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Doppler changes in PIH

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Abstract
To assess the role of colour Doppler in PIH. 80 patients of Preeclampsia were studied between the age group 20 to 35 years for the period of 2 years at Bharati Vidyapeeth Deemed University Medical College& Hospital, Wanlesswadi, Sangli. Doppler analysisof UTA, UMA and MCA were evaluated. A Doppler study is the only non- invasive modality for detection and follow up of PIH cases to prevent morbidity and mortality.

Keywords: Preeclampsia, Uterine artery (UTA), Umbilical artery (UA), Middle cerebral artery (MCA) Intra uterine fetal death (IUFD)

Introduction
Hypertensive disorders remain the most common medical complications during pregnancy, leading to a majority of adverse perinatal and maternal outcome; despite numerous efforts made at early diagnosis, prevention and treatment. It accounts for a total of 7-10% of perinatal mortality in developed countries and 20% in developing countries [1]. Early detection of preeclampsia may allow vigilant antenatal surveillance and appropriate timing of fetal delivery in order to avoid serious sequelae [2, 3].

Diagnostic ultrasound provides a new dimension to the management of obstetric cases and has aided in decreasing the infant mortality rate drastically. Doppler studies and especially color doppler with spectral evaluation provided the right tool in forewarning the obstetrician about impending problem which could become a disaster if not adequately prepared for and management protocols implemented. The aim of the study is to evaluate the role of Doppler in predicting compromised fetus and adverse fetal outcome in patients with pre-eclampsia and suspected IUGR.

Materials and Methods
This study was carried out at Bharati Vidyapeeth Deemed University and Medical College and Hospital, Wanlesswadi, Sangli during Oct 2013 to Oct 2015.Prior approval by the institutional ethical committee was taken and informed consent was obtained from all the patients.

In 80 patients with preeclampsiasonographic evaluation was performed. Pregnancies beyond 28 weeks of gestation complicated by pre-eclampsia were selected. Gestational age determination was based on a best estimate from menstrual history, clinical gestational age or fetal biometry preferably in the first trimester or early second trimester. Patients with preeclampsia and beyond 28 weeks were selected. Pregnancies with multiple gestations and congenital anomalies were excluded from the study.TheDoppler findings at the time of first examination were taken into consideration. Repeat Doppler studies were performed whenever required.

Study of various fetal vessels was performed using pulsed Doppler ultrasound (HD 11 XE Philips) with 3.5 MHz curvilinear probe with a high pass filter.

The following vessels were studied with the mother in a recumbent position during fetal inactivity and apnea.
1. Uterine artery (UTA)
2. Umbilical Artery (UA)
3. Middle Cerebral Artery (MCA)

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The above vessels were located in the standard plane:
The Uterine artery measurements were made from the placental side or the mean if there was a symmetrical placenta.
The umbilical artery measurements were made from free loop of cord midway between the placental and abdominal wall insertion.
The middle cerebral artery was located in a transverse plane at the level of the lesser wing of the sphenoid bone with sample gate placed on proximal portion of the vessel.
Flow velocity waveforms, the resistance index (R.I), pulsatility index (P.I), systolic/diastolic ratio (S/D) of umbilical artery and middle cerebral artery were noted.

The ratios examined were considered abnormal when:
1. S/D of MCA/UA < 1
2. P.I. of MCA/UA < 1

The flow velocity waveforms were computed automatically, the average value of three such recording was obtained. The data regarding perinatal outcome was collected which included birth weight, no. of fetal & perinatal deaths, admission to NICU & number of days in NICU and mode of delivery. Absent end diastolic velocity (AEDV), reversed end diastolic velocity (REDV) in umbilical artery& persistent early diastolic notch in uterine artery were considered abnormal. Increase in diastolic flow in fetal MCA suggested brain-sparing effect seen in asymmetric IUGR.

Perinatal Outcome
1. Major adverse outcomes were perinatal deaths - including intrauterine and early neonatal deaths.
2. Minor outcomes include-cesarean delivery for fetal distress, Apgar score below 7 at 5 minutes, admission to NICU (neonatal intensive care unit) for treatment.

Results
Age of patients; Doppler analysis and fetal outcome are detailed in the following tables:

Table 1: Table showing the age of patients in present study.

