Colour Doppler Study in the Evaluation of Intrauterine Growth Retardation of Fetus

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ABSTRACT: *Our study was an effort at establishing the role of Umbilical artery (UA) and Middle cerebral artery (MCA) Doppler indices in predicting the adverse perinatal out come in clinically suspected IUGR pregnancies. Elevation of the umbilical artery systolic/diastolic ratio or of the pulsatility index (PI); absent or reversed end-diastolic flow in the umbilical artery and decreased systolic/diastolic ratio or pulsatility index in the fetal middle cerebral arteries are the predictors of abnormal perinatal outcome. Our study was to evaluate the role of ratio of pulsatility index (PI) which is called as Cerebroplacental Ratio i.e.MCAPI/UAPI Doppler ratio as the most accurate predictor of adverse perinatal outcome among women with clinical suspicion of IUGR attending our New Civil Hospital, Surat. *Methodology*: 50 Antenatal women attending the antenatal O.P.D who were clinically suspected as having growth retardation based on clinical history of previous child with growth retardation. *Conclusion:* Cerebroplacental ratio is the most specific parameter in predicting the perinatal outcome when compared to UA Pulsatility Index or the MCA Pulsatility Index alone. Absent or reversed diastolic flow in umbilical artery is an ominous finding associated with adverse perinatal outcome and mortality.*

Keywords: Pulsatility index, Cerebroplacentalratio, IUGR, Doppler velocimetry, Fetal outcome

1. Introduction

Intrauterine growth retardation (IUGR) is a common complication of pregnancy associated with an increased risk of perinatal mortality, morbidity, and impaired neurodevelopment.

Now, in the present era of Doppler sonography, diagnosis of intrauterine growth restriction has become easier and thus decreasing the perinatal mortality and morbidity rate. The incidenceofIUGRin a population wherethe mothers are generally healthy and well-nourished is estimated to be about 3-5%.

In a population of women with hypertension or previous growth restricted fetus however the incidence increases to 15-20% or higher. The incidence of IUGR varies from region to region and even in thesame region, it varies in different sub populations.

In India, according to recent UNICEF surveys, the incidence of IUGR is 25-30%.

The rationale for suspecting that Doppler imaging may be a useful diagnostic technique for IUGR is based on a chain of reasoning:
1) Some cases of growth retardation are due to abnormalities of placental circulation;
2) These placental abnormalities may lead to increased resistance to blood flow in the placenta;
3) Increased resistance leads to decreased velocity in the feeding arteries, especially during diastole, and this in turn leads to decreased volume of blood flow through the placenta;
4) Disproportionate slowing of diastolic relative to systolic flow leads to elevation of a number of doppler indices, including the systolic/diastolic ratio and the pulsatility index.

As Doppler ultrasound provides a unique, non-invasive and safe method of studying blood flow Characteristics in both the Fetoplacental and uteroplacental circulations, it is being used in Clinical evaluation of high risk pregnancies.

Umbilical arterial (UA) Doppler velocimetry is the most evaluated test among noninvasive tests of fetal well-being. A low end-diastolic velocity in umbilical artery as a consequence of high flow resistance in capillaries of terminal villi.

At cordocentesis, a significant correlation has been observed between hypoxemia in fetuses with IUGR.

Our study was an effort to establish the role of Doppler indices, especially the MCA PI/UA PI Doppler ratio as the most accurate predictor of adverse perinatal outcome among women with clinical suspicion of IUGR attending our hospital and an abnormal MCA pulsatility index.

2. Aims and Objectives

1) To establish the role of umbilical artery and middle cerebral artery Doppler indices in diagnosing IUGR.
2) To evaluate the usefulness of umbilical artery and middle cerebral artery as predictors of adverse perinatal out come in clinically suspected IUGR Pregnancies.
3) To establish the Role of Doppler Ultrasound in the Management of IUGR pregnancy.

3. Methodology

Present study: Hospital based cross-sectional observational study conducted in the department of Radio diagnosis, Government Medical College and New Civil Hospital , Surat.This study was proved by the Ethical Committee of our institution.

