An Observational Evaluation of Pregnancy Induced Hypertension (PIH) and Intrauterine Growth Restriction (IUGR) In Primigravida

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Abstract

Aim: To assess the use of doppler studies in the assessment of pregnancy induced hypertension (PIH) and intrauterine growth restriction (IUGR) in first-time pregnant women.

Material and Method: This observational study was carried out in the Department of Obstetrics & Gynaecology Jawaharlal Nehru medical college & Hospital, Bhagalpur, Bihar, India. In our study a total of 100 Primigravida patients between 18 to 35 years of age, attending antenatal outpatient department, were screened at 18 to 22 weeks of gestation with USG along with Doppler study. Follow up Doppler studies were done after 30 weeks of gestation in the third trimester as per indicated to determine a favorable or worsening trend in Doppler indices.

Result: The study group included patients whose gestational age ranged from 18-22 weeks of gestation. Mean gestational age at the time of 1st scan was 20.10 weeks. The study group included patients whose gestational age ranged from 30-38 weeks of gestation. Mean gestational age at the time of 2st scan was 33.58 weeks. Of the 100 cases included in the study, 8 patients developed only PIH (3 PE + 5 GH); 9 patients had only IUGR and 7 patients were complicated by both PIH and IUGR. Incidence of PIH was 15% and IUGR was 16%. Mean gestational age at time of delivery - 37.68 weeks. Preterm delivery – 21%. Term delivery – 79%. Minimum Birth weight - 1.40 kilograms. Maximum Birth weight -3.24 kilograms. Mean Birth weight at time of delivery - 2.7023 kilograms. Stay in NICU – 22%. Minimum stay in NICU – 3 days. Maximum stay in NICU – 14 days. IUGR – 16%. Amongst 24 patients with abnormal Doppler: 7 patients delivered vaginally (29.17%). 17 patients underwent LSCS (70.83%). Amongst 76 patients with normal Doppler: 68 patients delivered vaginally (89.47%). 8 patients underwent LSCS (10.53%). In 100 patients: 75% had Vaginal delivery. 21% had Emergency LSCS. 4% had Elective LSCS.

Conclusion: Elevated uterine artery PI and presence of diastolic notch appears to be more significantly superior to other parameters in prediction of Preeclampsia. Umbilical artery Doppler findings are better predictor of perinatal outcome than abnormal MCA in early weeks of gestation whereas MCA PI Doppler is more useful than Umbilical PI or uterine artery in predicting the adverse perinatal outcome in later weeks.

Keywords: Uterine Artery Doppler, Pregnancy induced hypertension, Intrauterine growth restriction, Maternal Outcome, Neonatal Outcome

Introduction

Pregnancy-induced hypertension (PIH) and intrauterine growth restriction (IUGR) are two significant complications that can adversely affect maternal and fetal outcomes. PIH, which includes conditions like preeclampsia and gestational hypertension, is characterized by new-onset hypertension after 20 weeks of gestation. It poses a risk to both the mother and the fetus, leading to potential complications such as eclampsia, placental abruption, and preterm birth. IUGR, on the other hand, refers to a condition where the fetus does not grow at the expected rate during pregnancy, often due to placental insufficiency. Both conditions are critical contributors to perinatal morbidity and mortality, emphasizing the need for effective diagnostic tools to manage and mitigate risks. Doppler ultrasound has emerged as a vital non-invasive technique in the evaluation of these

