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ASSESSMENT OF THE POTENTIAL OF DOPPLER MEASUREMENTS OF FETAL AND UTEROPLACENTAL CIRCULATIONS IN THIRD TRIMESTER OF PREGNANCY.

Radiology

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ABSTRACT

Background: Color Doppler measurements of fetal and uteroplacental circulation in intrauterine growth retardation (IUGR) and hypoxia have revealed a redistribution of arterial blood flow with the increased flow to the cerebrum and myocardium and decreased flow to the periphery. This study aimed to evaluate the significance of changes in fetal Doppler parameters in IIIrd trimester and correlate it to the fetal outcome. **Method & Results:** This cross-sectional study consisted of 50 pregnancies with clinical suspicion of IUGR. The mean birth weight at delivery was 2.43 Kg +/- 0.26kg (SD). 60% of neonates (n=30) had a birth weight of less than 2.5kg. 48% of fetuses (n=24) had adverse outcomes while the remaining 26 fetuses had a favorable outcome. There were 7 intrauterine deaths (IUDs) and 43 live births. Eight neonates out of 43 live births were admitted to the neonatal intensive care unit (NICU). 7 neonates had a "5 minute Apgar score of less than 7" and 12 babies were borne by emergency caesarian section. **Conclusion:** Our studies confirm that best results are obtained when we used MCA /UA PI Ratio, rather than PIs of MCA and UA separately. The diagnostic accuracy of the MCA/UA PI ratio is 84% when compared to 80 for UAPI and 68.8% for MCA PI. There were 7 IUDs in whom 4 cases had a reversal of diastolic flow in the umbilical artery and 3 had absent diastolic flow.

KEYWORDS

Cerebroplacental, Uteroplacental circulation, Fetal colour doppler

BACKGROUND

Colour Doppler ultrasound is an important clinical tool for fetomaternal surveillance in high risk pregnancies. Assessment of Fetal circulation by Doppler ultrasound is employed in various conditions including IUGR where it has been used to assist the prediction of hypoxia, acidosis & death. Changes of flow velocity waveform are observed in various fetal blood vessels and Doppler evidence is based on relationship between circulatory changes and the fetal condition and attempt an early detection of fetal compromise to allow timely interventions is an attempt to prevent perinatal and as well as long term damage. Changes in flow velocity waveform suggest organ sparing effect at various level of fetal compromise. This includes the brain, adrenal and heart sparing. This study aims to examine the relationship between perinatal outcome with abnormality of arterial and venous flow patterns in IIIrd trimester.

METHOD

This one-year prospective study from August 2018 to July 2019 included all pregnant women in 3rd trimester who was referred to Department of Radiodiagnosis, Moti Lal Nehru Medical College, Prayagraj from 1st August 2018 to 30th July 2019.

Present study included a total number of 50 cases meeting the inclusion criteria. Doppler US evaluation was performed following a detailed clinical history, fetal biometry, and assessment of amniotic fluid and placental maturity. Follow up Doppler studies were performed (weekly scans for third-trimester IUGR and before delivery) in clinically indicated patients to determine a favorable or a worsening trend in the Doppler indices. However, only the result of the first Doppler ultrasound was used for analysis of perinatal outcomes.

Inclusion Criteria:

i. Normal fetal anatomy.
ii. Gestational age was determined by last menstrua period and/or sonographic examination before 20 weeks of gestation.
iii. Sonographically measured abdominal circumference.
iv. Continued antenatal surveillance in 3rd trimester. Last Doppler examination was performed before delivery as assured by LMP or USG.
v. (a)Abnormal umbilical artery velocity waveform defined as PI>2 SD above the mean for gestational age by reference value and/or absence or reversal of end-diastolic velocity (AEDV and REDV) respectively.

(b) For the Uterine artery and Ductus venosus elevation of PI>2 SD above the mean and pulsatile flow in the free umbilical vein (synchronic end-diastolic pulsation) was considered abnormal.
(c) Absent or reverse ductus venosus flow during atrial contraction was considered abnormal.
(d) A MCA, PI>2 SD below the gestational age mean was considered evidence of brain sparing.

vi. Continued antenatal surveillance in 3rd trimester.
vii. Pregnancy and Neonatal outcome.

Exclusion Criteria:

Birth weight above the 10th percentile for gestational age and multiple gestations.