Source of Data: Data for the study was collected from pregnant women clinically suspected to have IUGR, referred to the department of radio diagnosis, Government Medical College and New Civil Hospital , Surat

Size of the Data: The study included 50 singleton pregnancies.

Inclusion Criteria: (a) Singleton pregnancy (b) Fetal gestational age of 30 to 40 weeks with clinically suspected intrauterine growth retardation.

Exclusion criteria: for the study included any pregnancy with a) Documented major congenital abnormality b) Multiple gestations.

Method of Collection of Data: Doppler US evaluation was performed following a detailed clinical history, US biometry, and assessment of amniotic fluid and placental maturity. Repeat Doppler studies were performed if clinically indicated to determine a favorable or a worsening trend in the Doppler indices. The results of the first Doppler ultrasound were used for analysis of perinatal outcome.

Doppler US Technique: The patients were evaluated on ESOATE MY LAB 60 color Doppler ultrasound scanner with a curvilinear transducer, having a variable frequency of 3.5–5.0 MHZ. The Doppler wall filter was set at 50–100 Hz. Patients' consent was taken in the prescribed form as per PNDT Act.

4. Pulsatality Indices for Gestational Age

The normal range is shown in 5th, 50th and 95th percentiles.
- The Umbilical Artery (UA) Pulsatility index ratios were considered abnormal if the value was above the 95th percentile for gestational age.
- The Middle Cerebral artery (MCA) pulsatility index was considered abnormal if the value was below the 5th percentile for gestational age.
- The MCA/UA Pulsatility Index ratio (cerebro-placental ratio) is usually constant during the last 10 weeks of gestation. It is possible to use a single cut off value after 30th week because cerebral-umbilical Doppler ratio does not vary significantly between 30th and 40th weeks.
- Therefore, in our study a single cutoff value (1.08) was used, above which velocimetry was considered normal and below which it was considered abnormal.
- The sensitivity, specificity, positive predictive value, negative predictive Value and diagnostic accuracy were determined for all Doppler measurements.

CASES: Case 1: G3P2L1D1 with severe PIH with suspected IUGR.

UMBILICAL ARTERY

MCA
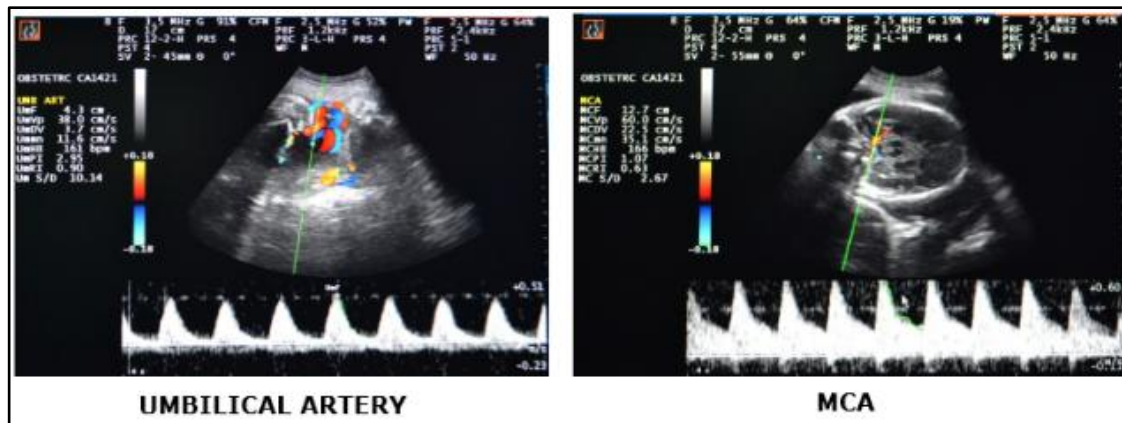
UMBILICAL ARTERY MCA: Decreased diastolic flow noted in Umbilical artery (increased PI value 2.9).MCA Doppler shows (decreased PI value 1.0). Cerebroplacental Ratio: 0.34 (abnormal). The child postnatally had low APGAR -4 and was admitted to ICU.

