

## Evaluation of Efficacy and Usefulness of Doppler in Patients with Pregnancy Induced Hypertension

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### Abstract

**Background:** Hypertensive disorders of pregnancy are one of the commonest complications of pregnancy. Pregnancy induced hypertension (PIH) and small for gestational age (SGA) babies are pathological conditions strongly related to development and function of utero-placental and fetoplacental circulations. The present study was conducted to evaluate the efficacy and usefulness of this new technology in patients with PIH and to evaluate the ability to predict the perinatal outcome. **Subjects and Methods:** The study group comprised of 30 pregnant patients between 28 to 36 weeks of pregnancy clinically diagnosed as PIH. Control group comprised of 30 patients with 28 to 36 weeks with no clinically detectable hypertension. Ultrasound examination and Doppler study was done. Colour Doppler and spectral Doppler were done in the same sitting. The Umbilical artery reflecting the foetoplacental circulation, the uterine artery reflecting the uteroplacental circulation and foetal middle cerebral artery reflecting foetal responses and adaptation to changes in the intrauterine growth retardation were studied. The wave form of uterine artery, umbilical artery and fetal middle cerebral artery was assessed with PHILIPS Envisor Doppler machine. **Results:** Normal S/D ratio was seen 56.7% (no=17), who had no REDV and no AEDV. They had 6.6% (no=2) still births, 6.6% (no=2) low birth weight babies and 43.3% (no= 13) had normal birth weight babies. In study group (PIH) of 30 patients, normal PI was seen in 36.7% patients and increased PI was seen in 63.3% patients. Of the patients with increased PI, 23.3% patients showed still-births, 23.3% patients had low birth babies. **Conclusion:** Doppler velocimetry of the fetoplacental and uteroplacental circulation has great potential in helping the managing obstetrician to identify the PIH patients with fetus at serious risk, which warrants urgent delivery by active intervention. It is helpful in distinguishing the serious patients from those where the approach can be a bit more conservative.

**Keywords:** Doppler, Hypertension, Pregnancy.

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### Introduction

Hypertensive disorders of pregnancy are one of the commonest complications of pregnancy. It is one of the leading causes of fetal and maternal mortality and morbidity.<sup>[1]</sup> Pregnancy induced hypertension (PIH) and small for gestational age (SGA) babies are pathological conditions strongly related to development and function of utero-placental and fetoplacental circulations. This results in improper blood flow in uterine and umbilical arteries. An adequate fetal circulation is necessary for normal fetal growth. To facilitate this remarkable maternal and placental vascular changes occur. Recent advances in Doppler ultrasound technology have led to a surge of interest in its clinical application for non-invasive assessment of maternal and fetal hemodynamics.<sup>[2-4]</sup>

The major advantage of Doppler ultrasound is that it simple, safe, non-invasive and easily reproducible tool for direct measurement of S/D ratio of umbilical, uterine and MCA. By direct evaluation of the fetal circulation it allows accurate assessment of fetal well being and earlier detection of fetal jeopardy. It may help to decrease the perinatal morbidity and mortality.<sup>5</sup> The present study was conducted

to evaluate the efficacy and usefulness of this new technology in patients with PIH and to evaluate the ability to predict the perinatal outcome.

### Subjects and Methods

The prospective study was conducted in the department of Radiodiagnosis, Rajindra Hospital Patiala. Patients were inducted into the study from antenatal clinic and obstetrics wards. The study group comprised of 30 pregnant patients between 28 to 36 weeks of pregnancy clinically diagnosed as PIH. Control group comprised of 30 patients with 28 to 36 weeks with no clinically detectable hypertension. The study was approved from institutional ethical committee. All patients were informed regarding the study and written consent was obtained. The following inclusion and exclusion criteria was used-

#### Inclusion criteria

Comprised of patients with rise of atleast 30 mm Hg and 15 mm of Hg in systolic and diastolic pressures respectively over the previous known blood pressure, patients whose previous blood pressures were not known, the blood

pressure of atleast 140/90 mm of Hg were considered abnormal, singleton pregnancy, regular periods and normotensive pregnant patients with gestational age between 28 to 36 weeks of gestation. Exclusion criteria were all cases of essential hypertension or chronic hypertension due to any other cause and major congenital malformation of foetus

