

# Study to Evaluate the Doppler Indices of Umbilical and Middle Cerebral Arteries for Predicting the Perinatal Outcome in Patients with Pre-Eclampsia

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## ABSTRACT

**Background:** Pre-eclampsia is one of the leading causes of maternal and fetal morbidity and mortality. The main goal of antepartum fetal surveillance is to identify fetuses at increased risk for perinatal mortality and morbidity. Doppler ultrasound allows a noninvasive assessment of fetal haemodynamics. This study was done to evaluate the usefulness of Doppler indices of umbilical & middle cerebral arteries, in patients with pre-eclampsia for predicting the perinatal outcome. **Methods:** It is a prospective study which was conducted in the Department of Radiodiagnosis in accord with the Department of Obstetrics and Gynecology at Dr. RPGMC Kangra at Tanda, Himachal Pradesh. All pregnant females >28 weeks of gestation, diagnosed of having pre-eclampsia were evaluated with fetal doppler. Data obtained was evaluated and compared with the clinical outcome. **Results:** During the study period, 104 patients suffering from pre-eclampsia presented to the department and were included in the study. Abnormal Doppler indices were observed in 29(27.9%) patients. 26(89.6%) of these 29 pregnancies had an abnormal perinatal outcome. **Conclusions:** Because the changes in the umbilical and middle cerebral artery strongly correlated with the perinatal outcome, Doppler ultrasound was found to be a primary tool for fetomaternal surveillance in hypertensive pregnancy and could reinforce the obstetric management by accurately timing the delivery and thereby reducing the morbidity and subsequent mortality.

**Keywords:** Umbilical, Middle Cerebral Artery, Pre-Eclampsia.

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## INTRODUCTION

Worldwide pre-eclampsia is the leading cause of maternal mortality, intrauterine growth retardation (IUGR), and fetal prematurity.<sup>[1,2]</sup> Pre-eclampsia affects 5-10% of pregnancies and manifests after 20 weeks of gestation.<sup>[5]</sup> It characterized by reduced organ perfusion secondary to vasospasm and endothelial pathophysiology. Almost all the morbidity occurring due to multi systemic manifestations involving organs including brain, liver, kidney and placenta.

The pathophysiology of pre-eclampsia is due to the inability of the trophoblast to invade the myometrium properly causing a limited remodeling of spiral arteries.<sup>[6]</sup> Consequently, the crucial hemodynamic changes seen in normal pregnant uterine vasculature – that is shift from low volume high resistance to high volume low resistance

environment does not take place leading to increased vascular resistance and decreased utero placental perfusion.<sup>[7]</sup>

As a result of impaired utero-placental blood flow, manifestations of pre-eclampsia may be seen in fetoplacental unit. These include IUGR, oligohydramnios, placental abruption, fetal hypoxia, perinatal death and non re-assuring fetal status observed on antepartum fetal surveillance by Doppler ultrasound.<sup>[8,9]</sup>

The study aims to evaluate the utility of Doppler indices of umbilical and middle cerebral arteries to predict the perinatal outcome in patients with pre-eclampsia.

## MATERIALS & METHODS

This was a prospective study which was conducted in the Department of Radiodiagnosis in accord with the Department of Obstetrics and Gynecology at Dr. RPGMC Kangra at Tanda, Himachal Pradesh after approval from institutional protocol review committee and institutional ethical committee. All pregnant females >28 weeks of gestation diagnosed of having pre-eclampsia in routine Obstetric and

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Gynecology OPD were sent for fetal doppler. Patients having chronic hypertension, cardiac diseases and pregnancies with congenital anomalies were excluded from the study.

#### Data Collection and Data Analysis

All patients satisfying the study criteria were approached for inclusion in the study. History and relevant physical examination findings of the patients were documented. Doppler ultrasound of the patients was performed using GE Logiq P5 ultrasound machine. Data were analysed descriptively and tabulated.

