

# Efficacy of Umbilical Artery Doppler for the Prediction of Perinatal Outcome in Pre-Eclampsia

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## ABSTRACT

**Background:** The most common medical problem encountered in pregnancy is hypertensive disorders and these remain a global public health challenge. Significant number of perinatal morbidities and mortalities are due to pre eclampsia mostly in developing countries. Doppler flow studies of the umbilical artery are non-invasive method of fetal surveillance in high risk pregnancies like preeclampsia. Adverse perinatal outcome is associated with abnormal umbilical artery flow. This study was designed to determine the efficacy of umbilical artery Doppler for the prediction of perinatal outcome in preeclampsia.

**Aim:** To assess the frequency of perinatal outcome in preeclampsia patients with abnormal umbilical artery Doppler blood flow.

**Methodology:** This Descriptive cross sectional study was held at Department of Obstetrics & Gynecology Unit III, Lady Willingdon Hospital/KEMU, Lahore for a period of six months from 1.1.2016 to 30.6.2016. After approval from ethical committee of the hospital, Cases of preeclampsia fulfilling the inclusion criteria were recruited for the study from labour ward. Umbilical artery Doppler flow study was carried out and the patients having abnormal umbilical artery Doppler flow (PI>1.2) were followed for perinatal outcome. Outcome variable like low Apgar score, Low birth weight, preterm delivery, early neonatal death and NICU admission were labeled as per operational definition.

**Results:** According to the results reported to us the mean age of the patients was 26.85±3.89 years. Whereas, the mean gestational age was 33.02±1.59 at the time of presentation. The minimum value of abnormal pulsatility index of umbilical artery was found to be 1.21 and it had maximum value of 4.52. Mean pulsatility index was 2.07±0.79. Regarding perinatal outcome, in 72.7% (218) of the neonates, there was at least one adverse outcome. Majority of neonates, 216(72%) had birth weight <2.5Kg, 142 neonates (47.3%) out of 300 were delivered at less than 34 weeks. Poor Apgar score of <7 at 5 minutes was seen in 27 neonates (9%) and 157 (52.3%) neonates were admitted to NICU.

**Conclusions:** Raised umbilical artery Doppler indices in pre-eclamptic patients are associated with poor perinatal outcome like low birth weight babies, NICU admission and preterm delivery.

**Keywords:** Preeclampsia, Umbilical artery Doppler, perinatal morbidity.

## INTRODUCTION

Hypertension is found to be the most common medical problem seen in pregnant women and responsible for the increased incidence of maternal and fetal morbidity & mortality, making it to be the third leading cause of maternal mortality after thromboembolism and haemorrhage<sup>1</sup>.

Hypertension is becoming more common due to delayed child bearing, a role in averting devastating effects of these disorders in developed world. However, in developing countries like Pakistan, social and financial constraints are major hindrance for the referral of pregnant women in antenatal clinics without any chance of early identification of the problem<sup>2</sup>. Pregnancies which are complicated with hypertensive disease like preeclampsia, the diagnostic tool commonly employed for fetal well-being is Doppler velocimetry and its benefits have been proved<sup>3</sup>. It is a non-invasive method for monitoring blood flow in fetuses with growth restriction. Inadequacy of circulation to placental bed leads to a rise in fetal placental vascular flow, and raised Doppler indices, for identification of pregnancies with high risk. In alarming situations there is absence of the diastolic velocity waveform along with the detection of reverse end-diastolic flow, which correlates with poor perinatal outcome<sup>4</sup>. Observation of velocities in the blood flow related to maternal and fetal vessels provides information related to uteroplacental blood

flow and fetal responses to physiologic insults. Doppler based tests have been evaluated in many randomized trials along with other antenatal surveillance tests. In this regard, evidences suggest that Doppler indices of the fetal circulation can adequately detect adverse perinatal outcome in high risk pregnancies. Compared to other methods of fetal surveillance, Doppler has proved to be highly sensitive in detecting fetal compromise early and aids in the guiding and making of decisions regarding the appropriate mode and timing of delivery<sup>5</sup>. In contrast to the other tests like biophysical profile and non-stress test, Doppler detects changes of hypoxia at least a week before, that's why it is considered to be the gold standard in the management and prediction of the growth-restricted fetus<sup>6</sup>. The fetuses having placental insufficiency, pulsatility index is increased as a result of decrease, absence or reversal of end- diastolic flow. The increased placental resistance causes these changes<sup>7</sup>.