In all the subjects systolic and diastolic blood pressure was recorded on right lateral position after a rest of half an hour. Ultrasound examination and Doppler study was done. Colour Doppler and spectral Doppler were done in the same sitting. The Umbilical artery reflecting the foetoplacental circulation, the uterine artery reflecting the uteroplacental circulation and foetal middle cerebral artery reflecting foetal responses and adaptation to changes in the intrauterine growth retardation were studied. The wave form of uterine artery, umbilical artery and fetal middle cerebral artery was assessed with PHILIPS Envisor Doppler machine.

Results thus obtained were subjected to statistical analysis using t-test and Chi-square test. P value less than 0.05 was considered significant.

### Results

**Table 1: Umbilical artery- Study group (PIH) S/D ratio and it's correlation with the fetal outcome**

	S/D Ratio		Still Birth	Low birth Weight	Normal Birth Weight
Normal	17 (56.7%)	REDV 0	2 (6.6%)	2 (6.6%)	13 (43.3%)
		AEDV 0			
Abnormal	13 (43.3%)	REDV 2 (6.6%)	6 (20%)	6 (20%)	1 (3.3%)
		AEDV 1 (3.3%)			
Total	30		8	8	14

[Table 1] shows that in the study group (PIH) of 30 patients, normal S/D ratio was 56.67% (no=17) and increased S/D ratio was present in 43.3% (no=13) patients. Out of the increased S/D ratio 43.3% (no=13), 6(20%) patients showed still-birth, 6 (20%) show low birth weight and 1(3.3%) was normal. Patients with having REDV and ADEV had still birth babies. Normal S/D ratio was seen 56.7% (no=17), who had no REDV and no AEDV. They had 6.6% (no=2) still births, 6.6% (no=2) low birth weight babies and 43.3% (no= 13) had normal birth weight babies.

**Table 2: Umbilicalartery- control group (non-hypertensive) SD ratio and it's correlation with the fetal outcome**

	S/D Ratio		Still Birth	Low birth Weight	Normal Birth Weight
Normal	30 (100%)	REDV 0	0	0	30 (100%)
		AEDV 0			
Abnormal	0	REDV 0	0	0	0
		AEDV 0			
Total	30		0	0	30

[Table 2] shows that in the control group (non-hypertensive) of 30 patients, normal S/D ratio was 100% (No.=30) and all patients had good fetal outcome in the form of normal birth weight babies. No still- birth or low birth weight babies was seen.

**Table 3: Umbilical artery pulsatility index (PI) in study group (PIH) and it's correlation with the fetal outcome**

		No.	Still Birth	Low birth Weight	Normal Birth Weight
Study	Normal PI	11 (36.7%)	1 (3.3%)	1 (3.3%)	9 (30%)
	Increased PI	19 (63.3%)	7 (23.3%)	7 (23.3%)	5 (16.7%)
Control	Normal PI	30 (100%)	0	0	30 (100%)
	Increased PI	0	0	0	0

[Table 3] shows that in the study group (PIH) of 30 patients, normal PI was seen in 36.7% patients and increased PI was seen in 63.3% patients. Of the patients with increased PI, 23.3% patients showed still-births, 23.3% patients had low birth babies. In the control group, all the patients showed normal PI of the umbilical artery and good fetal outcome in the form of normal birth weight babies.

**Table 4: Umbilical artery resistivity index (RI) (PIH) and it's correlation with the fetal outcome**

Group	Response	No.	Still Birth	Low birth Weight	Normal Birth Weight
Study	Normal RI	12 (40%)	6 (20%)	2 (6.6%)	4 (13.3%)
	Increased RI	18 (60%)	2 (6.6%)	6 (20%)	10 (33.3%)
Control	Normal RI	30 (100%)	0	0	30 (100%)
	Increased RI	0	0	0	0

[Table 4] shows that in the study group, increase RI was seen in 60% (no.= 18). Out of which 6.6% (no.=2) had still birth, 20% (no.=6) had low birth weight and 33.3% (no.=10) had normal birth weight babies. In the control group (non-hypertensive) of 30 patients, all the patients showed normal RI of the umbilical artery and good fetal outcome in the form of normal birth weight babies.

