ORIGINAL PROF-1537

# INTRAUTERINE GROWTH RESTRICTION;

## RELATIONSHIP BETWEEN ABNORMAL UMBILICAL ARTERY DOPPLER AND ADVERSE APGAR SCORE

**DR. ABEERA CHOUDRY**
**FCPS, MRCOG, FRCSEd**
Department of Obstetrics & Gynaecology
CMH, Multan

**DR. SUMAIRA KHAN, FCPS**
Department of Obstetrics & Gynaecology
CMH, Quetta

**DR. HUMAIRA HAFEEZ, FCPS**
Department of Obstetrics & Gynaecology
CMH, Khuzdar

***Dr. Ambreen Anwar, FCPS, MRCOG***
Department of Obstetrics & Gynaecology
CMH, Quetta

***Dr. Irfan Shukr***
***FCPS, FRCSEd, MCPS (Med Edu)***
Department of Surgery
CMH, Multan

**Article Citation:**
Choudry A, Khan S, Hafeez H, Anwar A, Shukr I. Intrauterine growth restriction; Relationship between abnormal umbilical artery Doppler and adverse apgar score. Professional Med J Dec 2009; 16(4): 589-599.

**ABSTRACT...Objective:** To compare fetal outcome in normal umbilical artery Doppler findings to abnormal umbilical artery Doppler findings in pregnant women with fetal growth restriction.**Main outcome measures:** Umbilical artery Doppler studies, apgar score at 1 minute and apgar score at 5 minutes after delivery.**Study Design:** Cross-sectional, comparative study. **Setting:** Department of Obstetrics and Gynaecology, Military Hospital and Combined Military Hospital, Rawalpindi.From Jan 2005 to Jan2007.**Methods:** Patients with fetal growth restriction between 28 to 37 weeks of pregnancy were selected, in whom diagnosis was confirmed by ultrasonography. All patients were followed up with umbilical artery Doppler studies. The study group consisted of 48 women (group I), where the umbilical artery waveform was compromised. The outcome in these was compared with an equal number of controls, where growth restricted fetuses had normal Doppler waveforms (group II). **Results:** The mean age of patients in group I was 26.9 years and in group II was 28.6 years. Fetuses with abnormal umbilical artery Doppler findings had higher incidence of maternal gestational hypertension and oligohydramnios. Rate of emergency cesarean section for fetal distress was also higher in this group. Growth restricted babies with abnormal umbilical artery Doppler waveforms had lower apgar scores. In babies with normal Doppler studies, 91.6% had apgar score above 7 at 5 minutes after birth. In babies with raised RI 78.1%, in babies with abscent end diastolic flow 54.5% and in babies with Reversed end diastolic only 20% had apgar score above 7 at five minutes after birth. The difference was statistically significant (P=0.001 ).**Conclusion:** Umbilical artery velocimetry can distinguish the group of growth restricted fetuses at risk of poor apgar. Growth restricted fetuses with normal Doppler studies are at a lower risk than those with abnormal Doppler findings in terms of poor apgar score.

**Key words:** Fetal growth restriction, Umbilical artery Doppler studies, fetal outcome.

## INTRODUCTION

Fetal growth restriction (FGR) is a syndrome, characterized by failure of the fetus to attain its normal growth potential; fetuses with FGR, therefore represent a subset of fetuses designated small for gestational age (SGA )[1]. Much of the published research with regard to

Article received on: 09/06/2009
Accepted for Publication: 15/08/2009
Received after proof reading: 10/10/2009
**Correspondence Adders:**
AbeeraChoudry
Department of Obstetrics & Gynaecology
CMH, Multan
abeera_choudry@yahoo.com

growth restriction is based on birth weight criteria.[2] Symmetrical FGR is caused by congenital infections or chromosomal abnormalities, whereas asymmetrical FGR is caused by utero-placental abnormality[3], maternal malnutrition[4] or multiple pregnancies. Asymmetrical FGR occurs more frequently after 26 weeks of pregnancy.

Detecting the fetus with pathological growth restriction that is at risk for perinatal complications has been an ongoing challenge in obstetrics[5]. Randomized controlled trials conducted in high risk pregnancies, particularly in association with FGR have demonstrated that management based on the results of umbilical artery(UA) Doppler significantly improves a number of important obstetric outcomes, including antenatal admissions, elective delivery and induction of labour. It constitutes a relevant important investigation in the prediction of perinatal mortality and neonatal resuscitation.

It is important to measure umbilical artery resistance using pulsatility or resistance indices. A raised index indicates an abnormality, and this, together with absent end-diastolic flow (AEDF) and reversed end diastolic flow ( REDF ) , reflects underlying vascular pathology[6]. AEDF and REDF correlate with more occlusive lesions in the placenta and hence a higher perinatal mortality. However, fetal compromise despite normal umbilical artery Doppler waveforms is well described in the late third trimester.