## RESULTS

**Table 1: Age distribution**

Age group (years)	Frequency	Percent
20-25 years	40	38.5
26-30 years	51	49.0
31-35 years	11	10.6
36-40 years	2	1.9

**Table 2: Gravida distribution**

Gravida	Frequency	Percent
1	54	51.9
2	36	34.6
3	9	8.7
4	3	2.9
5	1	1.0
6	1	1.0

**Table 7: Groups according to Doppler findings along with perinatal outcome**

Group	Mode of delivery		Time of delivery		Mortality			Fetal distress	Low appgar	Nicu Admission	Low Birth weight
	Nvd	Lscs	Term	Pre Term	Still birth	Iud	Neontal death				
Group i (n=75)	63 (84%)	12 (16%)	68 (90.7%)	7 (9.3%)	No	No	01 (1%)	no	4 (5%)	03 (4%)	23 (31%)
Group ii (n =2)	02 (100%)	No	02 (100%)	No	No	No	no	no	02 (100%)	no	02 (100%)
Group iii (n=27)	06 (22%)	21 (78%)	09 (33%)	18 (67%)	01 (4%)	01 (4%)	06 (22%)	06 (22%)	02 (7%)	15 (56%)	22 (81%)

The study included 104 patients. Age of the patients ranged from 20-40 years with maximum number of patients (49%) in the age group of 26-30 years [Table 1]. The Gravida status ranged from primigravida to gravida 6, among which 54 (51.9%) were primigravida.[Table 2]

Sixty nine (66.3%) cases had normal fetal outcome and 35 (33.6%) had adverse perinatal outcome. Out of 35 pregnant females having adverse perinatal outcome, 7(6.7%) had neonatal death, 18 (17.3%) had NICU admission, 1 (1%) was still birth, one (1%) was IUD and 8 (7.7%) had low APGAR score. [Table 3]

75(72.1%) pregnant females had normal Doppler indices in MCA and UA while 29(27.9%) had abnormal Doppler indices.[Table 4] In this study 26 pregnant females with adverse perinatal outcome had abnormal Doppler findings while 9 pregnant females having abnormal perinatal outcome had

**Table 3: Perinatal outcome**

Perinatal outcome	Frequency	Percent
Normal	69	66.3
NICU admission	18	17.3
Neonatal death	7	6.7
Still birth	1	1.0
Low APGAR score (at 5 mins<7)	8	7.7
IUD	1	1.0

**Table 4: Doppler Flow distribution**

Type of flow	Frequency	Percent
Normal	75	72.1
AEDF	6	5.8
PI and RI of UA>95th percentile	2	1.9
REDF	1	1.0
CPR < 1*	20	19.2

\*CPR = Cerebroplacental Ratio = MCA/UA PI or MCA/UA S/D

**Table 5: Doppler findings compared to adverse perinatal outcome**

	Normal Doppler	Abnormal Doppler
Normal Perinatal Outcome	66	3
Abnormal Perinatal Outcome	9	26

**Table 6: Patient groups based on Doppler findings (N =104)**

Groups	Doppler findings	Number	Percentage
Group I	NORMAL	75	72
Group II	ABNORMAL UA	02	02
Group III	ABNORMAL UA+MCA	27	26

normal Doppler findings [Table 5]. Pregnant females with normal perinatal outcome and abnormal Doppler findings were 3 and 66 pregnant females had normal doppler findings and normal perinatal outcome.

All the pregnant females were divided into three groups according to their respective Doppler findings.[Table 6 & 7]

We observed that majority of pregnant females 75 (72.1%) were in Group 1 in which 63 (84%) were delivered through NVD while 12 (16%) through LSCS. Pregnant females in this group who had preterm delivery were seven (9.3%) and 68 (90.7%) had term delivery. Neonatal death in this group was one (01%). Babies admitted to NICU from this group were 3 (04%), four (5%) babies had low APGAR score and 23 (31%) babies delivered in this group had low birth weight. No still birth and IUD was observed in this group.

In Group II those pregnant females were included who had abnormal umbilical artery Doppler and this group included two (two percent) pregnant females. Both the patients were delivered through NVD at term and both the babies had low APGAR score and Low birth weight.

Group III consisted of 27 pregnant females who had both abnormal UA and MCA Doppler. Pregnant females delivered through LSCS were 21 (78%) and six (22%) had NVD. Pregnant females delivered at term were nine (33%) and 18 (67%) had preterm delivery. In this group one (04%) pregnant female had still birth at 34 weeks of gestation due to abruption and one (04%) IUD at 31 weeks of gestation. Birth weight of this IUD baby was 1450 grams and this pregnant female had an episode of seizure. Six (22%) Neonatal deaths observed in this group, 15 (56%) were admitted in NICU, 22 (81%) babies had low birth weight, two (7%) had low APGAR score and six (22 %) had fetal distress.