**Table 5: Uterineartery (PIH) s/d ratio and it's correlation with the fetal outcome**

	S/D Ratio		Still Birth	Low birth Weight	Normal Birth Weight
Study	Normal	16 (53.3%)	1 (3.3%)	4 (13.3%)	11 (36.7%)
	Abnormal	14 (46.7%)	7 (23.3%)	4 (13.3%)	3 (10%)
Control	Normal	30 (100%)	0	0	30 (100%)
	Abnormal	0	0	0	0

[Table 5] shows that in the study group (PIH) of 30 patients, normal uterine artery S/D ratio was 53.3% (no=16) and abnormal S/D ratio was present in 46.7% (no =14) patients.

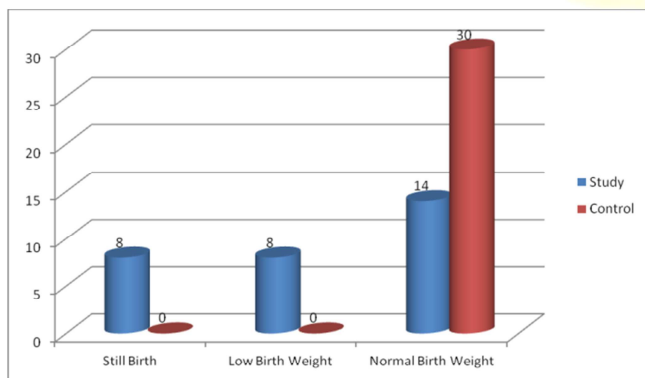


In the control group (non-hypertensive) of 30 patients, all patients had normal uterine S/D ratio and all patients had good fetal outcome in the form of normal birth weight babies.

**Table 6: Middle cerebral artery- (PIH) PI value and it's correlation with the fetal outcome**

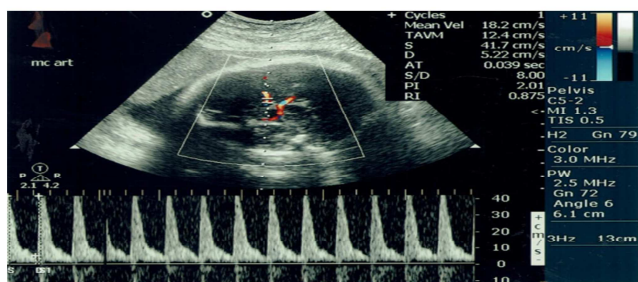
Groups	Response	S/D Ratio	Still Birth	Low birth Weight	Normal Birth Weight
Study	Normal	20 (66.7%)	5 (16.6%)	4 (13.3%)	12 (40%)
	Decreased	10 (33.3%)	3 (10%)	4 (13.3%)	2 (6.6%)
Control	Normal	30 (100%)	0	0	30 (100%)
	Decreased	0	0	0	0

[Table 6] shows that in the study group (PIH) of 30 patients, 66.7% (no.=20) patients showed normal PI and 33.3% (no.=10) patients had decreased PI. In the control group (non-hypertensive) of 30 patients, 100% (no.=30) patients showed normal PI and all 100% (no. =30) patients had good fetal outcome in the form of normal birth weight babies.