## MATERIAL AND METHODS

The study was conducted in the Department of Obstetrics and gynaecology, Military Hospital (MH) and Combined Military Hospital (CMH) Rawalpindi between Jan 2005-Jan 2007.

A total of 96 cases of fetal growth restriction(FGR) were selected and divided into two groups.

**Group I :** 48 pregnant women with FGR and normal umbilical artery Doppler findings.

**Group II :** 48 pregnant women with FGR and abnormal umbilical artery Doppler findings.

Sampling technique was purposive (non-probability). It was a cross-sectional, comparative study.

### Inclusion Criteria

The inclusion criteria were

- Pregnant women with fetal growth restriction
- Pregnancy of more than 28 weeks of gestation
- Women between the age of 18-38 years

### Exclusion Criteria

Following patients were excluded from the study

- Pregnant women unsure of last menstrual periods (LMP ) where 1st trimester dating scan was also unavailable.
- Those patients who lived at high altitude
- Patients with multiple pregnancy
- Fetal growth restriction associated with congenital anomalies

## DATA COLLECTION PROCEDURE

All women, who had singleton pregnancies with small for gestational age fetuses, were selected on the basis of above-mentioned inclusion and exclusion criteria. They either attended the antenatal clinic with us or were referred in view of FGR from the peripheral hospitals. The pregnancies were dated by a combination of last menstrual period and first trimester dating scan. The diagnosis of fetal growth restriction was suspected clinically and confirmed subsequently on ultrasound .For the purpose of our study FGR was defined as the fetal abdominal circumference below the 10th centile.

A detailed anomaly scan was performed on all fetuses and dysmorphic fetuses were excluded from the study. The fetal biometry included assessment of biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). Fetal weight was estimated according to the Hadlock formula that uses FL, AC and BPD[3]. Amniotic fluid index ( AFI ) was calculated by adding the vertical depths of the largest pockets in each of the four uterine quadrants. Oligohydramnios was considered when AFI was eight or less without premature rupture of membranes[6].

All women included in the study, were subjected to

umbilical artery Doppler measurements. These women were divided into two groups depending on their Doppler findings. Group I (n=48) comprised of women with FGR and normal umbilical artery Doppler flow. Group II (n=48) included women with FGR and abnormal umbilical artery Doppler flow. Group II was further subdivided into two subgroups: a) those with raised resistance indices only, b) those with absent or reversed end-diastolic flow in the umbilical artery. Some patients shifted from Group I to Group II and also subgroup a to b during the course of study. The final UA Doppler was then assigned to the patient and patient was grouped accordingly.

Each women was given a course of steroids (intramuscular dexamethasone 12 mg, 2 doses and 12 hours apart ) between 28 and 36 weeks to enhance fetal lung maturity. Umbilical artery Doppler examination was repeated weekly or biweekly according to the severity of Doppler findings. Fetal biometry to evaluate growth was done fortnightly. Intensive fetal monitoring was performed with CTG (cardiotocography), BPP (biophysical profile) and amniotic fluid estimation on ultrasound. The frequency of these tests varied on the basis of intensity of growth restriction, as judged in biometry and umbilical artery Doppler measurements.

The following criteria were considered for decision regarding delivery:

- Gestational age of 37 weeks
- Absent end-diastolic or reversal of end-diastolic flow
- Abnormal fetal heart rate pattern on CTG
- Worsening of maternal condition e.g. pre-eclampsia
- Severe fetal growth restriction with AFI < 5 with raised RI

Induction of labour was performed if spontaneous labour did not start in those women planned for vaginal delivery. A group of women with associated obstetric indications were scheduled for elective cesarean section. The women, in whom labour was induced and those who spontaneously went into labour, were delivered by emergency cesarean section if fetal distress developed during labour.

Data collected included umbilical artery Doppler findings, apgar score at 1 minute apgar score at 5 minutes after delivery. Vaginal delivery rate, elective cesarean section rate and emergency cesarean section rate for fetal distress were also noted.

Statistical analyses was performed using SPSS version. Categoric variables were analysed using Fisher exact test and continuous variables using student t test.A p value<0.05 was considered significant.

## RESULTS

A total of 96 patients of FGR were studied. The mean age of patients in group I was 26.9 years and that of patients in Group II was 28.6 years, which was comparable. There was no major difference in parity between mothers with growth restricted fetuses of normal umbilical artery (UA) velocimetry and those with abnormal umbilical artery velocimetry studies so the two groups were comparable. The obstetric history suggested a higher incidence of small for gestational age babies and pregnancy induced hypertension in previous pregnancies of the mothers of abnormal group (Table I).