Measuring Equipment:

Patients were scanned using SONOLINE G50 SIEMENS and MADISION SA 8000 Doppler USG machine fitted with a 3.5 MHz curvilinear transducer. Sonographic Diagnosis of IUGR

The Standard definition of IUGR is weight below the 10th percentile for gestational age obstetric sonography: IUGR is diagnosed if the sonographically estimated fetal weight falls below the 10th percentile for the gestational age. Calculating the weight percentile requires three steps [1,2,3]. First, gestational age is assigned to the fetus. Second, the fetal weight is estimated. Third, the weight percentile is calculated from the estimated weight of the gestational age. At the initial sonographic examination, gestational age is based on the crown-rump length in the first trimester and on the head circumference or corrected biparietal diameter in the second trimester [4] when the initial sonogram is in the third trimester, age assignment can be based on any one of head circumference, corrected biparietal diameter, or femur length. Once the gestational age and fetal weight have been estimated, the two values are assessed in relation to one another to determine the weight percentile for gestational age. This can be accomplished by using a table that lists the norms of weight for gestational age [5,6,7,8,9].

Doppler imaging in monitoring growth-retarded fetus:

Doppler imaging is of value for monitoring the pregnancy because it can provide indirect evidence of fetal compromise. Elevation of the umbilical artery systolic/diastolic ratio or of the pulsatility index is a moderately accurate predictor of adverse outcome in growth-retarded fetuses

Analysis of Doppler Velocimetry of Multiple Vessels and their Implication in Pregnancy:

Umbilical Arteries

The embryo connects to the developing fetoplacental vasculature via the umbilical cord at around 8 to 10 weeks of gestation. Transvaginal color flow Doppler ultrasound can demonstrate fetoplacental circulation, typically after 10 weeks of gestation. Throughout the first trimester, the umbilical artery waveform is characterized by absent end-diastolic flow (EDF) and pulsatile flow in the umbilical vein. Progressive growth of the placental villous tree, together with an increase in fetal cardiac output, increases both systolic and diastolic velocity in the umbilical artery [10,11,12]. Therefore, PI values progressively fall as pregnancy advances. Diastolic velocities are typically present in normal pregnancies by 14 to 16 weeks of gestation, such that absent end-diastolic velocity (AEDV) in the umbilical artery is an abnormal finding by the time of the 18 to 22 week anatomic ultrasound examination. Typically, the PI value declines from 2.0 in the early second trimester to around 1 in third trimester.

Middle Cerebral Artery

The circle of Willis is demonstrated by color Doppler ultrasound of the base of the skull in the transverse fetal head position. In this orientation, the middle cerebral arteries run in a vertical alignment along the edge of the sphenoid bone and are easily seen by color Doppler ultrasound. The typical middle cerebral artery waveform at 28 to 32 weeks is characterized by high systolic velocity and minimal diastolic velocity, resulting in high PI values, generally greater than 1.45. Low diastolic velocity indicates normal autoregulatory mechanisms limiting brain blood flow. Oxygenated blood is diverted across the interatrial septum by foramen ovale and onto the ascending aorta and carotid arteries, preferentially sending oxygenated blood to the developing brain. The aortic chemoreceptors sense oxygen tension in aortic arch blood and normally maintain high middle cerebral artery vascular resistance (and, thus, low diastolic velocities). In situations of low oxygen tension, the vascular tone is reduced in the middle cerebral artery, resulting in increased diastolic velocity and reduced PI values. This is known as cerebral blood flow redistribution to the fetal brain.

Uterine artery:

Each uterine artery was seen by colour Doppler as it crosses over the hypogastric artery and vein just before it enter the uterus at the uterine cervical junction. Pulsed Doppler velocimetry of the uterine artery would be obtained immediately after the vessel crosses the hypogastric artery and before it divides into the uterine and cervical branches; the presence of a notch in the waveform and an increase in the impedance index after 22 weeks of gestation characterizes an abnormal uterine circulation.

Fetal Venous Doppler:

IVC Doppler waveform will be obtained from coronal plane of the chest and abdomen. In this view, IVC will be imaged as it enters into right atrium, Joined by ductus venosus and the left hepatic vein. The IVC was studies at two locations: one at the inlet into the right atrium and another in the segment between the entrance of hepatic vein and ductus venosus. Ductus venosus Doppler wave form will be obtained from transverse view of the fetal abdomen at the same anatomic plane of the abdominal circumference.

Outcome Criteria:

Outcome analysis was limited to perinatal period; neonatal evaluation including APGAR score (at 1 and 5 minutes), birth weight and birth weight percentile as charted against local reference values for GA and Gender.

