

# Significance of Umbilical Artery Velocimetry in Perinatal Outcome of Growth Restricted Fetuses

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## Summary:

**Objectives:** To study pregnancy outcomes in growth restricted fetuses with normal umbilical artery velocimetry, low end-diastolic umbilical flow, and absent or reversed diastolic flow. **Methods:** Fifty pregnant women with growth restricted fetuses were evaluated by umbilical artery velocimetry between 28 and 39 weeks of pregnancy. **Outcome of pregnancy was recorded for the normal Doppler group (n=17; 34%), the low end diastolic flow group (n=23; 46%), the group with absent diastolic flow (n=8; 16%) and the group with reversed diastolic flow (n=2; 4%). Results:** The average birth weight, diagnosis to delivery interval and

gestational age at delivery were comparatively lower in case of abnormal umbilical Doppler velocimetry group. Again there was higher incidence of LSCS for fetal distress, Apgar score <7 at 1 minute, admission to neonatal intensive care unit and perinatal death with those of the abnormal umbilical Doppler velocimetry. **Conclusion:** Doppler study of umbilical artery allows a noninvasive assessment of uteroplacental insufficiency and is an accurate method for diagnosis and management of fetal growth retardation.

**Key Words:** Intrauterine Growth Retardation, Doppler, Umbilical Artery Velocimetry.

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## Introduction:

Intrauterine growth restriction is a common clinical sign of chronic fetal hypoxaemia. It is difficult to differentiate between suboptimal fetal growth due to intrauterine starvation and adequate growth of a constitutionally small infant. Umbilical artery velocimetry is a good predictor in these growth restricted fetuses at risk of antenatal compromise.<sup>1,2,3</sup>

Intrauterine growth retardation is defined as a birth weight below the 10<sup>th</sup> percentile for a given gestational age.<sup>4,5</sup> Small for gestational age (SGE) occurs in approximately 5-10% of all pregnancies.<sup>6</sup> The primary cause in 60% of pregnancies with fetal growth restriction (FGR) has been reported to be placental insufficiency.<sup>6,7</sup> Inadequate invasion or non-invasion of the trophoblastic tissue within chorionic villi vessels leads to reduction in umbilical artery blood flow. Doppler index increases and in the end, there appears absent/reversed end diastolic blood flow.<sup>6,8,9</sup> In IUGR fetuses there exists strict correlation between the umbilical artery doppler waveform and increased incidence of perinatal complications and, particularly, absent/reversed end

diastolic umbilical arterial blood flow has been shown to be associated with high perinatal mortality, long term impairment of intellectual development, and neuro-developmental delay.<sup>6,10,11,12</sup> detecting the fetus with pathological growth restriction that is at risk for perinatal complications has been an on going challenge in obstetrics.<sup>1</sup> Doppler flow velocity analysis can be valuable in resolving this question.<sup>13,14</sup>

## Materials and Methods:

A cross sectional comparative study on “Significance of Umbilical Artery Velocimetry in Perinatal Outcome of Growth Restricted Fetuses” was carried out in CMCH at the department of obstetrics and gynaecology during the period of April 2010 to March 2011. The study population consisted of 50 women with singleton IUGR pregnancy and their gestational age ranged between 28 and 39 weeks. The purpose of the study was explained to all potential candidates and those who volunteered were selected after taking their informed written consent. They were registered for delivery with us.

Known date of last menstrual period, clinical discrepancy of symphysis fundal height of four weeks or more and ultrasonography showed fetal weight less than 10<sup>th</sup> percentile of their gestational age on femur length (FL), biparietal diameter (BPD) and abdominal circumference (AC) were included as study group. Congenital malformation of the fetus, uterine malformation, transverse lie, PROM were excluded.

Data were collected in case record form containing both open ended and structured questionnaires through

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observation, interviewing, clinical examination and evaluation of all available medical reports, documents.

