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Original Research Paper

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CORRELATION OF FETAL DOPPLER VELOCIMETRY IN THE PERINATAL OUTCOME OF THE GROWTH RESTRICTED FETUSES

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ABSTRACT

Introduction: Fetal growth is a process influenced by various factors, including, fetoplacental blood flow, and endocrine development in both the mother and fetus. Any Change from the normal can result in Intrauterine Growth Restriction (IUGR), a condition associated with chronic fetal hypoxemia and significant morbidity, including meconium aspiration syndrome, intrapartum asphyxia, and stillbirth in extreme cases. Timely identification and management of IUGR are crucial for reducing perinatal mortality rates. Abnormalities in Doppler indices, such as the cerebroplacental ratio, can serve as sensitive predictors of fetal compromise, allowing for early detection and intervention to improve outcomes for IUGR fetuses.

Objectives:

1. To evaluate the role of umbilical artery Doppler in growth restricted fetuses.
2. To know the significance of Doppler flow velocity in perinatal outcome of the growth restricted fetuses.
3. To decide the timing of delivery of the growth restricted fetuses.

Materials and Methods: This study constituted a prospective examination of Doppler velocimetry involving the umbilical artery and middle cerebral artery in pregnancies afflicted with Intrauterine Growth Restriction (IUGR), spanning the gestational period from 30 to 40 weeks. **Results:** A total of 62 cases were included in the study on the basis of inclusion criteria in all the cases. Acceptable wave forms were obtained from MCA and UA in all the cases and were followed up for perinatal outcome. Cerebroplacental ratio was most sensitive (sensitivity 78.5%) MCA-PI was most specific (specificity 84.37%) . AEDF & REDF in umbilical artery were strong predictors of adverse perinatal outcome. Diagnostic accuracy of Cerebroplacental ratio (accuracy 75%) was better than MCA-PI (Accuracy 66.6%) and UA-PI (Accuracy 65%) in predicting adverse outcome. **Conclusion:** IUGR in pregnancy both Cerebroplacental ratio, UAPI are strong predictors of adverse perinatal outcome, cerebroplacental ratio was most sensitive and MCA-PI was most specific index in predicting adverse outcome, Absent / reverse end diastolic flow is omnious finding associated with major perinatal outcome and mortality.

KEYWORDS :

INTRODUCTION

The fetal growth is multifactorial which includes an appropriate hormonal fetoplacental blood flow and endocrine development for both mother and the fetus to enable optimal total growth. Any deviation from the normal leads to Intra Uterine Growth Restriction [IUGR], which is a clinical sign of chronic fetal hypoxaemia.

IUGR is associated with significant morbidity in the form of meconium aspiration syndrome, intrapartum asphyxia, hyaline membrane disease, early onset sepsis, hypoglycemia, delayed milestones and still birth in extreme cases[2].

The perinatal mortality of these infants is 6-10 times greater than that for a normally grown. This can be lowered by timely identification and management of growth restricted fetuses [3]. Doppler velocimetry is a non invasive sensitive tool for surveillance of fetal hemodynamics and feto-maternal circulation[4].

Doppler study helps in taking timely action plan management and also counsel the patient in their future pregnancies [5]. Umbilical artery [UA] Doppler Velocimetry is the most vigorously evaluated test among the non-invasive tests of fetal well being [6]. Several studies have reported a low end diastolic velocity in umbilical artery, a consequence of high flow resistance in capillaries of the terminal villi[7]. In response to prolonged fetal hypoxic stress, circulatory adaptation occurs resulting in redistribution of the cardiac output to provide a constant oxygen supply to the brain and other essential organs (i.e heart and adrenal glands) [8,9].

This compensatory adjustment on which the brain sparing effect is associated with a rise in diastolic velocities in Doppler cerebral wave forms. This rise is considered a manifestation of cerebral vasodilatation, causing a decrease in velocity indices such as pulsatility index. This has been substantiated at cordocentesis in which a significant correlation has been observed between hypoxaemia in fetuses with IUGR and abnormal MCA pulsatility index [PI].Recent studies indicate that the cerebroplacental ratio of PI of MCA and UA is the most sensitive Doppler index for predicting perinatal outcome in fetus which has IUGR.

This study is an effort at establishing role of UA and MCA Doppler ultrasound in predicting adverse perinatal outcome in clinically suspected IUGR pregnancies and to determine the role of Doppler Velocimetry in clinical management of the same.

Aims and Objectives

1. To evaluate the role of umbilical artery Doppler in growth restricted fetuses.
2. To know the significance of Doppler flow velocity in perinatal outcome of the growth restricted fetuses.
3. To decide the timing of delivery of the growth restricted fetuses

MATERIALS AND METHODS

Data for the study was collected from clinically suspected IUGR pregnancies from Vani Vilas and Bowring and Lady Curzon hospital attached to BMCRI, Bangalore. Study was done for a period of 2.5 years from March 2019 to October 2021.