## DISCUSSION

The current study showed that out of 35 pregnant females which had abnormal perinatal outcome, 29 had abnormal Doppler findings in the form of AEDF which was seen in six (5.8%) patients, REDF seen in one (01%), abnormal CPR in 20 (19.2 %), and abnormal PI & RI values with normal CPR in 2 (1.9%) patients.

In similar studies conducted by Bhatt CJ et al,<sup>[10]</sup> 44% of patients had normal findings on Doppler whereas 56% of patients had abnormal findings. Gupta U et al,<sup>[11]</sup> observed that 55% of their patients had abnormal results on Doppler where as in the present study only 27.9% of the patients were found to have abnormal results on Doppler. In our study, a correlation of 0.73 was observed between abnormal Doppler ultrasound findings and adverse perinatal outcome with p-value <0.001 which is statistically significant.

For Cerebroplacental Ratio (CPR = MCA/UA PI or MCA/UA S/D) Cut off value of 1 was chosen. All values <1 were considered abnormal as suggested by Yalti S et al.<sup>[12]</sup> In our study 20 (19.2%) pregnant females had <1 value of CPR. Out of 20 patients 17 (85%) had abnormal perinatal outcome and 3 (15%) had normal perinatal outcome. In above study by Yalti S et al,<sup>[12]</sup> 16 out of 50 i.e. 32% pre-eclamptic patients had CPR value < 1 and 75% of pregnancies with CPR <1 had adverse outcome.

For UA PI p-value <0.001 was observed which is statistically significant and odds ratio was 256.

In our study, UA PI has sensitivity of 95.4%, specificity of 94.1%, PPV of 98.2% and NPV of 80%.

For UA RI a p-value of <0.001 was observed which is statistically significant and odds ratio was 108. In our study UA RI has sensitivity of 94.2%, specificity of 88.2%, PPV of 97.2% and NPV of 74%.

For UA S/D ratio a p-value of <0.001 was observed which is statistically significant and odds ratio was 257. In our study UA S/D ratio has sensitivity of 98.7%, On comparing the indices data with Lakhkar BN et al,<sup>[13]</sup> in which RI sensitivity was 44%, specificity 81.8%, PPV 80% and NPV 47.3% and specificity and PPV were comparable to our study however sensitivity and NPV were higher in our study.

For MCA PI a p-value of <0.001 was observed which is statistically significant and odds ratio was 141.2. In our study MCA PI has sensitivity of 95.3%, specificity of 88.9%, PPV of 97.6% and NPV of 80%. Gramellini D et al,<sup>[14]</sup> calculated MCA PI values and found a sensitivity 11.1%, Specificity 97.7%, PPV 83.3% and NPV 52.3%.

For MCA RI p-value of <0.001 was observed which is statistically significant and odds ratio was 95.26. In our study compared with CPR MCA RI has sensitivity of 95.3%, specificity of 84.2%, PPV of 96.4% and NPV of 80%

One (01%) pregnant female had REDF at 33 weeks of gestation in which neonatal death was observed accounting for 100% mortality. AEDF was observed in 6 pregnant females out of which neonatal death occurred in 4 (66.6%) pregnant females. This confirms the findings of Karsdorp et al,<sup>[15]</sup> which showed that absent and reversed diastolic flow is better indicator of the adverse perinatal outcome. In studies by Bhatt CJ et al,<sup>[10]</sup> and Battaglia et al,<sup>[16]</sup> 50% mortality was seen in pregnancies with AEDF and REDF.

## CONCLUSION

Pre-eclampsia is associated with significant fetal morbidity and mortality. Absent end diastolic flow and Reverse diastolic flow in umbilical artery indicates severe fetal distress and is associated with 66% & 100% perinatal mortality respectively. Because the changes in the umbilical and middle cerebral artery strongly correlate with the perinatal outcome, Doppler ultrasound is a primary tool for fetomaternal surveillance in hypertensive pregnancy. Abnormal Doppler values in preeclampsia can predict poor perinatal outcome that could reinforce the obstetric management by accurately timing the delivery and thereby reducing the morbidity and subsequent mortality.

### Abbreviations

AEDF	Absent end diastolic flow
CPR	Cerebro-placental ratio
MCA	Middle cerebral artery
NPV	Negative predictive value
NICU	Neonatal intensive care unit
NST	Non Stress test
PPV	Positive predictive value
PIH	Pregnancy induced hypertension
PI	Pulsatility index
REDF	Reversed end diastolic flow
RI	Resistive index

S/D	Systolic/diastolic ratio
UA	Umbilical artery

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