

## Research Article

# Fetal outcome in relation with Colour Doppler study of middle cerebral artery & umbilical artery in intrauterine growth restriction

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### ABSTRACT

**Background:** The failure of the fetus to reach its genetically predetermined growth potential of sonographic estimated fetal weight (EFW) below 10<sup>th</sup> percentile for gestational age is called IUGR. This common clinical sign is fetal hypoxaemia. Therefore the challenge is to distinguish the constitutionally small but healthy fetus (Physiologically small) from pathologically small growth restricted fetus. Our objective is to study the fetal outcome in relation to Doppler study of middle cerebral artery and umbilical artery in intrauterine growth restriction (IUGR).

**Methods:** The prospective study was conducted on 100 patients with suspected Intrauterine growth restriction. The subjects were evaluated by middle cerebral artery and umbilical artery velocimetries. Since no treatment is of any help to IUGR fetuses, the main stay of treatment still remains the timely delivery.

**Results:** Mothers with abnormal velocimetries undergone more no of C-sections compared with mothers with normal velocimetries. Growth restricted fetuses with abnormal velocimetry in terms of APGAR score are more at risk of poor outcome. The average birth weight of neonates with abnormal Doppler study was lower when compared with neonates with normal velocimetry.

**Conclusion:** With the Colour Doppler, the study of middle cerebral artery flow along with umbilical artery flows was useful in identifying IUGR and managing them in an appropriate way.

**Keywords:** IUGR, Middle Cerebral artery, Umbilical artery

### INTRODUCTION

Intrauterine growth restriction is a complex multifactorial condition affecting 3 to 10% of all pregnancies.<sup>1</sup> IUGR is a common clinical sign of fetal hypoxaemia. It is the failure of the fetus to reach its genetically predetermined growth potential and as such defined as sonographic estimated fetal weight (EFW) below 10<sup>th</sup> percentile for gestational age.<sup>1,2</sup> Therefore the challenge is to distinguish the constitutionally small but healthy fetus (Physiologically small) from pathologically small growth restricted fetus. The aim is to avoid iatrogenic harm to physiologically small but healthy fetus. Accurate diagnosis of IUGR is essential since early detection and proper antenatal

management of IUGR can decrease perinatal mortality and morbidity. Umbilical and middle cerebral artery velocimetry<sup>3-5</sup> is a good predictor of growth restricted fetus at risk of antenatal compromise. The brain of normally developed fetus has low vascular impedance with continuous flow throughout cardiac systole. It is suggested that late onset of placental insufficiency is commonly associated with redistribution of blood flow in favour of fetal brain (i.e., brain sparing) combined with suboptimal growth of intraabdominal organs. In response to hypoxia the fetus as a compensatory mechanism redistribute cardiac output and blood supply to brain to maintain constant oxygen delivery to this vital organ. Increasing flow may be reflected in elevated diastolic velocities in Doppler

waveform obtained from cerebral blood vessels. In IUGR placental studies have shown that > 70% of placental vascular bed is obliterated once impedance increased in umbilical artery with AEDF (absent end diastolic flow).<sup>6-8</sup>

Because no treatment has been demonstrated to be of benefit for IUGR, the assessment of fetal well being and timely delivery remains as the main strategy for management. Doppler study combined with bio physical profile (BPP), amniotic fluid index (AFI) are the guiding factors for management of IUGR.

**METHODS**

This study was conducted at King Koti District Hospital APVVP, Hyderabad (which is secondary referral hospital), during the period March, 2013 to April, 2014. Out of 2430 deliveries conducted in our hospital during these 13 months, 121 (5%) were suspected IUGR cases. Out of these, 100 cases were randomly included in the study. The criteria for inclusion in the study group were.

1. Birth weight <10<sup>th</sup> percentile of gestational age.
2. History of regular menses.
3. Reliable dating of pregnancy.
4. Singleton pregnancy.
5. Disparity in fundal height more than 4 weeks.
6. Oligo hydromnios.

All the IUGR patients were admitted in our antenatal ward and perinatal outcome was prospectively analyzed at District Hospital, King Koti, APVVP, Hyderabad. Gestational age studied ranged from 28 weeks to 40 weeks. These women underwent Doppler study of umbilical and middle cerebral artery between 28 weeks and 40 weeks. The colour doppler examination was done at a standard ultrasonography centre in Hyderabad Helwett Packard machine with transducer of 2.5 MHZ. The cases were followed until the time of delivery and the perinatal outcome was noted. The details of mode of delivery and presence of fetal distress were recorded. The neonates were evaluated for respiratory distress and data was analyzed.

Ultrasonographic fetal biometry and biophysical profile was done in all cases. The presence of IUGR and expected fetal weight were noted. The placental grading and amount of liquor (Amnion) were noted in all cases. FVW in the umbilical artery and middle cerebral artery were noted. Absent and reversed end diastolic flow in umbilical artery, the pulsatile indices and resistance indices of umbilical artery were also recorded. The identification of middle cerebral artery was done in the transverse axial view of fetal head.