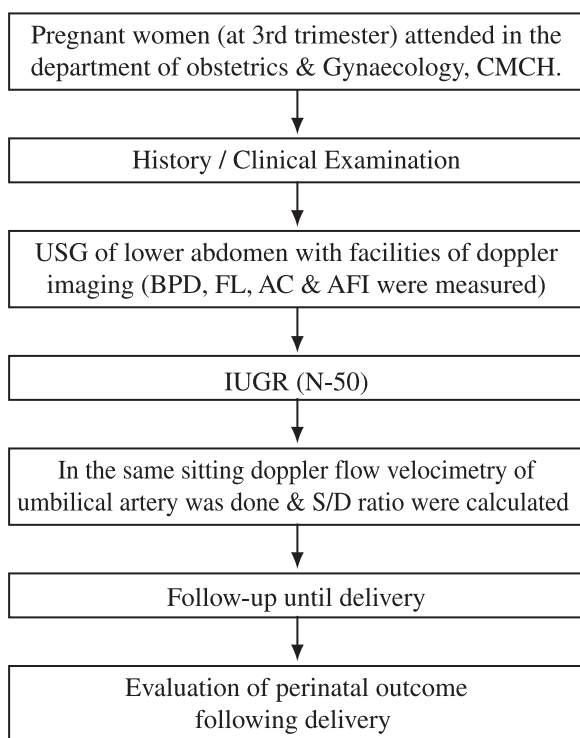
High definition image with a 3.5 MHz curvilinear transducer were used to obtain IUGR and doppler waveforms. BPD, FL, AC and AFI were measured and IUGR were corroborated. In the same sitting, doppler flow velocimetry of umbilical artery was done and systolic-diastolic ratio (S/D ratio) was calculated.

For the purpose of analysis, the study populations were distributed in four groups: a normal doppler group, a diminished end-diastolic flow group, an absent diastolic and reversed diastolic flow group. All the women were followed until delivery.

Data collected included diagnosis to delivery interval, abnormal fetal heart pattern before labour, elective cesarean section rate, emergency cesarean section rate for fetal distress, gestational age at delivery.

Perinatal outcome were evaluated following delivery and correlated with calculated values of doppler indices. Adverse perinatal outcome included low birth weight, Apgar score <7 at birth, admission to NICU and duration of stay there, need for positive pressure ventilation and perinatal death.

#### Following flow chart showing the Methodology:



#### Result:

Thirty three of the 50(66%) pregnancies with low birth weight had abnormal doppler waveforms in the umbilical arteries. Doppler waveform of the umbilical artery was considered abnormal if S/D ratio was equal to or more than 3 (three) or diastolic flow was absent/reversed in fetuses above the gestational age of 28 weeks.<sup>15-18</sup> The mean S/D ratio was 2.26 for the normal Doppler group (N=17) and the S/D ratio was 3.72 in case of low end-diastolic velocity of abnormal doppler group.(Table-I) An additional 8 fetuses had absent end diastolic velocity and two fetuses had reversal of diastolic flow.

There was no statistically significant difference in maternal age and parity between mothers with small for gestational age babies of normal umbilical artery velocimetry and those with abnormal umbilical artery velocimetry studies. Mothers of small for gestational age babies with abnormal umbilical artery doppler studies were more likely to need caesarean section for fetal distress. There was spontaneous labour of 5(29.4%) patient with normal doppler group, 4(17.48%) with low end diastolic velocity and there was no vaginal delivery in absent or reversed diastolic velocity wave form group.(Table-I)

The total fetuses delivered at less than 36 weeks gestation were 2(11.76%) in normal doppler group, 6(26%) in low end-diastolic velocity group, 7(87.5%) in the group with absent end-diastolic velocity (Table-II) Frequently the fetuses in the abnormal doppler group were delivered by caesarean section and mainly because of non-reassuring fetal heart rate pattern than the fetuses with normal umbilical flow findings.(Table-I) These neonates had lower birth weight percentiles with higher perinatal asphyxia in terms of low apgar score which was below 7 at birth. The need for positive pressure ventilation for resuscitation was more in fetuses with absent/reversed diastolic flow studies.(Table-II)

Babies with abnormal umbilical artery doppler studies were more likely to be admitted to the neonatal intensive care unit and spend longer time there. Overall 53% (n=9) of small for gestational age babies with normal umbilical artery doppler studies were admitted to neonatal intensive care unit (NICU) in contrast to 69.5% (n=16) small for gestational age babies with low end diastolic

velocity on umbilical artery doppler. However all the fetuses with absent/reversed diastolic umbilical artery flow were admitted to the neonatal intensive care unit.(Table-II)