conditions, providing crucial insights into placental and fetal circulatory status. [1-11] The pathophysiology of PIH and IUGR is closely linked to abnormal placentation and compromised uteroplacental blood flow. In PIH, inadequate trophoblastic invasion of the spiral arteries leads to high-resistance blood flow, resulting in poor placental perfusion and ischemia. Similarly, IUGR often results from placental insufficiency, where the placenta fails to supply adequate oxygen and nutrients to the fetus. Doppler ultrasound, by assessing blood flow in various fetal and placental vessels, helps in identifying these abnormalities early in the course of the disease. [12-16] One of the primary vessels evaluated in Doppler studies is the uterine artery. Abnormal uterine artery Doppler waveforms, characterized by increased resistance and the presence of diastolic notches, are early indicators of impaired placental perfusion and are associated with the development of PIH and IUGR. Early detection allows for close monitoring and timely intervention, which can significantly improve maternal and fetal outcomes. [17-20] The umbilical artery Doppler assessment is another crucial component of evaluating fetal well-being in cases of suspected IUGR. Increased resistance or absent/reversed end-diastolic flow in the umbilical artery is indicative of severe placental insufficiency and is associated with poor perinatal outcomes. In addition to the uterine and umbilical arteries, Doppler evaluation of the middle cerebral artery (MCA) provides insights into fetal adaptive mechanisms in response to hypoxia. In cases of placental insufficiency, the fetus redistributes blood flow to vital organs like the brain, a phenomenon known as the "brain-sparing effect." Furthermore, the cerebroplacental ratio (CPR), which is the ratio of the MCA to the umbilical artery Doppler indices, has emerged as a valuable parameter in assessing fetal well-being. A low CPR indicates fetal compromise and is associated with adverse outcomes. Doppler studies are also instrumental in guiding clinical management decisions. For instance, the timing of delivery in pregnancies complicated by IUGR and PIH is crucial to balance the risks of prematurity against the risks of continued intrauterine exposure to a compromised environment. [21-24]

Material and method

This observational study was carried out in the Department of Obstetrics & Gynaecology Jawaharlal Nehru medical college & Hospital, Bhagalpur, Bihar, India for 12 months. In our study a total of 100 Primigravida patients between 18 to 35 years of age, attending antenatal outpatient department, were screened at 18 to 22 weeks of gestation with USG along with Doppler study. Follow up Doppler studies were done after 30 weeks of gestation in the third trimester as per indicated to determine a favorable or worsening trend in Doppler indices. All the eligible candidates were included in the study depending on the following inclusion and exclusion criteria:

Inclusion Criteria: All Primigravida coming to our OPD. All Primigravida with singleton pregnancy.

Exclusion Criteria: Multiple gestations. Patients with history of medical disorders such as diabetes, hypertension, renal disease and cardiac disease. Unregistered Primigravida term gestation. All subjects with preterm labour and PROM. Congenital anomalies of uterus and fetus. Pregnant women of age less than 18 years and more than 35 years, or unknown last menstrual period. Intrauterine death at the time of first Doppler examination. Trophoblastic disease.

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using Statistical package for social sciences (SPSS) version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy was also calculated for all Doppler measurements.

Result

Table 1 showed the age distribution of 100 patients of my study group. All our patients' age ranged from 18 years to 35 years. 13% were in the age group of ≤20 years, Majority of the patients (50%) were in the age group of 21-25 years, 30% were in the age group between 26-30 years, least number of patients (7%) were seen in the age group of 31-35 years. The mean maternal age was 24.68 years.

Table 1: Distribution of the patients in study according to age group

Age (in years)	Number of patients	%
≤20	13	13
21-25	50	50
26-30	30	30
31-35	7	7
Total	100	100

The study group included patients whose gestational age ranged from 18-22 weeks of gestation. Mean gestational age at the time of 1st scan was 20.10 weeks.

Table 2: Distribution of patients according to gestational age at 1st scan (18-22 weeks)

Gestational age at 1st scan (weeks of gestation)	No. of Patients	Percentage (%)
18	20	20
19	16	16
20	22	22
21	19	18
22	23	24
Total	100	100
Mean	20.10	-
Std. Deviation	1.453	-

The study group included patients whose gestational age ranged from 30-38 weeks of gestation. Mean gestational age at the time of 2st scan was 33.58 weeks.