**RESULTS**

The patients studied were in the age group of 21 to 25 years and 44% cases were primigravidas. The risk factors were pregnancy induced hypertension, previous IUGR,

anemia, recurrent Abortions, Breech, Infertility, previous stillbirths and cord around neck. 78% of patients had pregnancy induced hypertension and 22% of patients did not have hypertension. All the patients with hypertension were treated with bed rest and antihypertensives. Other associated high risk factors were Hypothyroidism and RH Negative. In our study very few cases were associated with medical problems other than hypertension. Only one case had diabetes mellitus.

**Table 1: Gestational age at the time of first Doppler.**

Gestational Age	No of Cases
28-29 Weeks	4 (4%)
30-34 Weeks	46 (46%)
35-37 Weeks	40 (40%)
38-40 Weeks	10 (10%)
Total	100 (100%)

Gestational age at the time of first Doppler was between 30 to 34 weeks in most cases. Only 10 cases reached gestational age of 38 weeks.

**Table 2: Obstetric risk factors.**

Risk Factors	No of Cases
PIH with IUGR	58 (58%)
IUGR with no apparent case	8 (8%)
Hypothyroidism +IUGR	4 (4%)
BOH with IUGR	20 (20%)
Anemia with IUGR	6 (6%)
Malpresentation with IUGR	4 (4%)
TOTAL	100 (100%)

Pregnancy induced hypertension and IUGR constituted majority of the cases (58%) in 24 of our cases they were bad obstetric history with IUGR. No apparent cause was found in 8% of cases

**Table 3: Liquor fluid index (AFI).**

Amniotic Fluid Index (AFI)	No of Cases
Oligohydramnios < 5cm	24 (24%)
Decreased volume 5-10cm	53 (53%)
10-15cm Normal volume	23 (23%)
Total No of cases	100 (100%)

Most of our cases (53%) had decreased amniotic fluid. And 24% had oligohydromnios

**Table 4: Flow Pattern in Middle Cerebral Artery.**

Flow	No of Cases
Normal flow	30 (30%)
Increased flow	46 (46%)
Borderline increased flow	24 (24%)
	100 (100%)

**Table 5: Umbilical artery doppler.**

Flow	No of Cases
Normal flow	30 (30%)
Borderline resistance	42 (42%)
Absent diastolic flow (AEDF)	24 (24%)
Reversal flow	4 (4%)
TOTAL	100 (100%)

Majority of our cases had increased flow in middle cerebral artery (46%). In 24% cases there was border line increase in middle cerebral artery flow. Umbilical artery blood flow was border line in 42% of the cases. Absent end diastolic flow was detected in 24% of our cases 4% had reversal of blood flow. In cases where AEDF & RDI were noted in umbilical artery, there were corresponding increase in middle cerebral artery flows indicating brain sparing effect.

In our study S/D ratio in the middle cerebral artery showed significant decline averaging about 2.55. 70% of cases had abnormal S/D ratio.

**Table 6: Pulsatility index in middle cerebral artery.**

Index	No of Cases
1 – 1.5	30 (30%)
0.7 - 0.99	70 (70%)
Total	100 (100%)

Pulsatility index of middle cerebral artery was reduced in 70% of our cases. In 100 fetuses with IUGR 24 had a border line abnormality and 46 had marked increased middle cerebral artery blood flow. Most of them were between 32-36 weeks of gestation age. Normal Middle cerebral artery blood flow seen in 31 cases.

**Table 7: Correlation of IUGR with GA and middle cerebral artery blood flow.**

Gestation Age	Borderline	Increased Flow	Normal Flow
< 28 Weeks		4	-
30-34 Weeks		18	6
35-37 Weeks	16	22	20
38-40 Weeks	8	2	4

The following conditions were taken into consideration for the timing of the delivery.

1. Absent diastolic or Reversal of diastolic flow in umbilical artery, increased flow in middle cerebral artery.
2. Worsening maternal condition (preeclampsia).
3. Gestational age more than 34 weeks.
4. Severe fetal growth restriction with AFI < 5cms and BPP <6

The mode of deliveries were 30 vaginal deliveries and 70 LSCS. 20 had elective LSCS in view of IUGR and 50 had

emergency LSCS for PIH with fetal distress, BOH with IUGR patients. 19 patients delivered vaginally. 4 cases with reversal diastolic flow in umbilical artery (gestational age <30 weeks were terminated on account of severe fetal distress and weight < 1.2 kg.

**Table 8: Indication for LSCS.**

Indication	No of Cases
PIH with fetal distress with IUGR	26
BOH with IUGR with PIH	20
PIH with OLIGO	12
Previous LSCS	8
Malpresentation	4
TOTAL	70

Majority of the babies delivered had birth weight between 2.1 – 2.5 kg (41), 41%. The babies with weights 1.6 – 2 kg comprises about 36 i.e. (36%) Caesarean section were done only if the estimated fetal weight was >1.8 kg and the gestational age was >34 weeks as those were the criteria for neonatal survival of our neonatal unit. Babies weighing < 1.5 kg constituted 4% of our cases. There were 20% of the babies who weighed between 2.5 to 3 kg.