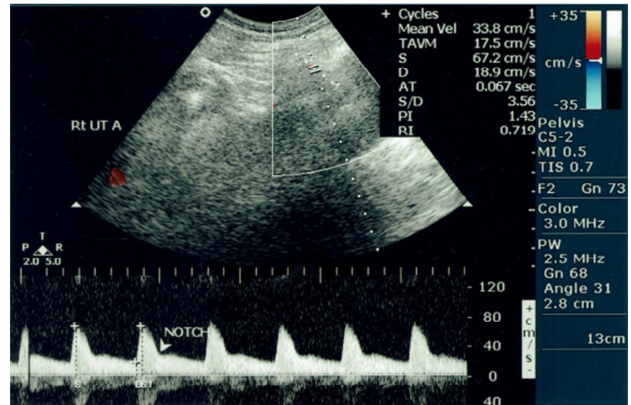


**Figure 1: Morbidity and mortality of fetuses (PIH) and it's correlation with the fetal outcome**

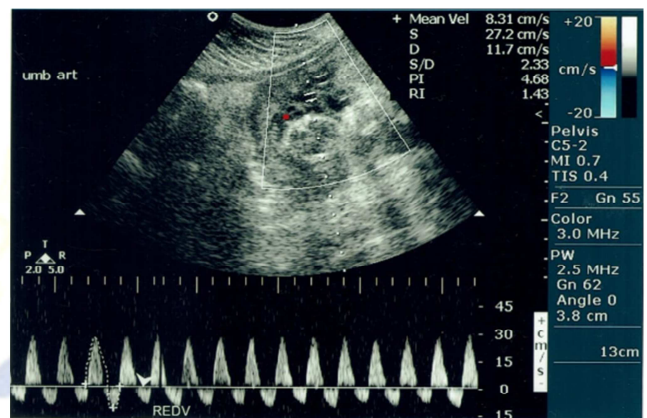
[Figure 1] shows that in the study group (PIH) comprising of 30 patients, 26.7% (no.= 8) patients delivered still-births, 26.7% (no.=8) patients delivered low birth weight babies out of which 6.6% (no. = 2) babies were admitted in NICU and 14 (46.7%) patients delivered normal birth weight babies. In the control group (non-hypertensive) comprising of 30 patients, all the 30 patients delivered normal birth weight babies and no patient had still-birth / low birth weight babies.



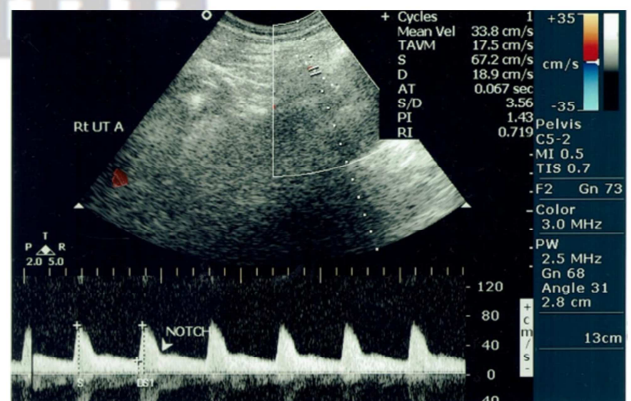
**Figure 1: MCA shows increased SD ratio.**



**Figure 2: Right uterine increase in velocity with diastolic notch.**



**Figure 3: Umbilical artery shows reversal of diastolic flow.**



**Figure 4: Right uterine artery increased SD ratio with diastole notch.**

## Discussion

Pregnancy induced hypertension (PIH) is an age old disease entity & is associated with impaired perfusion of the intervillous which causes antenatal fetal hypoxia and high perinatal morbidity and mortality. Accurate prediction of early recognition of fetal compromise by screening technique would facilitate management and initiation of therapeutic measures.<sup>[6]</sup> There is an evolving need of

diagnostic modalities, which can supply important information about maternal and fetal circulation in pregnancy complicated by hypertension.<sup>[7]</sup>

Our study comprised of 30 antenatal patients, the cases of PIH as a study group and 30 normal antenatal patients as control group. Both study and control group patients were in the 28-36 weeks of gestation. We found that in the study group of 30 patients (PIH), 43.3% (no.= 13) of patients had abnormal S/D ratio suggestive of increased resistance in umbilical flow, either alone or associated with abnormal uterine artery flow waveforms. Out of 43.3% (no.=13), 20% (no.=6) had low birth weight babies, 20% (no.=6) had still births and 3.3% (no.= 1) had normal birth weight babies. While 56.7% (no.= 7) patients had normal SID ratio, out of which 6.6% (no. = 2) patients had still-births 6.6% (no. =2) patients had still-births, 6.6% (no.=2) patients had low birth weight babies and 43.3% (no. =13) patients had normal birth weight babies. While in the control group all the patients had normal SID ratio and good fetal outcome.