Table 3: Distribution of patients according to gestational age at 2nd scan (After 30 weeks)

Gestational age at 2nd scan (weeks of gestation)	No. of Patients	Percentage (%)
30	10	10
31	11	11
32	14	14
33	15	15
34	12	12
35	12	12
36	19	19
37	4	4
38	3	3
Total	100	100
Mean	33.58	-
Std. Deviation	2.212	-

Of the 100 cases included in the study, 8 patients developed only PIH (3 PE + 5 GH); 9 patients had only IUGR and 7 patients were complicated by both PIH and IUGR. Incidence of PIH was 15% and IUGR was 16%.

Mean gestational age at time of delivery - 37.68 weeks. Preterm delivery – 21%. Term delivery – 79%. Minimum Birth weight - 1.40 kilograms. Maximum Birth weight -3.24 kilograms. Mean Birth weight at time of delivery - 2.7023 kilograms. Stay in NICU – 22%. Minimum stay in NICU – 3 days. Maximum stay in NICU – 14 days. IUGR – 16%

Table 4: Adverse pregnancy outcome in study population

Outcome		Number of patients				
		PIH (PE + GH)	IUGR	PIH + IUGR	Normal subjects	Total
Gestational age at delivery	<37 weeks	1	8	7	5	21
	37- 42weeks	7	1	0	71	79
>42weeks		0	0	0	0	0
Birth Weight	<10th centile	0	9	7	0	16
>10th centile		8	0	0	76	84
Stay in NICU	YES	1	9	7	5	22
NO		7	0	0	71	78
APGAR≤7		1	9	7	5	22
at 1 minute	>7	7	0	0	71	78
APGAR≤7		1	9	7	4	21
at 5 minute	>7	7	0	0	72	79

Amongst 24 patients with abnormal Doppler: 7 patients delivered vaginally (29.17%). 17 patients underwent LSCS (70.83%)

Amongst 76 patients with normal Doppler: 68 patients delivered vaginally (89.47%). 8 patients underwent LSCS (10.53%)

In 100 patients: 75% had Vaginal delivery. 21% had Emergency LSCS. 4% had Elective LSCS

Table 5: Mode of delivery

TYPE OF DELIVERY	Only PIH	Only IUGR	PIH + IUGR	NORMAL SUBJECTS	TOTAL
Vaginal Delivery	6	1	0	68	75
Emergency LSCS	2	8	6	5	21
Elective LSCS	0	0	1	3	4
TOTAL	8	9	7	76	100

Table 6: Test performance values for uterine artery, umbilical artery and middle cerebral artery for PIH at 18-22 weeks

PIH	SENSITIVITY	SPECIFICITY	PPV	NPV	DA
		UTERINE			
S/D	80	96.47	80	96.47	94
RI	66.67	96.47	76.92	94.25	92
PI	86.67	92.94	68.42	97.53	92
ED NOTCH	86.67	90.59	61.90	97.47	90
		UMBILICAL			
S/D	46.67	82.35	31.82	89.74	77
RI	33.33	83.53	26.32	87.65	76
PI	40	88.24	37.50	89.29	81
		MCA			
S/D	40	90.59	42.86	89.53	83
RI	33.33	92.94	44.45	88.76	84
PI	33.33	91.76	41.67	88.64	83

Table 7: Test performance values for uterine artery, umbilical artery and middle cerebral artery for IUGR at 18-22 weeks

IUGR	SENSITIVITY	SPECIFICITY	PPV	NPV	DA
		UTERINE			
S/D	43.75	90.48	46.67	89.41	83
RI	68.75	89.29	55	93.75	86
PI	68.75	90.48	57.89	93.83	87
ED NOTCH	75	89.29	57.14	94.94	87
		UMBILICAL			
S/D	75	89.29	57.14	94.94	87
RI	75	91.67	63.16	95.06	89
PI	81.25	96.43	81.25	96.43	94
		MCA			
S/D	50	92.86	57.14	90.70	86
RI	37.50	94.05	54.55	88.76	85
PI	43.75	94.05	58.33	89.77	86