There was a trend for more underlying medical problems in mothers with abnormal Doppler studies. 12( 37.5%) fetuses with raised resistance indices (RI) and 11(68.7%) fetuses with absent end-diastolic flow (AEDF) or reversed end-diastolic flow (REDF) were associated with maternal gestational hypertension. However, 29.1% fetuses with normal umbilical artery Doppler studies also had pregnancy induced hypertension (PIH). Oligohydramnios was associated with PIH and was more commonly seen with abnormal Doppler studies(Table II).

| Table-I. Demographic and antenatal features | | |
|---|---|---|
| **Maternal Obstetric History** | **Group I. Normal UA Doppler (n=48)** | **Group II. Abnormal UA Doppler (n=48)** |
| Average maternal age | 26.9 years | 28.6 years |
| Primipara | 16 (33.3%) | 18 (37.5%) |
| Multipara | 32 (66.6%) | 30 (62.5%) |
| Past history of SGA | 02 (4.1%) | 06 (12.5%) |
| Past history of PIH | 04 (8.3%) | 06 (12.5%) |
| Past history of intrauterine death | 03 (6.2%) | 05 (10.4%) |
| *UA=umbilical artery, SGA=small for gestational age, PIH=pregnancy induced hypertension* | | |

| Table-II. Comparison of antenatal characteristics | | | |
|---|---|---|---|
| **Antenatal Characteristics** | **Group I. Normal UA Doppler (n=48)** | **Group II. Abnormal UA Doppler (n=48)** | |
| | | **Raised RI (n=32)** | **AEDF/REDF (n=16)** |
| PIH / Pre-eclampsia | 14 (29.1%) | 12 (37.5%) | 11 (68.7%) |
| Gestational diabetes | 01 (2.1%) | 01 (3.1%) | 01 (6.2%) |
| Oligohydramnios | 09 (18.7%) | 09 (28.1%) | 10 (62.5%) |
| Idiopathic | 25 (52.0%) | 02 (6.25%) | Nil |
| *UA=umbilical artery, RI=resistance index, AEDF=absent end-diastolic flow, REDF=reversed end-diastolic flow, PIH=pregnancy induced hypertension* | | | |

Each of the 3 diabetics with FGR had prepregnancy insulin dependant diabetes. Patients with FGR and abnormal umbilical artery Doppler studies were more likely to need cesarean section for fetal distress. 21.8% patients with raised RI and 68.7% patients with AEDF / REDF had emergency cesarean section for fetal distress. For the later distress was mostly prelabour Whereas, only 12.5% patients with normal umbilical artery Doppler studies had emergency cesarean section. Women in group II were less likely to be induced than those in group I (Table III).

| Table-III. Comparison of mode delivery | | | |
|---|---|---|---|
| **Mode of Delivery** | **Group I. Normal UA Doppler (n=48)** | **Group II. Abnormal UA Doppler (n=48)** | |
| | | **Raised RI** | **AEDF/REDF** |
| Spontaneous vaginal delivery | 11 (22.9%) | 02 (6.2%) | Nil |
| Vaginal delivery following Induced Labour | 14 (29.1%) | 04 (29.1%) | 01 (6.2%) |
| Emergency Cesarean Section | 06 (12.5%) | 07 (21.8%) | 11 (68.7%) |
| Elective Cesarean Section | 17 (35.4%) | 19 (59.3%) | 04 (25%) |
| Caesarean section rate | 50% | 81% | 93% |
| *UA=umbilical artery, RI=resistance index, AEDF=absent end-diastolic flow, REDF=reversed end-diastolic flow* | | | |

Growth restricted babies with abnormal UA velocimetry waveforms (Group II) had higher perinatal asphyxia in

terms of lower apgar scores, which were measured at 1 minute and 5 minutes after birth. In babies with REDF, 60% had apgar score < 3, 40% had apgar score between 4-7 and no baby had apgar score > 7 at 1 minute after birth (Table-IV).

**Table-IV. Comparison of UA Doppler findings for apgar score at one minute**

| UA Doppler findings | Apgar Score at 5 minutes | | | Total / mean apgar | P Value |
|---|---|---|---|---|---|
| | < 3 | 4-7 | > 7 | | |
| Normal | 01(2.0%) | 08 (16.6%) | 39 (81.2%) | 48 / 9 | |
| Raised RI | 04(12.5%) | 10 (31.2%) | 18 (56.2%) | 32 / 7.3 | 0.001 |
| AEDF | 02(18.1%) | 07 (63.6%) | 02 (18.1%) | 11 / 6.4 | 0.001 |
| REDF | 03(60%) | 02 (40%) | Nil | 05 / 4.7 | 0.001 |
| Total | 10 | 27 | 59 | 96 | |

*Sum-up Normal Doppler: apgar score>7=39(81%) Abnormal Doppler: apgar score>7=20(41%)*

Comparison of 5 minutes apgar shows that in group with normal UA Doppler studies 44(91.6%) had apgar >7 and in the abnormal only 32(66.6%) had apgar >7.