On analysis of umbilical and uterine arteries waveforms obtained by Doppler ultrasound, it was observed that out of 30 patients in the study group (PIH), 26.7% patients (No.=8) had abnormal findings in both umbilical artery and uterine artery. 16.7% (no.=5) had abnormal results in umbilical artery with normal uterine arteries waveforms. 36.60/0 (no.=11) had normal Doppler findings in both umbilical and uterine arteries.

From our present study group (PIH) of 30 patients, 43.3% (No.=13) of patients had abnormal S/D ratio suggestive of increased resistance in umbilical artery either alone or associated with abnormal uterine arteries waveforms. It was observed that patients who had abnormal S/D ratio had poor fetal outcome in the form of still births and low birth weight babies. So, the abnormal S/D ratio incidence was higher in the study group. This is similar to the findings observed by Fleischer et al,<sup>[8]</sup> that 40% of hypertensive pregnancies had increased S/D ratio which were significantly associated with IUGR, perinatal mortality and morbidity.

From the above study it is evident that S/D ratio is an important parameter to interpret the umbilical artery waveform to predict the fetal outcome. Normal pregnancy is characterized by gestational age related progressive increase in diastolic component to waveform. Increased vascular resistance in PIH causes a decreased in forward flow during diastole.<sup>[9]</sup> This is reflected as high S/D ratio. The overall rate of adverse fetal outcome was higher in the study group in which umbilical artery S/ D ratio was >3. This could be explained by the fact that these babies being compromised were more, likely to have intrapartum asphyxia leading to fetal distress due to fetoplacental insufficiency.<sup>[10]</sup>

In the present study group (PIH) of 30 patients, umbilical artery evaluation showed that 63.3% (no.= 19) had abnormal PI and 36.7% (no.=11) showed normal PI value. The patients who showed increase in PI, 23.3% (no.=7) had still births, 23.3% (no.=7) had low birth weight babies and 16.7% (no.=5) had normal birth weight babies. The patients who had normal PI 36.7% (no.=11), 3.3% (no. = 1) had still birth, 3.3% (no.=1) had low birth weight and 30% (no.=9) had normal birth weight babies. While in the control group

of the 30 patients, all had normal PI and good fetal outcome.

It was observed in the present study that in 43.3% (no.= 13) patients with abnormal S/D ratio and increase in PI. It was observed that both the S/D ratio and PI were abnormal fetal outcome was bad. Roland and Vyas observed that when there was increase in PI value,<sup>[12]</sup> morbidity and mortality in the fetuses increased and fetal outcome was poor. They concluded that PI of umbilical artery is a good indicator in identifying the morbidity and mortality in high risk pregnant patients. Our present study also shows that PI of umbilical artery is a good predictor of fetal outcome.

In our study 6.6% (no.=2) patients recorded REDV and 3.3% (no.=1) patients recorded AEDV in the umbilical artery. All patients who had AEDV and REDV showed the still births. Similar results had been reported by Rochelson et al,<sup>[13]</sup> in a study of 161 women of whom 10 had AEDV. Severe PIH was present in 7 patients. All the babies delivered earlier and weighed less.

In the study group of 30 patients 53.3% (no.= 16) had normal uterine arteries S/D ratio, out of these 36.70/0 (no.=11) had normal birth weight babies. 13.3% (no.=4) had low birth weight and 3.3% (no.=1) had still birth while 46.7% (no.=14) patients had abnormal S/D ratio. Out of abnormal S/D ratio, 23.3% (no.=7) had. still births, 13.30/0 (no. = 4) had low birth and 10% (no. = 3) patients had normal birth weight babies. In the control group all the patients had normal S/D ratio and good fetal outcome.

It was observed from our present study that 46.7% (no.=14) who had abnormal uterine artery S/D ratio had the bad fetal outcome in the form of still births and low birth weight babies. Our study is similar Valensise,<sup>[14]</sup> Veille et al.<sup>[15]</sup> They studied that abnormal uterine artery wave forms are associated with higher incidence of lower mean birth weight and higher no. of growth restricted babies.

## Conclusion

Doppler velocimetry of the fetoplacental and uteroplacental circulation has great potential in helping the managing obstetrician to identify the PIH patients with fetus at serious risk, which warrants urgent delivery by active intervention. It is helpful in distinguishing the serious patients from those where the approach can be a bit more conservative.

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