

# Role of Umbilical and Middle Cerebral Artery Doppler in Predicting Perinatal Outcome in Cases of Preeclampsia

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## ABSTRACT

### BACKGROUND

One of the most common complications of pregnancy is preeclampsia, characterized by abnormal placental development, leading to inadequate uteroplacental blood flow. Doppler ultrasonography can pick up these abnormalities; thus, it is a useful tool to assess fetal outcome. Objective is to calculate the role of colour Doppler (umbilical and middle cerebral artery) in predicting the perinatal outcome. We wanted to evaluate the application of Doppler ultrasound in analysing the blood flow velocity waveform.

### METHODS

This was a cross sectional study carried out between May 2010 - November 2012 in Obstetrics Department, Yenepoya Medical College, Karnataka, among 150 pregnant women with preeclampsia.

### RESULTS

49.3 % of patients belonged to 25 - 30 years, 58.7 % were primigravida, and 73.3 % and 26.7 % had mild and severe preeclampsia respectively. Patients with increased resistance umbilical artery Doppler - 63.8 % had babies  $\leq$  2.5 Kg birth weight, 60.9 % Apgar  $\leq$  7 at 5 minutes of birth and 67.5 % neonatal intensive care unit (NICU) admissions; absent end diastolic flow - all had birth weight  $<$  2 Kg, 90 % Apgar  $\leq$  7 at 5 minutes, 1 neonatal death and all required NICU admissions; reversal end diastolic flow - 1 neonatal death, all had birth weight  $<$  2.5 Kg, an Apgar  $\leq$  7 at 5 minutes and required NICU admission. Patients with abnormal Doppler in middle cerebral artery, 46.2 % were low birth weight and had Apgar  $<$  7 at 5 minutes, 50 % required NICU admissions, but no perinatal mortality.

### CONCLUSIONS

Doppler analysis helps in early detection of uteroplacental and fetoplacental changes and to take decisions for early interventions, like administration of steroids for fetal lung maturity and transferring preterm pregnancies to higher centres for better NICU facilities. Umbilical artery Doppler findings are slightly better predictors of adverse perinatal outcome than an abnormal middle cerebral artery.

### KEYWORDS

Doppler, Preeclampsia, Perinatal Outcome, Umbilical Artery, Middle Cerebral Artery

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**BACKGROUND**

Worldwide, preeclampsia is the cause of maternal mortality, intrauterine fetal growth restriction and fetal prematurity.<sup>1,2</sup> Preeclampsia affects 5 – 10 % of pregnancies and is clinically manifested after 20 weeks of gestation.<sup>3,4</sup> The aetiology of preeclampsia is unknown, although an excessive maternal systemic inflammatory response and an imbalance between circulating angiogenic and anti-angiogenic factors have been described.<sup>5,6</sup>

The pathophysiology of preeclampsia is based on the incapability of the trophoblast to invade the myometrium properly causing a limited remodelling of spiral arteries.<sup>7</sup> The impaired placental perfusion caused by vascular abnormalities precedes clinical manifestations of preeclampsia and it can be detected by Doppler ultrasound (US). The latter has been considered as an useful method for prediction of preeclampsia and adverse pregnancy outcome.<sup>8,9</sup>

Uterine artery is the most studied vessel in the Doppler evaluation in preeclampsia, because it represents the maternal vascular condition, through the pulsatility index and resistance index (PI and RI respectively) and the presence of early diastolic notch (N).<sup>10,11</sup> Although there are some studies including the umbilical artery as a relevant vessel in the preeclampsia evaluation, traditionally this artery is taken together with the middle cerebral artery in the fetus status evaluation.<sup>12-15</sup>

Doppler ultrasound of the fetal circulation can diagnose fetal hypoxemia, which is an early and more precise predictor of fetal jeopardy, as compared to biophysical profile (BPP) or non-stress test (NST). Abnormal heart rate is a late finding.

**METHODS**

This study was conducted at a tertiary care centre in Karnataka. Study design was cross sectional study. The study was conducted after taking an informed consent from the patient and clearance from the ethical committee. 150 consecutive singleton pregnant patients diagnosed with preeclampsia between 28 to 36 weeks were included in the study. Patients with other medical complications in pregnancy, fetuses with congenital anomalies and those who presented for the first time were excluded from the study.