Age	No Of Patients	Percentage
<20YRS	9	11.25%
21-25YRS	44	55%
26-30YRS	26	32.5%
31-35YRS	1	1.25%

Table 2: Doppler Analysis of Pre-Eclampsia (n=80)

Normal Doppler	60	75%
Abnormal Doppler	20	25%

Table 3: Table Showing Fetal Outcome in Present Study

	No of Patients	Percentage
Preterm deliveries	14	17%
IUFD	4	5%
Low birth weight	26	32%
NICU admissions	11	14%

The present study comprised of total 80 patients of preeclampsia and among these, maximum number of patients were in the age group of 21-25 years (55%). 60 patients (75%) had normal Doppler findings while 20 patients(25%) had abnormal doppler findings.
There were 14 preterm deliveries(17%) out of which 11(79%) babies were admitted to NICU. There were 2 early

neonatal deaths(14%), 5(36%) required admission for more than 10days for various preterm complications. There were 26 low birth weight babies due to asymmetric IUGR

Diagnostic accuracy of Doppler indices in predicting adverse perinatal outcome tabulated below

Table 4: For predicting IUGR

Serial no.	INDEX	Sensitivity(%)	Specificity (%)	Positive predictive value(%)
1	Umb. Artery PI	66.66	74	71.25
2	Umb. Artery RI	63.33	68	66.25
3	S/D of MCA/UA	56.66	88.25	77.5
4	PI of MCA/UA	60	82	73.75

The most sensitive index for detecting compromised fetus in preeclampsia with IUGR is PI of Umbilical artery (66.66%) while S/D ratio of MCA/UA (88.25%) is most specific and has high PPV (77.5%)

Table 5: Comparison with previous studies

Dandolo Gramellini *et al.*	MCA	UA	MCA/UA
Sensitivity (%)	24	64	68.0
Specificity (%)	100	90.7	98.4
PPV(%)	100	72.7	94.4

Our study	MCA	UA	MCA/UA
Sensitivity(%)	38.46	87.5	84.61
Specificity(%)	94.02	70.3	76.7
PPV(%)	85	73.75	77.5

The results were compared with the study by Dandelo Gramellini *et al.* in which the most sensitive indicator for foetal compromise was MCA/UA (68%) whereas in our study the most sensitive indicator was UA PI (87.5%) followed by MCA/UA (84.61%).

Table 6: For predicting APGAR<7 at 5 minutes

Serial no.	Index	Sensitivity (%)	Specificity (%)	Positive predictive value(%)
1	Umb. Artery PI	91.66	70.88	73.75
2	Umb. Artery RI	91.66	70.88	73.75
3	S/D of MCA/UA	91.66	82	85
4	MCA PI	53.84	97.01	90
5	MCA/UA	91.66	76.4	78.75

Most sensitive index for detection of Apgar score less than 7 (at 5 mins) was PI and RI of Umbilical Artery and S/D ratio of MCA/UA (91.66%).
The most specific index was MCA PI (97.01%) and also had the highest predictive value (90%).

Table 7: For predicting NICU stay (>7 days)

Serial no.	Index	Sensitivity (%)	Specificity (%)	Positive predictive value (%)
1	Umb. Artery PI	87.5	70.3	73.75
2	Umb. Artery RI	81.25	65.02	68.75
3	S/D of MCA/UA	84.61	83.88	83.65
4	MCA PI	38.46	94.02	85
5	MCA/UA	84.61	76.70	77.5

For prediction of NICU admissions the most sensitive indicator was Umbilical artery PI (87.5%) while MCA PI was the most specific (94.02%) and also had the highest PPV (85%)

The '*p' value* was found to be > 0.05 for the following parameters in detection of adverse perinatal outcomes:
1. S/D Ratio
2. MCA PI
3. Umb. A RI
4. Umb. A PI
5. MCA/UA PI Ratio
These values are statistically significant.

Umbilical Artery
Outof 80 patients, reduced end diastolic volume was seen in 6patients(8%)andreversal/absence end diastolic velocity was noted in 10(13%) patients. Out of these 10 patients 4(40%) had IUFD and 6 patients (60%) had to undergo emergency LSCS for compromised fetus due to chronic hypoxia of which 2 had early neonatal death.

Middle Cerebral Artery
Increased end diastolic velocity is seen in 9 patients (11%) and absent in 2 patients(3%) who subsequently developed IUFD.

Discussion
The main objective of antepartum fetal surveillance in a high risk pregnancy in preeclampsia is to detect compromised fetus to allow timely delivery. Doppler velocimetry study is one such noninvasive tool which can be carried out to prevent adverse perinatal outcome.
In normal pregnancy the 3 indices S/D, PI and RI decreases with advancing gestation in umbilical artery [4](figure 3) but in IUGR first there is decreased diastolic flow in umbilical arterydue to increase in the resistance that occurs in small arteries and arterioles of the tertiary villi. This raises the S/D ratio; PI and RI of umbilical artery. As the placental insufficiency worsens, the diastolic flow decreases, then becomes absent, and later reverses. The prevalence of perinatal death in fetuses with absent or reversed end diastolic flow velocity is reported is reported to be over 40% [5]. Yoon *et al.* [6] demonstrated in their study that absent umbilical artery waveform is a strong and independent predictor of adverse perinatal outcome. Fetal MCA is low resistance circulation throughout pregnancy and accounts for 7% cardiac output of the fetus [7, 8]. The MCA seems to react earlier and sensitively to hypoxia and ischemia.
In our study it was observed that MCA-PI was the most specific indicator in predicting neonatal morbidity and also had the highest positive predictive value.
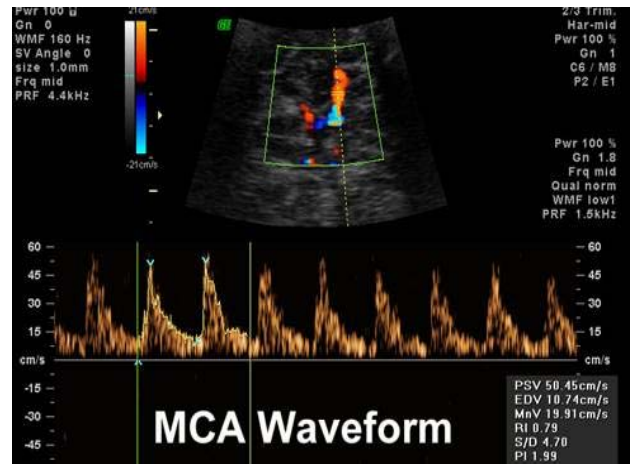