Difference in apgar scores in the two groups was statistically Significant, for apgar score at 1minute (P=0.001) and for apgar score at 5 minutes (P=0.001 ). o sum up out of the 48 patients with abnormal UA Doppler 16(33.3%) had apgar score <7 and only 4(8.3%) with normal UA Doppler had apgar <7 at 5 minutes(Table V)

**Table V. Comparison of UA Doppler findings for Apgar**

| UA Doppler findings | Apgar Score at 5 minutes | | | Total / mean apgar | P Value |
|---|---|---|---|---|---|
| | < 3 | 4-7 | > 7 | | |
| Normal | Nil | 04 (8.3%) | 44 (91.6%) | 48 / 9 | 0.001 |
| Raised RI | Nil | 07 (21.8%) | 25 (78.1%) | 32 / 8.1 | 0.001 |
| AEDF | Nil | 05 (45.4%) | 06 (54.5%) | 11 / 7.4 | 0.001 |
| REDF | Nil | 04 (80%) | 01 (20%) | 05 / 5.9 | 0.001 |
| Total | 0 | 20 | 76 | 96 | |

*UA=umbilical artery, RI=resistance index, AEDF=absent end-diastolic flow, REDF=reversed end-diastolic flow*
*Sum-up Normal Doppler: apgar score>7=39(81%)*
*Abnormal Doppler: apgar score>7=20(41%)*

**Fig-1. Comparison of UA Doppler findings for apgar score at 1 minute**

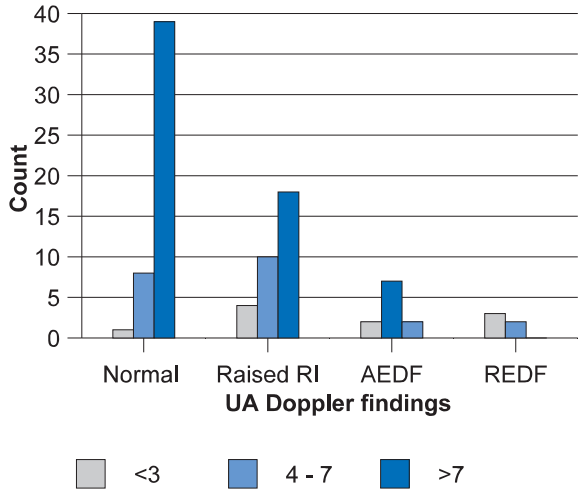
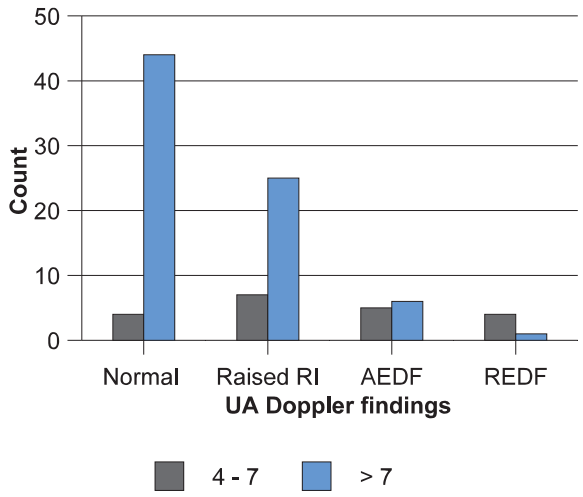



**Fig-2. Comparison of UA Doppler findings for apgar score at 5 minutes**




## DISCUSSION

FGR contributes disproportionately not only to neonatal morbidity and mortality but also to major psychiatric sequel as depression and suicide. Timely prediction of growth restriction due to ischemic placental disease and compromise of fetal wellbeing is of essence in antenatal care. Without accurate prediction, clinicians are handicapped. Wrong or delayed prediction puts baby at risk of an adverse outcome whereas correct prediction provides an opportunity to optimize care. Our study included a mixed group of population belonging to lower and middle or upper socioeconomic class, MH being a hospital for other ranks and CMH for wives of army officers.

We used the 10$^{th}$ centile of abdominal circumference for diagnosis of IUGR . Other studies have used 5$^{th}$ or 10$^{th}$ centile for expected fetal weight along with abdominal circumference. ARED flow of umbilical artery was shown to be a reliable predictor of major nuerological sequel but not of IQ performance in school[7]. The Growth restriction intervention trial (GRIT) was a multicentric trial in 96 European hospitals that studied the management of 58,59 IUGR fetuses with abnormal Doppler. In fetuses <30 weeks with abnormal doppler 3 day delay was associated with less cerebral palsy and Grifffiths development coefficient under 70[8,9].

Various studies have confirmed the clinical benefits of umbilical artery Doppler velocimetry in high risk pregnancies, where this method has been compared with conventional CTG ,BPP and ultrasound fetometry. Doppler surveillance of growth restricted fetuses supplemented with cardiotocography, preferably combined with biophysical profile testing, results in a prolonged gestational age and acceptable fetal outcome[10] In our study we based intensity of monitoring on the results of Doppler. Ominous signs include UA absent or reverse end-diastolic flow, non-assuring NST, low BPP.[11] Another study concluded that umbilical artery Doppler as a screening test for fetal well-being in a high risk population was associated with a decreased incidence of cesarean delivery for fetal distress compared to the nonstress testing[13]. Abnormal Doppler precedes decreased growth velocity in fetal growth charts[7].