Neonatal outcome was assessed depending on

1. Birth weight
2. Apgar of 5 minutes
3. Requirement of NICU stay
4. Duration of NICU stay
5. Perinatal mortality

Data was entered into the Microsoft excel sheet and was analysed using statistical package for social sciences (SPSS) version 16. Descriptive statistics such as frequency and percentage was calculated. Chi square test was used to find the statistical significance.

**RESULTS**

	Variables	N = 150	Percentage
Age	18 - 24 years	67	44.7
	25 - 30 years	74	49.3
	> 30 years	9	6.0
	<b>Total</b>	<b>150</b>	<b>100.0</b>
Gravity	Primigravida	88	58.7
	Multigravida	62	41.3
	<b>Total</b>	<b>150</b>	<b>100.0</b>
Gestational Age at Delivery	28 - 31 weeks 6 days	2	1.3
	32 - 35 weeks 6 days	62	41.3
	36 - 39 weeks 6 days	83	55.4
	40 weeks onwards	3	2.0
	<b>Total</b>	<b>150</b>	<b>100.0</b>

**Table 1. Demographic Profile**

	Variables	N = 150	Percentage
Umbilical Artery	Normal	68 (65)	45.3 (43.3)
	Increased resistance	66 (69)	44.0 (46.0)
	AEDV	10 (10)	6.7 (6.7)
	REDV	6 (6)	4.0 (4.0)
	<b>Total</b>	<b>150</b>	<b>100.0</b>
MCA	Normal	112 (124)	74.7
	Abnormal	38 (26)	25.3
	<b>Total</b>	<b>150</b>	<b>100.0</b>

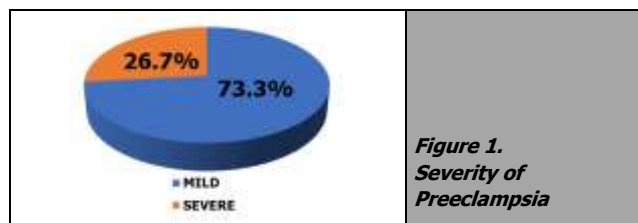
**Table 2. Doppler Velocimetry (S / D Ratio) of Umbilical Artery and MCA**

	Variables	N = 150	Percentage
Mode of Delivery	Caesarean	61	40.7
	Vaginal delivery	89	59.3
	<b>Total</b>	<b>150</b>	<b>100.0</b>
Indication for Caesarean Section	Severe preeclampsia	9	
	Abnormal Doppler changes	27	
	Foetal distress / NRRHR	9	
	MSAF	7	
	Severe oligohydramnios	4	
	Failed induction	5	

**Table 3. Mode of Delivery and Indication for Caesarean Section**

	Doppler Results	> 2 Kg	≤ 2 Kg	P-Value
Birth Weight	Increased Resistance in Umbilical Artery	25 (36.2 %)	44 (63.8 %)	0.03 Significant
	AEDV in Umbilical Artery	0 (0 %)	10 (100 %)	0.01 Significant
	REDV in Umbilical Artery	0 (0 %)	6 (100 %)	0.028 Significant
	Abnormal MCA	14 (53.8 %)	12 (45.2 %)	0.830 Not Significant
Apgar Score at 5 Mins	Increased Resistance in Umbilical Artery	42 (60.9 %)	27 (39.1 %)	0.014 Significant
	AEDV in Umbilical Artery	9 (90 %)	1 (10 %)	0.009 Significant
	REDV in Umbilical Artery	6 (100 %)	0 (0 %)	0.009 Significant
	Abnormal MCA	12 (46.2 %)	14 (53.8 %)	0.830 Not Significant
Need for NICU Admission	Increased Resistance in Umbilical Artery	52 (67.5 %)	16 (20.8 %)	0.005 Significant
	AEDV in Umbilical Artery	7 (100 %)	0 (0 %)	0.015 Significant
	REDV in Umbilical Artery	5 (100 %)	0 (0 %)	0.061 Significant
	Abnormal MCA	13 (50 %)	13 (50 %)	0.726 Not Significant

**Table 4. Associations between Abnormal Doppler Velocimetry of S / D Ratio of Umbilical Artery and MCA with Low Birth Weight, Poor Apgar Score, NICU Admission**