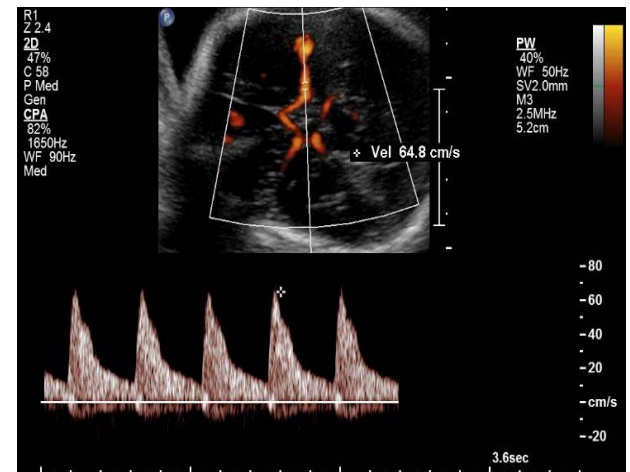**Fig 1:** Normal middle cerebral artery waveform

Fig 2: Middle cerebral artery waveform with increased diastolic flow.

The different ratios like S/D ratio of MCA/UA, MCA/UA PI, also showed high sensitivity in predicting adverse perinatal outcomes like IUFD, neonatal death as compared to individual vessels.
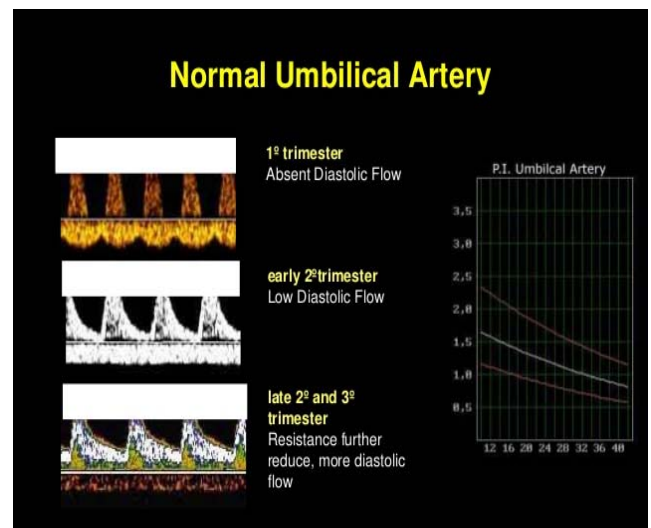

Fig 3: Normal Umbilical artery waveform with good diastolic flow

Umbilical artery diastolic flow
- Reduced
- Absent
- Reversed

In preeclampsia there is decreased diastolic flow in umbilical artery due to increased resistance in small arteries and arterioles of the tertiary villi. As the placental insufficiency worsens the diastolic blood flow decreases, then becomes absent, and later reverses. Some fetuses have decreased diastolic velocity which remains constant with advancing gestation age and never becomes absent or reversed which may be due to milder form of placental insufficiency.

In our study we observed that out of 80 patients of preeclampsia, 3 patients (4%) with absent/reverse end diastolic velocity in umbilical artery developed IUFD at 30, 33 and 35 weeks.6 patients (8%) with absent /reversal of EDV had to undergo emergency LSCS at gestational age of 30-32 weeks with birth weight around 1.1 to 1.7kgand required prolonged NICU admission for various preterm complications. Of these 2 babies had early neonatal death.

Conclusion

We conclude that Doppler study should be the primary imaging modality of choice for feto-maternal surveillance in preeclampsia. Reduced, absent or reversal of EDV in umbilical artery should prompt the obstetrician for timely intervention and prevent adverse perinatal outcome. Doppler study helps us i.e. Radiologists and OB & Gynecologists to take timely action, plan the correct treatment and counsel the parents in future deliveries.

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