In fetuses with suspected IUGR, abnormal Middle Cerebral Artery/Umblical artery (MCA/UA) S/D ratios are strongly associated with low gestational age at delivery, low birth weight, and low UA pH. Abnormal MCA/UA S/D ratios are also significantly associated with shorter

interval to delivery and the need for emergent delivery. We did not use these ratios as MCA Doppler was not available in our institute at the time of commencement of this study[13].

Controversy continues as to which the best fetal vessel for deciding pregnancy continuation is. Evidence from authorities[15] recommend umbilical artery Doppler to be good, but supplementation of other vessels such as middle cerebral artery or ductus venosus, may add value to decision making[14]. Among preterm growth restricted fetuses with absent end-diastolic blood flow in the umbilical artery, the umbilical artery / middle cerebral artery ratio is the best predictor of neonatal mortality or severe morbidity[16]. Another study shows that in high risk pregnancies with umbilical absent or reversed end-diastolic flow velocities, determination of blood flow velocities in the ductus venosus is a useful additional parameter for prediction of fetal outcome and for timing delivery[17]. But ductus venosus waveforms are time consuming and may not be possible for all sonographers. Therefore, umbilical artery Doppler is preferred in clinical settingswhich is in perfect agreement with our study. We also relied on UA Doppler for decision making in the management of these high risk cases. High flow resistance in the capillaries of the terminal villi leads to a low end-diastolic velocity in the umbilical artery and consequent hypoxia[18]. As a result adaptation occurs in the form of cerebral vasodilatation, resulting in the redistribution of the cardiac output to provide an adequate oxygen supply to the brain. These changes, which help fetus to adapt to a hostile environment, may correlate with fetal neonatal health.The cerebroplacental ratio offers the advantage of detecting redistribution of blood flow with decreased cerebral flow resistance. Evidence is accumulating to show that ductus venosus Doppler is a good sorrugate marker for fetal academia. ductus venosis abnormalities correlate well with adverse outcome but the question remains whether fetal damage has already occurred by the time these changes occur[8]. Although UA-REDV is an independent contributor to poor neurodevelopment in IUGR no such effect could be demonstrated for abnormal venous Doppler findings or BPP. UA Doppler is a placental function test that provides important diagnostic and prognostic information in preterm IUGR.Relationships between perinatal outcomes, arterial and venous Doppler status and gestational age require ongoing observational research effort. Randomized management trials are necessary to verify that delivery timing based on venous Doppler will impact on outcome in preterm IUGR. Meanwhile UA Doppler refines the decision making process in agreement with our study.

Gestational age and birth weight remain the predominant factors for poor neurodevelopment in growth-restricted infants. Backward stepwise logistic regression analysis was used to determine the optimal model for the prediction of neonatal mortality and severe neonatal morbidity all other independent variables were excluded for the optimal model. There was no mortality for the group with normal birth weight Z score.

This study suggests that birth weight Z score is the strongest predictor of adverse neonatal outcome in severe placental insufficiencies. Such use of Z scores, allowing to get rid of gestational age or sex covariates could be extended to estimated fetal weight and might help in making important decisions in the management of compromised pregnancies. We did not stratify our results of fetal outcome by weight as it was not part of our study design. We only established link between UA Doppler and poor Apgar scores[13]. The study by Karger etal showed that both cerebral artery an umbilical artery doppler need to be used in perinatal monitoring of growth-retarded fetuses. The two methods can be used as important parameters in deciding to end pregnancies with IUGR when pathological values occur in NST[3].

Doppler is the most effective approach to differentiate potentially manageable placenta-based FGR from aneuploidy, nonaneuploid syndromes, and viral infection. Although placental dysfunction results in a multisystem fetal syndrome with impacts on short- and long-term outcome, only cardiovascular and behavioral responses are helpful to guide surveillance and intervention. Choosing appropriate monitoring intervals based on anticipated disease acceleration and intervention when fetal risks exceed neonatal risks are the prevailing current management approaches[15]. A study carried out

in Aga Khan University Hospital Karachi, confirmed that Doppler ultrasound is an accurate method for diagnosis and management of fetal growth restriction[14]. as was also highlighted by Rana et al[19]. Therefore, Doppler sonography in combination with the other biophysical methods such as cardiotocogram and biophysical profile score should be used in everyday practice for the monitoring and appropriate management of the growth restricted fetuses[20]. A study was undertaken to compare the efficacy of nonstress test, biophysical profile, or abnormal Dopplers in predicting adverse perinatal outcomes in intrauterine growth restriction. It concluded that in cases of intrauterine growth restriction, the presence of abnormal Doppler is the best predictor of adverse perinatal outcome[21].In our study there was a direct and linear relationship between poor Apgar and abnormal UA Doppler.