Relationship between increase Doppler blood flow parameters in the umbilical artery, disturbance of placental perfusion, ultimately leading to deterioration of fetal acid-base status which reflects to the type of the Doppler abnormality. In the fetal compartment, rise of the umbilical artery Doppler index is noted when almost one third of the fetal villous vessels are affected. Absence or finally reversal of umbilical artery end-diastolic velocity is observed when 60 to 75 percent of the villous vascular tree is involved. This benefit of umbilical artery Doppler in the management of high risk pregnancies is proved by the randomized controlled trials and Meta analysis. In these trials, umbilical artery Doppler, when performed in combination with other non invasive antepartum tests, was associated with a reduction of up to 38 percent in perinatal mortality, inductions of labor, antenatal obstetrical admissions and cesarean sections for fetal distress in women of high risk pregnancies<sup>8</sup>. Likewise, the prevalence of perinatal mortality in fetuses with

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absent or reversed end diastolic flow velocity is found to be more than 40%. Morris et al conducted a study and after their results suggested that AEDF is an independent and strong predictor of adverse perinatal outcome<sup>9</sup>. The adverse parameters like reverse diastolic flow is seen if there is high perinatal mortality (27-64%) and perinatal mortality >50%<sup>9</sup>. It has also been observed that women with high-risk pregnancies, such as gestational hypertension preeclampsia, and growth restriction, need to be evaluated with umbilical artery Doppler velocimetry to reduce the possibility of perinatal mortality and morbidity<sup>10</sup>. Rationale of our study was to evaluate the frequency of perinatal outcome in women having preeclampsia with abnormal umbilical artery Doppler blood flow.

## MATERIAL & METHODS

This Descriptive cross sectional study was done at Department of Obstetrics & Gynecology Unit III, Lady Willingdon Hospital/ KEMU, Lahore for a period of six months from 1.1.2016 to 30.6.2016. Total of 300 cases were recruited by non-probability, consecutive sampling technique.

### Inclusion Criteria

- Pregnant ladies aged between 20-35 years.
- Pts diagnosed as preeclampsia with singleton pregnancy.
- Pts with gestational age: 24-37 weeks assessed by LMP.
- Abnormal umbilical artery Doppler flow i.e. PI >1.2.

### Exclusion Criteria

- Unsure about LMP
- Multiple pregnancies
- Patients with coexisting Medical disorder like Diabetes, Heart disease, Epilepsy.
- Eclamptic patients

After approval from ethical committee of the hospital, Cases of preeclampsia fulfilling the inclusion criteria were recruited for study. Informed consent was taken. Doppler flow studies of the Umbilical artery were done and followed for perinatal outcome in patients with abnormal umbilical artery Doppler flow. The perinatal outcome variables were, low birth weight, low Apgar score, preterm delivery, early neonatal death & admissions in the neonatal intensive care unit (NICU). Demographic profile like name, age, parity, gestational age at delivery was recorded. Analysis of the data was done using SPSS 20. Descriptive statistics were applied for the calculation of mean and standard deviation for age and gestational age of the patients. Whereas, Percentages and frequencies were used to calculate for perinatal outcome.

## RESULTS

Results revealed that the mean age of our patients was 26.85±3.89 years. Majority of the cases i.e. 136(45.3%) were between 26-30 years of age. There were 104 cases (34.7%) between 20-25 years, 60 cases (20%) were between 31-35 years (Table 1). The gestational age distribution of the patients showed that at the time of presentation, majority of patients 188(62.7%) were between 30.1-34 weeks of gestation. 102 patients (34%) were having gestational age between 34.1-37 weeks and 10 patients (3.3%) were in 24-30 weeks of gestation. The mean gestational age was 33.02±1.59 at the time of presentation (Table 2). The minimum value of abnormal pulsatility index of umbilical artery was found to be 1.21 and it had maximum value of 4.52. Mean pulsatility index was 2.07±0.79 (Table 3). Regarding perinatal outcome, in 72.7% (218) of the neonates, there was at least one adverse outcome including preterm birth (less than 34 weeks), other adverse

outcomes were low birth weight (<2.5kg), NICU Admissions or early neonatal death, low Apgar score (<7 at 5 minutes) were associated with abnormal umbilical artery Doppler. Majority of neonates, 216(72%) had birth weight <2.5 Kg. 142 neonates (47.3%) out of 300 were delivered at less than 34 weeks. Poor Apgar score of <7 at 5 minutes was seen in 27 neonates (9%) and 157 (52.3%) neonates were admitted to NICU. In this study, there were 24(8%) perinatal deaths (Table 4).