There was absent end diastolic flow in 8 (eight) subjects and reversed end-diastolic flow in 2 (two) subjects in this study. One subject with reversed end-diastolic

velocity (REDV) of umbilical artery had stillborn and neonatal death occurred on 7<sup>th</sup> day of life in case of another one. Out of 8 (eight) subjects with absent end-diastolic velocity (AEDV) of umbilical artery 3 had IUD (Intrauterine death), 2 had neonatal death (one on 1<sup>st</sup> day of life and another one on second day of life) and 3 of them survived.(Table-III)

**Table-I**

<i>Characteristics of patient and labour outcome (N=50)</i>				
	Normal Doppler (N=17, 34%)	Abnormal Doppler (N=33, 66%)		
		Low end-diastolic velocity N=23, 69.70%)	Absent diastolic velocity (N=8, 24.24%)	Reversed diastolic velocity (N=2, 6.06%)
Mean S/D Ratio	2.62		3.72	
Maternal age (years)	24.78		25.52	
Parity a) primipara	6(35.29%)		11(33.31%)	
b) Multipara	11(64.70%)		22(66.66%)	
Diagnosis of abnormal Doppler to delivery interval	NA	9.0 days	4 days	Within 6 hours
Emergency LSCS for fetal distress	2(70%)	19(82.6%)	5(62.5%)	2(100%)
Spontaneous labour	5(29.4%)	4(17.4%)	3(37.5%)	nil

S/D – Systolic /Diastolic

NA – Not Applicable

LSCS – Lower Segment Caesarean Section

**Table-II**

<i>Neonatal outcome (N=50)</i>				
	Normal Doppler (N=17, 34%)	Abnormal Doppler (N=33, 66%)		
		Low end-diastolic velocity N=23, 69.70%)	Absent diastolic velocity (N=8, 24.24%)	Reversed diastolic velocity (N=2, 6.06%)
Delivery at less than 36 weeks gestation	2(11.8%)	6(26%)	7(87.5%)	0 (0.0%)
Average birth weight (gm)	2091	1965	1330	1285
NICU Admission	9(53%)	16(69.5%)	5(62.5%)	1(50%)
Average stay in Neonatal intensive care unit (days)	1.8	4.5	7.6	3.5
Need for positive pressure ventilation	2(12%)	6(23%)	5(62.5%)	1(50%)
Apgar score <7 at birth	5(29%)	9(39%)	5(62.5%)	1(50%)
Perinatal death	0(0.0%)	0(0.0%)	5(62.5%)	2(100%)
Sex a) Female	6	7	4	-
b) Male	11	16	4	2

NICU - Neonatal intensive care unit

**Table-III**

<i>Profile of women with AEDV / REDV</i>					
Umbilical arterial	Fetal Outcome Blood flow velocity	Birth Weight (g)	Apgar score at 1 & 5 min	Admission in NICU	Perinatal Outcome
REDV at 36 wks 3 days	Still Born at 36 wks 4 days LSCS	1400	-	-	-
REDV at 36 wks 2 days	Alive LSCS at 36 wks 2 days	1500	6 and 8	Needed	Death on 7 <sup>th</sup> day
AEDV at 29 wks 5 days	Alive LSCS at 30 wks	800	5 and 7	Needed	Death on 2 <sup>nd</sup> day
AEDV at 29 wks 4 days	Alive LSCS at 30 wks	700	5 and 7	Needed	Death on 1 <sup>st</sup> day
AEDV at 31 wks 1 days	Alive LSCS at 31 wks 1 days	1250	6 and 8	Needed	Survived
AEDV at 31 wks 3 days	Alive LSCS at 31 wks 5 days	1300	6 and 8	Needed	Survived
AEDV at 32 wks 2 days	Alive VD at 32 wks 4 days	1200	4 and 7	Needed	Survived
AEDV at 33 wks 2 days	IUD VD at 33 wks 3 days	1300	-	-	-
AEDV at 33 wks 3 days	IUD VD at 33 wks 5 days	1250	-	-	-
AEDV at 35 wks 2 days	IUD VD at 38 wks	1200	-	-	-