Several studies have been carried out to prove the role of umbilical artery Doppler in high risk pregnancy. It was found that middle cerebral artery / umbilical artery Doppler ratio was valuable for predicting the outcome of pre-eclamptic and hypertensive pregnancies[18]. A study concluded that there was a strong correlation between the middle cerebral artery / umbilical artery resistance index and neonatal outcome in women with preeclampsia[22]. Resistive index of umbilical artery proved to be an early indicator of fetal compromise before any fetal distress becomes obvious[20]. At the time of commencement of our study the exact predictive value of these variables was not clearly established .So we relied on UA Doppler alone and found it to be very useful. For very low birth weight fetuses it helped us prolong pregnancy and add several useful days to fetal maturity. Fetoplacental vascular reactivity is altered in FGR pregnancy[23]. Umbilical artery Doppler should not be used as a screening tool in healthy pregnancies, as it has not been shown to be of value in this group[24]. Doppler velocimetry is a noninvasive technique that evaluates abnormal fetal hemodynamics that results in abnormal pregnancy outcomes[5].

It has been shown by various workers [25,26] that perinatal morbidity and mortality were significantly greater in growth restricted babies with abnormal umbilical artery Doppler studies than in those with normal studies. Various studies have been reported on the association of abnormal umbilical artery velocity waveforms with fetal growth restriction and its prediction[27]. Reversed flow should be seen as a particular clinical entity with higher incidences of perinatal and overall mortality as compared to the absent end-diastolic flow group[28].Similar results were duplicated in our study with four out of five babies with REDF having low apgar of <7 at 5 minutes.

In low resource country like ours the latter can help us choose which patient is likely to benefit from UA Doppler studies. Various studies report that oligohydramnios and gestational hypertension is a poor predictor of perinatal outcome in pregnancies with FGR.[7,29] However, in another study it was concluded that in the borderline amniotic fluid index ( AFI ) group, the presence of abnormal Doppler velocimetry measurement was related to increased risk of perinatal outcome[30]. UA Doppler velocimetry is not a good predictor of adverse perinatal outcomes in diabetic pregnancies[30].In our study we had 3 diabetics in normal and 2 in abnormal doppler arm , all with prepregnancy insulin dependant diabetes of more than 7 years duration .All cases incidentally also had PIH. Bachet et al [3]evaluated fetuses under the 5$^{th}$ centile and Mare etal[14] weight under under 3$^{rd}$ centile Both concluded that in addition to abnormal Doppler the best predictor of intact survival was gestational age >or equal to 29 weeks .In our study we only concentrated on outcome of abnormal Doppler and did not stratify our results in the light of fetal gestationt.Gonzalez[21] performed a retrospective cohort analyses of FGR fetuses with fetal weight below 5$^{th}$ centile .The objective was to compare the efficacy of CTG,BPP or abnormal umbilical Doppler in predicting adverse pregnancy outcome .The study proved that only abnormal Doppler was associated with increased risk. This is in perfect agreement with our study. While we compared apgar scores various workers have noticed in fetuses with abnormal UA Doppler velocimetry a similar poor perinatal outcome[30,31,32]. In a large study on 145 growth restricted fetuses from Italy, Cosmi and co-workers[33] reported that neonatal death was increased in fetuses with umbilical artery reversed flow ( $P < 0.05$ ).

Recent work of Vergani et al[34] showed that in fetal growth restricted cases delivered at or beyond 34 weeks gestation with abnormal umbilical artery velocimetry, it independently predicts the likelihood of admission to the NICU for reasons other than low birth weight alone. We only recorded apgar score and its link to degree of reduced end diastolic flow and did not follow the neonate regarding morbidity/mortality any further as per our study design. Schwarze et al[35] after analyzing 74 growth restricted fetuses between 24 to 34 weeks of gestation, concluded that abnormal venous Doppler waveforms in preterm IUGR fetuses with absent / reversed end-diastolic flow, are strongly related to adverse fetal and perinatal outcomes before 32 weeks of gestation. Our study confirmed the same.

The mothers of growth restricted babies with abnormal UA Doppler velocimetry were frequently delivered by cesarean section for fetal distress and were less likely to undergo induction of labour than those with normal Doppler. Patients with abnormal UA should be counseled regarding risk high risk of caesarean section. Only one baby was delivered following induction in AEDF group as the baby had expected fetal weight of only 0.7 kg and we felt caesarean section was not justified. The low apgar scores, as were also documented by Seyam et al[10]. Unlike our study this study only included patients with prelabour caesarean section and only AEDF/REDF.