Table 1: Distribution of age in the preeclamptic patients with abnormal UA Flow (n=300)

Age (years)	n	%age
20 — 25	104	34.7
26 — 30	136	45.3
31 — 35	60	20.0

Table 2: Gestational age distribution of the preeclamptic patients with abnormal UA Flow (n=300)

Gestation (in weeks)	n	%age
24 – 30	10	3.3
30.1 – 34	188	62.7
34.1 – 37	102	34

Table 3: Descriptive statistics

Variable	Mean±S.D.
Patient's Age (in years)	26.85±3.89
Gestational Age(in weeks)	33.02±1.59
Pulsatility Indices of UA	2.07±0.79

Table 4: Perinatal outcome in preeclamptic patients with abnormal UA Flow (n=300)

Complications	n	%age
Delivery < 34 weeks (preterm)	142	47.3
Recorded Birth weight <2.5 Kg	216	72
Apgar Score calculation <7 at 5 Minutes	27	9
Early Neonatal Death	24	8
NICU Admission	157	52.3

## DISCUSSION

All over the world, Pre-eclampsia along with the other hypertensive diseases of pregnancy is one of the leading causes of maternal and perinatal mortality and morbidity<sup>11</sup>. It has been seen that almost 26% of maternal mortality in Latin America and Caribbean are due to hypertensive disorders, however, in Africa and Asia their contribution is 9% of the total deaths. In a WHO report it is estimated that after every seven minutes at least one woman dies from complications of hypertensive disorders of pregnancy<sup>12</sup>. The perinatal mortality associated with preeclampsia is around 35/1000 total births in the UK and much higher in developing countries like Pakistan.

The use of umbilical artery Doppler velocimetry in high risk pregnancy with preeclampsia or presumed impaired fetal growth has been associated with reduction in perinatal deaths and there is also lowest number of inductions of labor and hospital admissions<sup>13</sup>.

A strong correlation has been observed between the raised umbilical artery Doppler indices and high incidence of perinatal complication in the pregnant women having preeclampsia, especially, absent/reversed end diastolic umbilical artery blood flow is associated with poor perinatal outcome, high perinatal mortality rate, long term impairment of intellectual development and neurodevelopment delay, proving it a strong predictor of perinatal outcome<sup>14</sup>.

Our study was designed to determine the efficacy of umbilical artery Doppler studies for the prediction of perinatal outcome in patients of preeclampsia. The study revealed that 218(72.7%) of neonates had at least one adverse perinatal

outcome. Majority of the neonates 216(72%) were low birth weight (<2.5 Kg), 142(47.3%) of the neonates were delivered at <34 weeks, 27 neonates (9%) had poor apgar score <7 at 5 minutes. There were 157(52.3%) admission to NICU and 24(8%) perinatal deaths. These results are comparable with national and international literature. Rana MJ and colleagues have reported that Babies with abnormal umbilical artery Doppler were born with poorer Apgar score and were more likely to suffer from asphyxia (10.7%) and hypoglycemia (46%), more admission to NICU(75%) than those babies with normal umbilical artery Doppler<sup>15</sup>. Their findings strengthened the results of our study,

Arduini and Rizzo in their study designed to measure the characteristics of the pulsatility index from the UA, MCA. In 46.7% (56 of 120) of fetuses, there was at least one of the following adverse outcomes: cesarean section due to fetal distress, 5-minute Apgar score below 7, perinatal mortality and asphyxia that necessitated admission to the neonatal intensive care unit for more than 48 hours<sup>16</sup>.

A similar study conducted in India by Anshul D et al, revealed that fetuses with abnormal umbilical artery velocimetry have preterm delivery (before 36 weeks of gestation (28% vs 76%), high NICU admission (24% vs 78%), low apgar score (3.7% vs 52%), need for PPV (0.8% vs 47%), than those with normal Doppler. The results were very close to our study

Seyam *et al* evaluated that fetuses who have abnormal PI of umbilical artery, and came to know that they were at increased risk for early delivery, 68% of them had reduced birth weight, 22% of them admitted to NICU and 11% of them need positive pressure ventilation<sup>18</sup>, whereas in our study neonatal admission were 52%. This difference may be because of better resuscitative facilities in their setups.

Another study done by Malhotra Neena et al found the perinatal mortality in fetus having AEDF/REDF was 40%, as compare to 10% in those with normal Doppler findings. However, in our study this figure is only 8%, this remarkable difference is most probably due to better neonatal facilities in the teaching hospital where our study was conducted<sup>19</sup>.

James and colleagues investigated the relationship between the umbilical artery Doppler scan, biophysical profile and abdominal circumference for the determination of the temporal relationship between the three ultrasonographic parameters. The observed order of deterioration was, first, the umbilical artery Doppler scan, then the abdominal circumference, and finally the biophysical profile<sup>20</sup>. Our study too revealed the importance of these parameters for detection of IUGR in the fetuses in the mothers suffering from preeclampsia.