Inclusion Criteria

1. Women with singleton pregnancies with small for gestational age (SGA) fetuses.
2. Fetal gestational age of 30weeks and above with clinically suspected IUGR.
3. The gestational age was based on LMP, ultrasound biometry performed before 20th gestational week when the LMP is uncertain or not known and early ultrasound before 13 weeks has not been performed.

Exclusion Criteria

1. Women with multiple pregnancy.
2. Dysmorphic fetuses and karyotypically abnormal fetuses.
3. Those who have not given consent.

Procedure

The study enrolled 62 cases meeting inclusion criteria, with meticulous obstetric and medical histories obtained after informed consent. Thorough general and obstetric examinations were conducted, followed by Doppler ultrasound evaluations, ultrasound biometry, and amniotic fluid assessments. Doppler assessments of the umbilical artery and middle cerebral artery were conducted serially between 30 and 40 weeks using a Phillips iU22 ultrasound machine. Waveforms were obtained during fetal inactivity, and umbilical artery measurements were taken from a free loop of cord. MCA Doppler ultrasounds involved obtaining transverse images of the fetal head at the level of sphenoid bones. Women were categorized into two groups based on Doppler findings: Group 1 with IUGR fetuses showing absent or reversed diastolic flow and abnormal cerebroplacental ratio, and Group 2 with normal Doppler flow waveforms. All women received a course of steroids between 30 and 34 weeks to enhance fetal lung maturity.

Outcome Criteria

Doppler US results were analysed for prediction of perinatal outcome. Decision to deliver was taken in situations as:

1. Gestational age of 37 weeks.
2. AEDF/REDF.
3. Abnormal Doppler flow measures.
4. Abnormal FHR pattern.
5. Poor biophysical profile.
6. Worsening of maternal condition.
7. IUD.

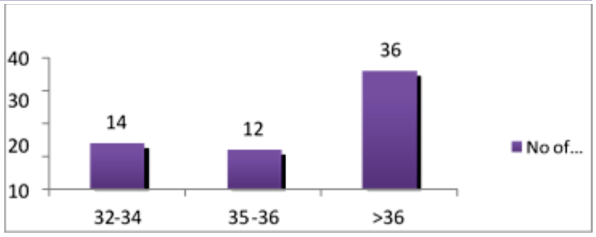
Outcome variables included are:

1. Birth weight
2. Perinatal death
3. Emergency CS for fetal distress
4. Low APGAR score(5min score less 7)
5. Admission to NICU
6. Complications of low birth weight.

Pregnancy was considered to have adverse outcome when any of the above variables were present. The outcome for each pregnancy was obtained by examining the labour ward records and neonatal intensive care unit records wherever appropriate. The UA PI ratios were considered abnormal if the value was above the 95th percentile of previously published values for gestational age. The MCA pulsatility index was considered abnormal if the value was below the 5th percentile of previously published values for gestational age. The MCA/UA PI ratio (cerebro-placental ratio) is considered abnormal when it is less than 1.08 as given by the Gramellini D et al.[12]

RESULTS

Study was done for a period of 2 years from November 2010 to October 2012. 62 pregnancies with clinically suspected IUGR were evaluated with Doppler US. Acceptable waveforms were obtained in all cases.



Graph 1: Gestational Age Distribution In Study Group

Table 1:

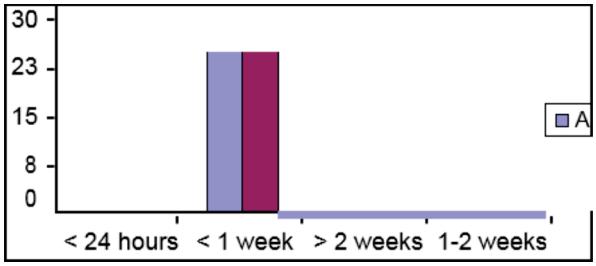
AMNIOTIC FLUID DISTRIBUTION IN STUDY GROUP		
AFI	Count of Patients	%
Normal	26	42%
Nil	7	11%
OLIGO	29	47%
Grand Total	62	100%

47 % had oligohydramnios. 11% had anhydramnios. 42% had normal amniotic fluid volume.

Table 2: Distribution Characteristics Of Placental Maturity

Placental Grading	Abnormal	Normal	Abnormal%	Normal%
2	5	26	16%	84%
3	26	5	84%	16%
Total	31	31	100%	100%

84%(n=26) had grade 3 placenta an abnormal Doppler group. However, advanced placental maturity is not an indicator of fetal distress.