The result of the present study clearly demonstrated the efficacy of umbilical artery Doppler in predicting fetal outcome. Gerber et al [25] studied the short and long term morbidity and mortality among children associated with abnormal umbilical artery Doppler and concluded that FGR associated with umbilical Doppler absent / reversed end-diastolic flow does not show any benefit from an expectant management in terms of long term morbidity, in addition to being associated with an increased perinatal loss. Another study concluded that in FGR fetuses, low birth weight and umbilical artery reversed flow were associated with an increased perinatal morbidity and mortality[34].Morbidity/mortality was not our focus of attention as the end point of our study was the Apgar score at 1and 5 minutes. This score then translates into poor short/long term outcome. Our data indicates that umbilical artery velocimetry can distinguish the group of growth restricted fetuses at risk of complications.The decision to continue pregnancy or to deliver fetuses in the prescence of AEDF is perplexing for the treating obstetrician. However, a study observed that pregnancy could be continued even in the presence of AEDF for approximately 10 days; with intensive fetal surveillance[1] this may provide time for administration of steroids to enhance fetal lung maturity. This time also enables for shifting of the patient to a tertiary centre where proper neonatal care can be provided. A recent work of Brodszki et al[36] found that FGR caused by placental insufficiency appears to be associated with impaired vascular growth persisting into young adulthood in both men and women.

Currently managing these pregnancies requires deligent fetomaternal monitoring. Doppler studies help in finer decision making with aim to reduce iatrogenic complication of prematurity and at the same time minimizing the long term consequences of hostile in utero environment.

## CONCLUSION

The present study indicates that the umbilical artery velocimetry can distinguish the group of growth restricted fetuses at risk of perinatal asphyxia. Growth restricted fetuses with normal umbilical artery velocimetry are at a lower risk than those with abnormal velocimetry in terms of poor apgar score. The study shows that instead of focusing on the small size of fetus, it is more important to observe fetoplacental function that is integral to neonatal outcome. Umbilical artery Doppler studies should be an integral parameter while evaluating in-utero health of the growth restricted fetuses. With this surveillance tool timing of delivery becomes less controversial.



## REFERENCES

1. Malhotra N, Chanana C, Kumar S, Roy K, Sharma JB. **Comparison of perinatal outcome of growth-restricted fetuses with normal and abnormal umbilical artery Doppler waveforms.** Indian J Med Sci 2006 Aug;60(8):311-7

2. Naheed I, Yasin A. **Determinants of low birth weight babies:a prospective study of associated factors and outcome.** Ann KE Med Coll 2000;6:361-3

3. Baschat AA, Hecher K. **Fetal growth restriction due to placental disease.** Semin Perinatol 2004;28:67-80

4. Khan N, Jamal M. **Maternal risk factors associated with low birth weight.** J Coll Physicians Surg Pak 2003;13:25-8

5. Arora D, Desai SK, Sheth PN, Kania P. **Significance of umbilical artery velocimetry in perinatal outcome of growth restricted fetuses.** J Obstet Gynecol India 2005;55:138-43.

6. Bilardo CM, Wolf H, Stiger RH, et al. **Relationship between monitoring parameters and perinatal outcome in severe, early intrauterine growth restriction.** Ultrasound Obstet Gynecol 2004;23:119-25

7. Chauhan SP,Cole J,Sanderson M rt al. **Suspension of intrauterine growth restriction:Use of abdominal circumference alone or estimated fetal weightbelow 10%.** J Maternal Fetal Neonatal Med 2006;19:557-562.

8. The Grit Study Group. **A randomized trial of timed delivery for the compromised preterm fetus: short term outcome an Baysenian interpretation.** BJOG2003;110:27-32.

9. Thorntorn JG, Hornbuckle J,Vail Aet al. **Infant well being at 2 years of age in Growth Restriction Intervention Trial (GRIT): Multicentered Randomised control trial.** Lancet 2004;364:513-520.

10. Seyam YS, Al-Mahmeid MS, Al-tamimi HK. **Umbilical artery Doppler flow velocimetry in intrauterine growth restriction and its relation to perinatal outcome.** Int J Gynaecol Obstet 2002 May;77(2):131-

11. Maulik D. **Management of fetal growth restriction: an evidence-based approach.** Clin Obstet Gynecol 2006 Jun;49(2):320-34

12. Harman CR, Baschat AA. **Arterial and venous Dopplers in IUGR.** Clin Obstet Gynecol 2003 Dec;46(4):931-46

13. Morris RK, Khan KS, Coomarasamy A, Robson SC, Kleijnen J. **The value of predicting restriction of fetal growth and compromise of its wellbeing: Systematic quantitative overviews (meta-analysis) of test accuracy literature.** BMC Pregnancy Childbirth 2007 Mar 8;7:3

14. Mari G,Hanif, Treadwell MC, Kruger M. **Gestational age at delivery and Doppler waveforms in very peterm intrauterine growth restricted fetuses as predictors of perinatal mortality.** J Ultrasound Med 2007;26:555-559.

15. Coomarasamy R, Fisk NM, Gee H, Robson SC. **The investigation and management of the small for gestational age fetus. Royal College of Obstetricians and Gynaecologists.** Guideline No. 31 [November 2002]. Available from: http://www.rcog.org.uk/.

16. Vergani P,Roncaglia N, Loctelli A et al. **Antenatal predictors of neonatal outcome in fetal groth restriction with assent end-diastolic flow in umbilical artery .** Am J Obstet Gynecol 2005 Sep;193:1213-8.