Case2: 22yr old G2P1L1 with severe PIH.

UMBILICAL ARTERY

MCA

Reversal of diastolic flow within umbilical artery showing (high PI value 2.2). Similarly MCA shows decreased PI value 1.1.Cerebroplacental ratio: 0.5 (abnormal).There was

IUD of the fetus within 48 hours as the patient refused admission.

5. Results

Gestational Age	Number	Percentage
30-32	21	42%
33-35	12	24%
36-40	17	34%
TOTAL	**50**	**100%**
MEAN+/-2SD	33.66+/-2.46	
Gestational age distribution in the study group		

Parity	No. of Cases	Percentage
Primigravida	32	54%
Multigravida	18	36%
Parity distribution among the study group		

Patients with abnormal PI values in Umbilical artery (value above 95th percentile and low PI value in MCA (less than 5th percentile) had a subnormal clinical outcome.

Adverse Outcome	No. Of Cases	Percentage
Intrauterine deaths	7	20%
Emergency CS	12	34.28%
Low Apgar score	8	22.85%
Admission to NICU	8	22.85%
Adverse Fetal Outcomes		

Of the 7 IUDs 4 cases had reversal of diastolic flow and 3 had absent diastolic flow. In all cases with reversal of diastolic flow, IUD of the fetus occurred within one week of diagnosis – S/o 100% mortality and all the 4 cases were less than 32 weeks.

TP- true positives; TN –true negatives; FP-false positives; FN-false negatives.

Doppler index	TP	TN	FP	FN	Sensitivity	Specificity	Diagnostic Accuracy
UA PI	26	4	7	13	86.60%	80%	78%
MCA PI	20	5	13	11	76%	78%	52%
MCAPI/UAPI RATIO	27	8	4	16	90%	88%	86%
Performance Characteristics of Doppler Indices							

Doppler index	Diagnostic accuracy
UA PI	78%
MCA PI	62%
MCA/UA PI Ratio (Cerebroplacental Ratio)	86%
Table showing Diagnostic accuracies of Doppler Indices	

6. Discussion

Doppler velocimetry is a noninvasive technique that evaluates the abnormal fetal hemodynamics that take place in response to changes in placental resistance. A Doppler index that reflects these changes can be useful in identifying the fetuses with increased placental and decreased cerebral resistance.

We chose incidences of perinatal death, emergency section for fetal distress, NICU admission for complication of low birth weight and low Apgar score as outcome variables in concurrence with previous studies done.

Cerebro-placental ratio has a high sensitivity, specificity and diagnostic accuracy in predicting adverse perinatal outcome. Our results in evaluating the usefulness of umbilical and middle cerebral artery Doppler in predicting the adverse perinatal outcome in IUGR indicate that bothabnormal umbilical Doppler indices and cerebro-placental ratio are strong predictors of adverse outcome in IUGR. MCA PI is not a reliable indicator when used alone. The combination of umbilical and middle cerebral Doppler indices may increase the utility of Doppler ultrasound in clinically suspected IUGR.

7. Conclusion

1) Doppler Ultrasound is a valuable initial modality for the evaluation of patients With suspected intrauterine growth retardation.
2) Doppler evaluation of umbilical and middle cerebral arteries has an important role in the early diagnosis of clinically suspected growth retardation.
3) Abnormal Cerebroplacental ratio, in particular is a strong predictor of adverse perinatal outcome in IUGR.
4) Umbilical artery Doppler is more useful than middle cerebral artery inPrediction of outcome in IUGR when considered individually.
5) Umbilical artery Doppler is more useful than middle cerebral artery in prediction of outcome in IUGR when considered individually.
6) Absent and reversed diastolic flow in umbilical artery in IUGR is an ominous finding associated with increased mortality and morbidity.

Fetal Doppler study plays a significant role in the management of growth restricted fetuses by early identification of compromised fetuses and thus determine the line of management.

Thus fetal Doppler study should be an integral part in evaluation of a suspected IUGR pregnancy, diagnosingand predicting the adverse outcome

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