**Table 9: Fetal outcome in relation to abnormal umbilical and middle cerebral artery Flowshy.**

Sl. No.	Doppler Flow	No of cases	Mode of delivery	NICU Admissions
1	Abnormal Umbilical Artery and Middle cerebral artery flows.	70	Vaginal 6 LSCS 60 Termination of pregnancy 4*	35
2	Normal Umbilical Artery and Middle cerebral artery flows.	30	Vaginal 20 LSCS 10 Termination of pregnancy Nil	05

\* All these 4 cases showed reversal of end diastolic flow in umbilical artery.

Out of 100 cases 70 had abnormal MCA and UA Doppler wave forms. Normal Doppler wave forms were seen in 30% of our cases in the present study. Out of 30 fetuses with normal flows, 20 had normal vaginal deliveries and 10 cases under went LSCS. Only 5 cases required NICU admission due to mild respiratory distress. In the remaining 70% of the cases with abnormal MCA and UA flows, 60% of the cases under went LSCS. 4% cases were terminated due to reverse flow in the UA, with gestational age between 28 to 30 age and babies were weighing less than 1.2 kg. 35% cases in this group were kept in NICU for respiratory distress and meconium staining of liquor.

Perinatal mortality rate in this series is 8%. 80% of the patients had neonatal care less than a week. One patient had to be kept in neonatal unit for 2 weeks. One baby had mild ventricular dilatation and small VSD and shifted to higher centre. 4% of cases died in neonatal unit due to respiratory distress.

## DISCUSSION

The first step in the management of IUGR fetus is diagnosis. Doppler velocimetry is the most important means of diagnosing the IUGR fetus who is at risk for adverse perinatal morbidity and mortality. The Doppler velocimetry identifies normal and altered blood flow in the middle cerebral and umbilical arteries in response to placental resistance. Various workers found out that perinatal morbidity and mortality was significantly greater in small for gestational age (SGA) babies with abnormal Doppler (Pathologically small babies) than babies with normal Doppler studies (physiologically small).

Doppler ultrasonography in severe IUGR fetuses revealed progressive reduction in pulsatility index and S/D ratio of middle cerebral artery consistent with brain sparing effect when used for prediction of adverse perinatal outcomes. Absent or reversal end diastolic flow of umbilical artery and that of abnormal middle cerebral artery have the sensitivity, specificity and positive predictive value in the range of 71%, 92% and 94% respectively. Distribution of cases according to mode of delivery shows more no of C-sections (60%) were done in cases with abnormal Doppler waveforms when compared to the normal Doppler waveforms (10%). This compares with the results published by Dhand Hemlata<sup>9</sup> et al in the year 2011, 84% of their cases with abnormal underwent C-sections doppler flows the study 75% of babies with abnormal Doppler flows were subjected to caesarean section where as 50% cases with normal Doppler flows underwent caesarean section. 4% of the cases needed termination of the pregnancy on account of severe oligohydromnios in fetuses with reversal of flow in umbilical artery where as none of the cases with normal Doppler flow required termination of pregnancy.

Various studies have reported on association of abnormal velocity waveforms with IUGR and its prediction. Technically all infants whose birth weight is below 10<sup>th</sup> percentile are not exposed to pathological process but some are constitutionally small but healthy. These cases had statistically significant improved perinatal outcome. In our study the patients with abnormal Doppler flow required more no of NICU admissions (35%) where as only 5% cases with normal Doppler flow required NICU admissions. The similar results were published by Dhand Hemlata and Kansal Hemant Kumar.<sup>9</sup> They have noticed in fetuses with abnormal Doppler velocimetry has similar poor perinatal outcome Doppler study of MCA and UA waveforms are more useful in identifying fetuses with growth restriction than simple sonographic estimation of fetal weight. Mothers of SGA babies with abnormal

Doppler flows required more no of C-sections for fetal distresses. There is high chance terminating pregnancy in cases severe oligohydromnios with PIH associated with reversal diastolic flow.

Fleischer<sup>10</sup> pointed out the role of venous Doppler study in assessing the degree of hypoxemia and formulating the guidelines for correct time of delivery. MCA flow velocimetry should be considered as an integral parameter for evaluating IUG R. This will help improve the pregnancy management and can identify and assess IUGR at the earliest gestational age.

## CONCLUSIONS

The advent of Colour Doppler to study the fetal cerebral blood flow and umbilical artery flow enabled the obstetricians to diagnose Intrauterine growth restriction and its subsequent management. The study of middle cerebral artery flow along with umbilical artery flows definitely helped us in identifying IUGR and their management in an appropriate way.

IUGR with normal middle cerebral flows pose no significant perinatal problems. Abnormal flows lead to high morbidity and mortality in IUGR fetuses.

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