17. Muller T, Nanan R, Rehn M, Kristen P, Dietl J. **Arterial and ductus venosus Doppler in fetuses with absent or reverse end-diastolic flow in the umbilical artery: correlation with short-term perinatal outcome.** Acta Obstet Gynecol Scand 2002 Sep;81(9):860-66.

18. Yalti S, Oral O, Gurbuz B, Ozden S, Atar F. **Ratio of middle cerebral to umbilical artery blood velocity in preeclamptic & hypertensive women in the prediction of poor perinatal outcome.** Indian J Med Res 2004 Jul;1209(1):44-50

19. Rana MJ, Amanullah A, farooq O. **The role of umbilical artery Doppler in detection and management of fetal growth retardation.** Biomedica 2005 Jun;21(1)

20. Botsis D, Vrachnis N, Christodoulakos G. **Doppler assessment of the intrauterine growth-restricted fetus.** Ann N Y Acad Sci 2006 Dec;1092:297-303

21. Gonzalez JM, Stamilio DM, Ural S, Macones GA, Odibo AO. **Relationship between abnormal fetal testing and adverse perinatal outcomes in intrauterine growth restriction.** Am J Obstet Gynecol 2007 May;196(5):e48-51.

22. Ebrashy A, Azmy O, Ibrahim M, Waly M, Edris A. **Middle cerebral / umbilical artery resistance index ratio as sensitive parameter for fetal well-being and neonatal outcome in patients with preeclampsia: case-control study.** Croat Med J 2005 Oct;46(5):821-

23. Mills TA, Wareing M, Bugg GJ, Greenwood SL, Baker PN. **Chorionic plate artery function and Doppler indices in normal pregnancy and intrauterine growth restriction.** Eur J Clin Invest 2005 Dec;35(12):758-64

24. Gagnon R, Van den Hof M. **The use of fetal Doppler in obstetrics.** J Obstet Gynecol Can 2003 Jul;25(7):601-14

25. Gerber S, Hohlfeld P, Viquerat F, Tolsa JF, Vial Y. **Intrauterine growth restriction and absent or reverse end-diastolic blood flow in umbilical artery (Doppler class II or III): A retrospective study of short- and long-term fetal morbidity and mortality.** Eur J Obstet Gynecol Reprod Biol 2006 May;126(1):20-6

26. Borrelli AL, Zurzolo VS, Felicetti M, Di Domenico A, Corcione M, torella M. **The importance of Doppler ultrasonography in the management of fetal growth restriction.** Minerva Ginecol 2005 Apr;57(2):179-84

27. Soregaroli M, Bonera R, Danti L, et al. **Prognostic role of umbilical artery Doppler velocimetry in growth-restricted fetuses.** J Matern Fetal Neonatal Med 2002 Mar;11(3):199-203.

28. Ertan AK, He JP, Tanriverdi HA, Hendrik J, Limbach HG, Schmidt W. **Comparison of perinatal outcome in fetuses with reverse or absent end-diastolic flow in the umbilical artery and/or fetal descending aorta.** J Perinat Med 2003;31(4):307-12

29. Kwon JY, Kwon HS, Kim YH, Park YW. **Abnormal Doppler velocimetry is related to adverse perinatal outcome for borderline amniotic fluid index during third trimester.** J Obstet Gynaecol Res 2006 Dec;32(6):545-9

30. 0tt WJ. **Reevaluation of the relationship between amniotic fluid volume and perinatal outcome.** Am J Obstet Gynecol 2005 Jun;192(6):1802-9.

31. Wong SF, Chan FY, Cincotta RB, McIntyre DH, Stone M. **Use of umbilical artery Doppler velocimetry in the monitoring of pregnancy in women with pre-existing diabetes.** Aust N Z J Obstet Gynecol 2003 Aug; 43 (4):302-6

32. Bohem FH, Gabbe SG. **Putting it all together.** Clinical Obstet Gynecol 2002;45:1063-8

33. Cosmi E, Ambrosini G, D'Antona D, Saccardi C, Mari G. **Doppler, cardiotocography, and biophysical profile changes in growth-restricted fetuses.** Obstet Gynecol 2005 Dec;106(6):1240-5.

34. Vergani P, Anderotti C, Roncaglia N, et al. **Doppler predictors of adverse neonatal outcome in the growth restricted fetuses at 34 weeks gestation or beyond.** Am J Obstet Gynecol 2003;189:1007-11

35. Schwarze A, Gembruch U, Krapp M, Katalinic A, Germer U, Axt-Fliedner R. **Qualitative venous Doppler flow waveform analysis in preterm intrauterine growth-restricted fetuses with ARED flow in the umbilical artery-correlation with short-term outcome.** Ultrasound Obstet Gynecol 2005 Jun;25(6):573-9

36. Brodszki J, Lanne T, Marsal K, Ley D. **Impaired vascular growth in late adolescence after intrauterine growth restriction.** Circulation 2005 May 24;111(20):2623-8.