AEDV – Absent End Diastolic Velocity

REDV – Reversed End Diastolic Velocity

IUD – Intra Uterine Death

VD – Vaginal Delivery

LSCS – Lower Segment Caesarean Section

NICU – Neonatal Intensive care unit

### Discussion:

Doppler velocimetry identifies normal and altered blood flow velocity in the umbilical artery and is responsive to changes in placental resistance. It is a noninvasive technique that evaluates abnormal fetal hemodynamics that results in abnormal pregnancy outcome. It has been shown by various workers that perinatal morbidity and mortality were significantly greater in small for gestational age babies with abnormal umbilical artery doppler studies than in those with normal studies.<sup>1,18-20</sup> Various studies have reported on the association of abnormal umbilical artery velocity waveforms with fetal growth restriction and its prediction.<sup>1,2,3</sup> All infants whose birth weight is below the 10<sup>th</sup> percentile are not exposed to pathologic process in utero but some are constitutionally small and healthy. It is a challenge to differentiate the fetus with pathologic growth restriction and hence at risk for perinatal complications from constitutionally small but healthy fetus.

Meta-analysis of the use of doppler ultrasonography in high risk pregnancies with IUGR has revealed a statistically significant improved perinatal outcome.<sup>21</sup> The result shown in Table - II reveal that fetuses with abnormal umbilical artery velocimetry have a shorter

diagnosis to delivery interval, early delivery, decreased birth weight, increased NICU admission and duration of stay there, and need for positive pressure ventilation with low apgar scores than those with normal doppler group. Various workers have noticed in fetuses with abnormal umbilical artery doppler velocimetry a similar poor perinatal outcome.<sup>15,17,21-23</sup>

Torres et al in their retrospective study, reported that absence of end diastolic flow was correlated with IUGR in 100% of pregnancies and fetal death by 66.6%.<sup>24</sup> Higher mortality rates are reported in those fetuses with absent or reversed end-diastolic flow on antenatal doppler velocimetry which is similar with present result.<sup>25,26</sup> In this study it was found that still birth and IUD (Intrauterine death) was 4(8%) and neonatal death was 3(6%).

Doppler findings may be detected several hours to days before any abnormality, in cardiotocographic tracings.<sup>27,28,29</sup> Assessment of EDF(end diastolic flow) is useful because when it is reduced it detect 30% severe hypoxia, when there is AEDF(absent end diastolic flow) is very worrying sign & detect 50% severe hypoxia and in case of REDF (reverse end diastolic flow) is ominous which detect 70% severe

hypoxia and fetal death occur within 7 days.<sup>30</sup> The pregnancy could be continued even in the presence of AEDF for approximately 1 to 2 weeks with intensive fetal surveillance. This may provide time for administration of steroids to enhance fetal lung maturity and also the extra days may add to the fetal weight. This time also enables for shifting of the patient to a tertiary centre where proper neonatal care can be provided.<sup>27</sup> REDF is a terminal event associated with an extremely high perinatal mortality.<sup>27</sup> Immediate delivery is advocated when REDF sets in usually within 24 hours of diagnosis and mainly the route of delivery is cesarean section in these pregnancies.<sup>31</sup> It is reasonable to assume that decreased uteroplacental perfusion during uterine contractions is likely to further jeopardize gaseous exchange in fetuses with preexisting abnormal umbilical artery velocimetry.<sup>32</sup> However, despite encouraging results, controversy still exists as to the optimal timing of delivery. Arguments tending towards an immediate delivery in the absence of the diastolic velocity waveform or by the appearance reverse end-diastolic blood flow are counterbalanced by the risks associated with prematurity.<sup>31,33,34</sup> In most studies intrauterine growth restriction (IUGR) has been shown to have deleterious effects on mortality and morbidity in newborn infants, both in term and preterm infants.<sup>31, 35,36,37</sup>

### Conclusion:

In conclusion, this can be recommended that doppler studies should be done for all pregnant women with intrauterine growth retardation (IUGR). If end-diastolic flow is normal or reduced, we can wait and patient should be followed-up by repeat doppler along with other methods of fetal surveillance like non-stress test (NST) and biophysical profile (BPP). But in women with absent end diastolic flow (AEDF) or reversed end diastolic flow (REDF), if the baby is salvageable and nursery facilities are available, it is safer to deliver the baby for a better perinatal outcome, as the number of perinatal deaths is very high in this group. Where nursery facilities are not available, patients should be followed-up closely and carefully by biophysical profile and cardiotocographies in order to gain time for steroid administration in premature fetuses. These measures will reduce perinatal death.

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