios were calculated from each vessel. Doppler examination was done when 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 the uterine artery substantially. The uterine signal was obtained per abdomen by pointing the probe in the iliac fossa towards the lower para-cervical area. In the color mode, the 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 the sampling point. S/D >2.6, RI > 0.58 and persistent early diastolic notch is considered abnormal.

2. Umbilical Artery: Flow velocity waveforms from umbilical artery can be easily obtained, for this color flow is not usually needed. Doppler signals can be acquired from different points in cord, usually from midportion of cord. S/D ratio of umbilical artery >3, RI>0.7, presence of absent end diastolic velocity (AEDV) and reversed 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 <1.3 and RI <0.7 were considered abnormal.

Results

Table 1: Normal and Abnormal Doppler Wise Distribution of Cases

Doppler	Number	Percentage
Normal	25	41.67
Abnormal	35	58.33
Total	60	100.00

After studying three arteries, patients were classified into normal and abnormal based on their color Doppler indices. Normal were those with no abnormality in any of the arteries.

Table 2: Uterine artery S/D ratio

S/D ratio	No. of cases	Percentage
Abnormal	20	57.14
Normal	15	42.86
Total	35	100

The table shows more than 50% of cases with elevated S/D ratio.

Table 3: Uterine artery resistance index

Resistance index	No. of cases	Percentage
Abnormal	26	74.28
Normal	9	25.72
Total	35	100.00

The table shows 74% of cases with abnormal RI in this study.

Table 4: Umbilical artery S/D ratio

Umbilical artery S/D ratio	No. of cases	Percentage
Abnormal	30	85.71
Normal	5	14.29
Total	35	100.00

Maximum number of cases showed abnormal umbilical artery S/D ratio.

Table 5: Cases with Doppler Abnormality

Parameters	S/D UA		S/D UT		Notch		AEDV	
	No.	%	No.	%	No.	%	No.	%
Abnormality present	30	85.71	20	57.14	24	68.57	6	17.14
Abnormality absent	5	14.29	15	42.86	11	31.43	29	82.86
Total	35	100.00	35	100.00	35	100.00	35	100.00

Comparing to S/D umbilical and S/D uterine $\chi^2=7.00$, $p<0.01$, significant.

Table 6: Middle cerebral artery sensitivity

Parameters	No. of cases	Percentage
No. of cases with abnormal MCA Doppler	15	42.85
No. of cases with normal MCA Doppler	20	57.15
Total	35	100.00

42% cases show abnormal MCA Doppler findings in the present study.

Table 7: 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 Doppler study of umbilical artery is most sensitive of all the vessels under the study.

In present study, it was found that the cases with bilateral notch were more than those with unilateral notch.

Discussion

In the present study out of sixty pregnancy 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.

Table 8: Mean Age of Pih Cases

	Mean age in Yrs
U.Gupta <i>et al</i> ^[5]	23.53
Present Study	23.1

Present study shows mean maternal age 23.1 yrs which is comparable with other studies and in accordance with normal reproductive age group (18-28) of Indian women.

Table 9: Normal and abnormal Doppler wise distribution of cases

	Normal	Abnormal
Bhatt CJ <i>et al.</i> [6]	44%	56%
U. Gupta <i>et al.</i> [5]	45%	55%
Present Study	41.66%	58.33%

As compared with other studies present study also had majority of cases with abnormal Doppler.

Table 10: Cases with Doppler abnormality

	Abnormal Ut.A. S/D	Abnormal UA S/D
Trudinger <i>et al.</i> [7]	47.3%	40%
U. Gupta <i>et al.</i> [5]	55%	39%
Saxena <i>et al.</i> [8]	77%	40%
Khalid <i>et al.</i> [9]	94.44	80.56
Present Study	57.14%	85.71

Present study has shown majority of cases (85.71%) with abnormal umbilical artery S/D ratio, which is comparable to the study conducted by Khalid *et al.* In other studies majority showed abnormal uterine artery S/D ratio [10].

Conclusion

- Out of 60 cases studied, 35 (58%) showed positive Doppler indices in any of the three vessels studied. The remaining 25 (42%) cases showed normal Doppler indices in all the three vessels studied.
- Among abnormal 35 cases, 30 cases had abnormal S/D ratio, 23 cases had abnormal RI and 6 cases had AEDV in umbilical artery, followed by uterine artery diastolic notch in 24 cases (68.57%), S/D ratio of uterine artery >2.6 in 20 cases (57.14%), RI of >0.58 in 26 cases (74.28%) and abnormal MCA in 15 cases (42.85%).

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