**Figure 1. Severity of Preeclampsia**

## DISCUSSION

Most of reports related to preeclampsia (PE) evaluation by Doppler US have been focused on the study of the uterine artery and its parameters,<sup>16-18</sup> there are descriptive trials about the haemodynamic changes during pregnancy.<sup>19</sup> Studies to determine the normality ranges of the Doppler US values in some populations,<sup>20,21</sup> and reports in which the aim has been to get a spectral pattern of Doppler US to predict which pregnancies will evolve to PE.<sup>22,23</sup> Only a few papers provide an extended description of other vessels in PE evaluation and even fewer have shown the combination of two or more arteries with the objective of establishing a more informative and accurate report.<sup>24,25</sup>

In this, umbilical artery and middle cerebral artery were studied with special emphasis on jeopardized fetus, so that timing of delivery can be decided and thus significantly reducing the perinatal mortality and morbidity. In the present study, majority of the patients (58.7 %) were primigravidae and belonged to the age group of 25 - 30 year (49.3 %). 73.3 % patients had mild preeclampsia whereas 26.7 % had severe preeclampsia.

Among the 150 preeclamptic patients, caesarean section was done in 40.7 % cases. Majority of the sections had to be performed in the cases having abnormal Doppler flow velocity waveforms. Thaler et al.<sup>26</sup> noted that the incidence of caesarean section was much higher in cases with abnormal Doppler patterns. Trudinger et al.<sup>27</sup> observed that 50 % of caesarean section were performed in cases which had abnormal flow velocity waveforms (FVWs). Fleischer<sup>28</sup> studied 30 women having preeclampsia (with abnormal FVW) out of which 61 % underwent caesarean section for fetal distress.

### **Umbilical Artery**

In our study, 82 patients had abnormal umbilical artery flow velocity waveforms, among whom 66 had increased resistance to flow, 10 had absent end diastolic flow and the remaining 6 had reversal end diastolic flow. In patients with increased resistance in umbilical artery Doppler, 63.8 % babies had a birth weight of less than or equal to 2.5 Kg. 60.9 % had an Apgar of less than or equal to 7 at 5 minutes of birth. 67.5 % required NICU admission and the average duration of NICU stay was 2.86 days. All babies were less than 2 kg in patients with absent end diastolic flow. 90 % had an Apgar score of less than or equal to 7 at 5 minutes of birth. All required NICU admission and the average duration of NICU stay was 5.8 days. There was 1 neonatal death associated with this Doppler change.

All patients with reversal end diastolic flow (6 patients) were delivered by caesarean section and had babies of birth weight less than or equal to 2.5 Kg and Apgar score of less than or equal to 7 at 5 mins of birth and required NICU admission with an average duration of 7 days of NICU stay. There was 1 neonatal death.

Yoon et al.<sup>29</sup> demonstrated that poor perinatal outcome occurred more frequently in women with an abnormal umbilical artery waveform than those with a normal waveform. Bhatt et al.<sup>30</sup> in his study showed that 44 % had

normal Doppler velocimetry whereas 56 % had abnormal S / D ratio in umbilical artery. 60 % of these hypertensive patients with abnormal velocimetry delivered babies with poor perinatal outcome in the form of intrauterine growth restriction (IUGR).

### **Middle Cerebral Artery (MCA)**

In the present study, abnormal Doppler velocity waveform in the S / D ratio of the MCA was seen in 26 patients (17.3 %). 46.2 % had low birth weight and the same number had an Apgar of less than 7 at 5 minutes of birth. 50 % required NICU admissions and the average duration of NICU stay was 2.35 days. There was no perinatal mortality; MCA Doppler does not show positive correlation with poor perinatal outcome which is consistent with the present study.

## CONCLUSIONS

Preeclampsia during pregnancy is the most common medical condition encountered. Doppler analysis helps not only in earlier detection of uteroplacental and fetoplacental changes associated with the disease but also in taking decision with regard to early intervention. Intervention may be required in preterm gestation so that the patient can be referred to higher centre for better NICU facilities. Also, steroids can be administered for fetal lung maturity to improve perinatal outcome.

Umbilical artery Doppler findings are slightly better predictors of adverse perinatal outcome than an abnormal MCA. Thus, Doppler ultrasound makes it possible to distinguish between compensated and decompensated placental insufficiency. Any abnormality in the umbilical artery blood flow should prompt the obstetrician for timely intervention and prevent adverse perinatal outcome.

Doppler technology has provided the best opportunity for repetitive non-invasive haemodynamic monitoring in pregnancy. Perinatal morbidity and mortality can be reduced by fetal surveillance with Doppler velocimetry study.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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