As long as our country is concerned efforts must be taken for spreading awareness about the significant maternal and perinatal morbidity and mortality associated with preeclampsia. Doppler studies of the Umbilical artery effectively predict the perinatal outcome and hence timely obstetrical intervention based on its findings can improve the associated morbidity.

## CONCLUSION

Based on the findings of this study it can be concluded that Raised umbilical artery Doppler indices in preeclamptic patients are associated with poor perinatal outcome like low birth weight babies, NICU admission and preterm delivery. It is an effective method of fetal surveillance in pregnancies complicated by preeclampsia.

## REFERENCES

1. Young BC, Levine RJ, Karumanchi SA. Pathogenesis of preeclampsia. Annual Review of Pathological Mechanical Disease 2010; 5:173-92.
2. Haws RA, Yakoob MY, Soomro T, Menezes EV Reduce still births: screening and monitoring during pregnancy and labour. BMC Pregnancy Childbirth. 2009;9(Suppl 1):S5.
3. Hoffman C, Galan HL: Assessing the 'at-risk' fetus: Doppler ultrasound. Curr Opin Obstet Gynecol. 2009;21(2):161-166.
4. Alfirovic Z, Stampalija T, Gyte GM: Fetal and umbilical Doppler ultrasound in high-risk pregnancies. Cochrane Database Syst Rev. 2010;(1):CD007529.
5. Padmagirison R, Rai L. Fetal doppler vs NST as predictors of adverse perinatal outcome in severe pre-eclampsia & fetal growth restriction. J Obstet Gynecol. 2006; 56: 134-8.
6. Young BC, Levine RJ, Karumanchi SA. Pathogenesis of preeclampsia. Annual Review of Pathological Mechanical Disease 2010;5:173-92
7. Grivell RM, Wong L, Bhatia V. Regimens of fetal surveillance for impaired fetal growth. Cochrane Database Syst Rev. Jan 21 2009;CD007113.
8. Chauhan SP, Gupta LM, Hendrix NW, et al. Intrauterine growth restriction: comparison of American College of Obstetricians and Gynecologists practice bulletin with other national guidelines. American Journal of Obstetrics and Gynecology. 2009;200:409.e1-409.e6.
9. Morris RK, Malin G, Robson SC, et al. Fetal umbilical artery Doppler to predict compromise of fetal/neonatal wellbeing in a high-risk population: systematic review and bivariate meta-analysis. Ultrasound Obstet Gynecol. 2011;37:135.
10. Wang KG, Chen CY, Chen YY. The effects of absent or reversed end-diastolic umbilical artery Doppler flow velocity. Taiwan J Obstet Gynecol. 2009;48(3):225-31.
11. Duley L. The global impact of pre-eclampsia and eclampsia. Semin Perinatol. 2009;33:130-37.
12. Dadelszen P V, Magee L. What matters in preeclampsia are the associated adverse outcomes: the view from Canada. Current opinion in obstetrics and gynecology. 2008;20:110.
13. Gagnon R, Van den Hof M; Diagnostic Imaging Committee, Executive and Council of the Society of Obstetricians and Gynaecologists of Canada. The use of fetal Doppler in obstetrics. J Obstet Gynaecol Can. 2003;25:601-14;quiz 615
14. Arauz JF, Leon JC, Velasquez PR, Jimenez GA, Perez CJ. Umbilical artery Doppler velocimetry and adverse perinatal outcome in severe preeclampsia. Ginecol Obstet Mex. 2008 Aug;76(8):440-9.
15. Rana MJ, Amanullah A. The role of umbilical artery Doppler in detection and management of fetal growth retardation. 2005;: <http://www.thebiomedicapk.com/articles/26.pdf>
16. Arduini D, Rizzo G. Prediction of fetal outcome in small for gestational age fetus: comparison of Doppler measurements obtained from different fetal vessels. J Perinat Med. 2012; 20:29-38.
17. Anshul D, Neelu S, Suneeta G. Significance of umbilical artery Doppler velocimetry in the perinatal outcome of the growth restricted fetuses. Indian J Obstet Gynecol. 2010;60:38-43.
18. Seyam YS, Al-Mahmeid MS. Umbilical artery Doppler flow velocimetry in intrauterine growth restriction and its relation to perinatal outcome. Int J Gynaecol Obstet. 2002; 77:131-137.
19. Malhotra N, Chanana C, Kumar S et al. Comparison of perinatal outcome of growth restricted fetuses with normal and abnormal umbilical artery Doppler waveforms. Indian J Med Sci. 2006;60:311-7.
20. James DK, Parker MJ, Smoleniec JS. Comprehensive fetal assessment with three ultrasonographic characteristics. Am J Obstet Gynecol. 2013 May;166(5):1486-95.