Graph 2: Duration Between Doppler And Delivery

Table 3 : Birth Weight

Birth weight	Abnormal	Normal	Grand Total
1-1.5	10	6	16
1.6-2	21	17	38
2.1-2.5	0	6	6
Grand Total	31	29	60

P <0.001 Majority of the babies were between 1.6-2 Kg.

Table 4 : Doppler Velocimetry And Perinatal Outcome

	Abnormal	Normal	Grand Total
Complication or Death	22	6	28
Live or Healthy	9	23	32
Grand Total	31	29	60

22 out of 31 babies had adverse perinatal outcome in abnormal Doppler group.6 out of 29 had adverse outcome in normal group.

P<0.001(very highly significant)

There Is Significant Doppler Indices And Perinatal Outcome.

Table 5: Spectral Characteristics Of Umbilical Artery

Diastolic Flow	No of cases	IUD/ Neonatal Death	Mortality
Absent	10	2	20%
Decreased	15	2	13%
Reversed	6	5	83%
Grand Total	31	9	

Out of 6 cases of reversed flow, 2 were IUD's and 3 were neonatal deaths. 2 in each absent and decreased flow were IUD/neonatal death.

In all the cases with reversal of flow IUD of fetus occurred within 1 week of diagnosis.

Table 6: Showing Performance Characteristics Of Doppler Indices

Parameters	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
UAPI	75%	56.2%	60%	72%	65%
MCAPI	46.4%	84.37%	72.2%	64.2%	66.66%
MCAPI/ UAPI	78.5%	71.8%	70.9%	79.3%	75%

CP ratio was most sensitive (sensitivity 78.5%) than UAPI 75% and MCAPI 46.4%MCAPI was the most specific (specificity 84.37%) than CP ratio 78.8% and UAPI 56.2%. MCAPI had highest PPV of 72.2% followed by CP ratio 70.9% and UAPI 60% NPV of CP ratio was 79.3% when compared to 72% for UAPI and 64.2 for MCAPI. Diagnostic accuracy of CP ratio 75% was better than MCAPI 66.66% and UAPI 65% in predicting adverse perinatal outcome.

DISCUSSION

Intrauterine growth restriction (IUGR) poses risks of perinatal morbidity, mortality, and impaired neurological development. Differentiating pathologically growth-restricted fetuses from constitutionally small yet healthy ones is challenging. Doppler velocimetry, a noninvasive technique, assesses abnormal hemodynamics in response to placental resistance changes. Doppler indices like umbilical artery (UA) and middle cerebral artery (MCA) help identify fetuses with increased placental and decreased cerebral resistance.UA and MCA Doppler ultrasounds provide insights into placental resistance and fetal hemodynamic changes. We selected UA pulsatility index (PI), MCA PI, and cerebroplacental ratio (CP ratio) as tools for predicting perinatal outcomes in IUGR. We studied UA Doppler after the 30th week, considering the difficulty in defining normal flow velocity before this, except for absent end-diastolic flow velocity after the 20th week.

Comparisons with reference values by Harrington et al. guided our assessment of abnormal UA and MCA Doppler indices. We observed adverse outcomes such as intrauterine deaths, neonatal deaths, NICU admissions, and low APGAR scores. Reversal of diastolic flow in the umbilical artery within a week of diagnosis correlated with adverse outcomes.UA PI exhibited sensitivity of 75%, while MCA PI had 46.4%. CP ratio showed the highest sensitivity (78.5%) and specificity (71.8%), aiding in ruling out adverse perinatal outcomes. AEDF and REDF in the umbilical artery strongly associated with major perinatal morbidity and mortality.Overall, CP ratio demonstrated the highest diagnostic accuracy (75%) compared to UA PI (65%) and MCA PI (66.66%). Doppler ultrasound of fetoplacental circulation plays a crucial role in predicting adverse perinatal outcomes in IUGR, aiding in management decisions. Both abnormal UA Doppler indices and CP ratio serve as strong predictors of adverse outcomes in IUGR, with MCA PI providing additional specificity when used in combination.

CONCLUSION

Doppler US is the best noninvasive investigation to assess changes in fetal heamodynamics in clinically suspected IUGR. Fetal Doppler indices provide information i.e. not readily obtained from more conventional tests of fetal well being.Fetal vessels such umbilical artery and middle cerebral artery Doppler helps todifferentiate the fetus with pathological growth restriction from that of other small for gestational age (SGA) fetus.

Both Abnormal umbilical Doppler indices and cerebro-placental ratio are strong predictors of adverse outcome in IUGR. AFDF and REDF in umbilical in IUGR is an ominous finding associated with increased perinatal morbidity and mortality. Fetal Doppler study plays a significant role in management of IUGR fetus by identifying compromised fetus from that of non-compromised fetus. Also helps in timely intervention and improves perinatal outcome. Fetal Doppler showed to be an integral part while evaluating In-utero health of growth restricted fetus.

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