Table 8: Test performance values for uterine artery, umbilical artery and middle cerebral artery for PIH after 30 weeks

PIH	SENSITIVITY	SPECIFICITY	PPV	NPV	DA
		UTERINE			
S/D	53.33	97.65	80	92.22	91
RI	40	96.47	66.67	90.11	88
PI	60	92.94	60	92.94	88
ED NOTCH	66.67	96.47	76.92	94.25	92
		UMBILICAL			
S/D	40	88.24	37.50	89.29	81
RI	26.67	84.71	23.53	86.75	76
PI	33.33	89.41	35.71	88.37	81
		MCA			
S/D	46.67	87.06	38.89	90.24	81
RI	33.33	85.88	29.41	87.95	78
PI	46.67	83.53	33.33	89.87	78

Table 9: test performance values for uterine artery, umbilical artery and middle cerebral artery for IUGR after 30 weeks

IUGR	SENSITIVITY	SPECIFICITY	PPV	NPV	DA
		UTERINE			
S/D	18.75	91.67	30	85.56	80
RI	25	94.05	44.44	86.81	83
PI	18.75	94.05	37.50	85.87	82
ED NOTCH	31.25	90.48	38.46	87.36	81
		UMBILICAL			
S/D	75	95.24	75	95.24	92
RI	81.25	95.24	76.47	96.39	93
PI	81.25	98.81	92.86	96.51	96
		MCA			
S/D	81.25	94.05	72.22	96.34	92
RI	68.75	92.86	64.71	93.98	89
PI	87.50	91.69	66.67	97.47	91

Discussion

This study was primarily done to evaluate whether abnormal Doppler findings at 18 – 22 weeks and after 30 weeks of gestational period is useful in predicting the development of PIH and IUGR. In this study, 100 pregnant Primigravida women with singleton pregnancy attending our OPD between 18-22 weeks of gestation were selected. They were assessed with Doppler velocimetry, follow up of all the patients was done. The period between 18 -22 weeks was chosen to perform the Doppler because a routine anomaly scan was done regularly in all pregnant mothers during that period. Coming to age distribution of the patient, all our patients age ranged from 18 years to 35 years. Majority of the patients (50%) were in the age group of 21-25 years, 30% were in the age group between 26-30 years, 13% were in the age group of ≤20 years and least number of patients (7%) were seen in the age group of 31-35 years. The mean maternal age was 24.68 years. Before going in deep about Doppler findings let's see prevalence of adverse outcomes in our study group. Among 100 patients in our study group; 21 patients (21%) delivered preterm before 37 weeks of gestation, 7 out of 100 mothers (7%) in our study group developed pre-eclampsia and 8 mothers (8%) developed gestational hypertension. A total of 15 mothers (15%) developed pregnancy induced hypertension (PIH) at some point of time in their pregnancy. Pregnant mothers in our study group delivered 16 IUGR babies (16%), while 22 neonates (22%) delivered had their 1minute APGAR Score <7. 22 babies (22%) required NICU admission due to various reasons like fetal distress, low birth weight, prematurity etc. In our study, cesarean section (elective as well as emergency cesarean section) was done in 25 patients (25%) which included 17 patients with abnormal Doppler indices as well. Dildy et al. [14] have reported the rate of cesarean delivery in patients of hypertension in the range of 11-57%.

The Doppler findings in our study group was as follows. To start with evaluation of uterine artery. Among the 100 patients studied there were 21 patients with abnormal uterine artery Doppler when 95th percentile was taken as cut off. Among them 15 Patients had abnormal SD ratio, 13 patients had abnormal RI, 19 patients had abnormal PI and 21 patients had early diastolic notch during their first scan which was done between 18-22 weeks of gestation. On follow up scan, done after 30 weeks of gestation, there were 15 patients with abnormal uterine artery Doppler when 95th percentile was taken as cut off. Among them 10 Patients had abnormal SD ratio, 9 patients had abnormal RI, 15 patients had abnormal PI and 13 patients had persistence of diastolic notch. Coming to the evaluation of umbilical artery, there were 22 patients with abnormal umbilical artery Doppler when 95th percentile was taken as cut off. Among them 22 Patients had abnormal SD ratio, 19 patients had abnormal RI and 16 patients had abnormal PI during their first scan done between 18-22 weeks of gestation. On follow up scan, done after 30 weeks of gestation, there were 17 patients with abnormal umbilical artery Doppler when 95th percentile was taken as cut off. Among them 16 Patients had abnormal SD ratio, 17 patients had abnormal RI and 14 patients had abnormal PI. None of them had reversal or absent diastolic flow in the umbilical artery. In the middle cerebral artery, there were 14 patients with abnormal Doppler indices when 95th percentile was taken as cut off. Among them 14 Patients had abnormal SD ratio, 11 patients had abnormal RI and 12 patients had abnormal PI during their first scan done between 18-22 weeks of gestation. On follow up scan, done after 30 weeks of gestation, there were 21 patients with abnormal middle cerebral artery Doppler when 95th percentile was taken as cut off. Among them 18 Patients had abnormal SD ratio, 17 patients had abnormal RI and 21 patients had abnormal PI.

This indicates that elevated uterine artery PI and presence of notch appears to be more significantly superior to other parameters in prediction of Preeclampsia. This is similar to opinions by Sieroszewski; et al. [15] Barati M; et al. [19] Saptarshi Chakraborty, et al. [16] Jeltsje S Cnossen et al. [17] and Samir hazra et al. [4] where they concluded that an abnormal uterine artery Doppler result had an high specificity and negative predictive value for predicting preeclampsia.

According to Ochi, et al. [24] increased PI and the presence of diastolic notch in the uterine artery flow velocity, indicate increased uterine arterial resistance and impaired uterine circulation. The findings in the present study suggest that the increased Doppler indices in uterine artery with associated diastolic notch and persistence of diastolic notch after 30 weeks of gestation constitute an ominous sign and indicate the requirement for timely and intense fetal surveillance and intervention. The present study concludes that elevated uterine artery PI and presence of diastolic notch at early weeks of gestation appears to be a better predictor and more significant than uterine artery S/D in assessment of intrauterine fetal growth and in predicting perinatal outcome. [25]

While studying the usefulness of MCA parameters, we observed an increasing trend of sensitivity for MCA PI and MCA RI with increasing gestational age. This outstanding performance of the middle cerebral artery PI and MCA RI in between 31-36 weeks of pregnancy is because changes of IUGR in the artery become prevalent in later weeks of pregnancy, as in earlier weeks there is brain sparing effect which protects the fetal brain from the profound effects of hypoxia. The MCA pulsatility index had a higher sensitivity and positive predictive value for predicting the adverse perinatal outcome than the Umbilical Artery pulsatility indices and uterine artery PI while using Doppler ultrasound results for interpretation. Our findings agree with the results of the studies that have shown MCA PI Doppler to be more useful than Umbilical PI or uterine artery in predicting the adverse outcome in later weeks whereas Umbilical artery Doppler findings are better predictor of perinatal outcome than abnormal MCA in early weeks of gestation. Hence we are of the opinion that, Doppler data containing both umbilical and cerebral velocimetry provide additional information on fetal consequences of the placental abnormality.

Conclusion

Elevated uterine artery PI and presence of diastolic notch appears to be more significantly superior to other parameters in prediction of Preeclampsia. Umbilical artery Doppler findings are better predictor of perinatal outcome than abnormal MCA in early weeks of gestation whereas MCA PI

Doppler is more useful than Umbilical PI or uterine artery in predicting the adverse perinatal outcome in later weeks.

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