Perinatal Outcome parameters will be:

(a) Perinatal morbidity and mortality
(b) Respiratory distress syndrome (RDS)
(c) Bronchopulmonary dysplasia (BPD)
(d) Intraventricular hemorrhage
(e) Necrotizing enterocolitis (NEC)
(f) Circulatory failure (Systolic BP above 10th percentile for GA after initial trial of crystalloid/colloid solution/catecholamine support)

Pregnancy was considered to have "Adverse outcome" when any of the following complication were present:

(i) Perinatal death
(ii) Emergency CS for fetal distress
(iii) 5 minute Apgar score of less than 7
(iv) Admission to NICU for complications of low birth weight

Pregnancy outcome was considered to be uneventful or favorable when the above complications were absent. The outcome for each pregnancy was obtained by examining the labor 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 [13,14]. The MCA PI was considered abnormal if the value was below the 5th percentile of previously published values for gestational age.

Statistical Analysis:

All data were managed and analyzed using the statistical package SPSS version 17.0. Chi-square test has been used to find the association between variables. The sensitivity, specificity, positive predictive value, negative predictive Value and diagnostic accuracy were determined for all Doppler measurements using the following formulae.

Sensitivity= $\frac{A}{A+C} \times 100$

Specificity= $\frac{D}{B+D} \times 100$

Positive Predictive Value $\frac{A}{A+B} \times 100$

Negative Predictive Value $\frac{D}{C+D} \times 100$

Diagnostic Accuracy $\frac{A+D}{\text{Total Number of Cases}} \times 100$

Where: A = True positive, B = False positive, C = False negative, D = True negative

RESULTS:

Of the 50 pregnancy studies, acceptable waveforms were obtained from all the 50 cases, repeated Doppler examinations were done in 7 patients. 56% (n=28) of the mothers had Pregnancy Induced Hypertension (PIH), 22% (n=11) had anemia, one patient had diagnosed HELLP Syndrome (Hemolysis, Elevated Liver Enzymes and Low Platelet count) at first Doppler examination (Table 1).

Table-1: showing Distribution of Associated Maternal Complications

Maternal Complications	Number	Percentage
PIH	28	56%
ANEMIA	11	22%
HELLP SYNDROME	1	2%

76% of cases (n=38) had Grade III Placental maturity at the time of first Doppler Examination and 24% (n=12) had Grade II Placental maturity (Table 2). 22% (n=11) had normal liquor and 78% (n=39) had oligohydramnios at first Doppler Examination.

Table-2: showing distribution of Characteristics of Placental Maturity

Placental Maturity	No. of Cases	Percentage
Grade II	12	24
Grade III	38	76

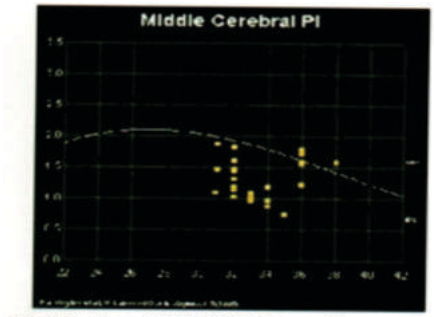
Doppler waveforms obtained, were superimposed on Harrington and Heacher nomograms. Cerebroplacental ratio (MCA/UA PI Ratio) was most specific (specificity 91.7%), it was more specific than either UA PI (specificity 87.9%) or MCA PI (specificity 69.2%) alone in predicting any adverse outcome. MCA/UA PI and UA PI were equally sensitive (sensitivity=76.9%) and MCA PI had comparably low sensitivity (sensitivity-70.8%) (Table 3).

Table-3: showing Performance Characteristics of Doppler Indices

Doppler index	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
UA PI	76.5%	87.9%	76.5%	87.9%	80.0%
MCA PI	70.8%	69.2%	68.0%	72.0%	68.8%
MCA/UA PI ratio	76.9%	91.7%	90.9%	78.6%	84.0%

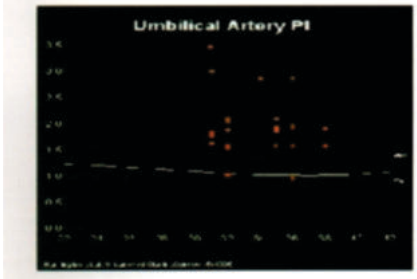
Cerebroplacental Ratio (MCA/UA PI) had highest Positive Predictive Value (PPV=90.9%) followed by UA PI (PPV-76.5%) and MCA PI (PPV=68.0%). Negative Predictive Value of Cerebroplacental Ratio was 78.6% when compared to 87.9% for UA PI and 72.0% for MCA. Diagnostic accuracy of Cerebroplacental ratio (Accuracy=84%) was more than UA PI (Accuracy=80%) and MCA PI (Accuracy=68.8%) in predicting adverse outcomes.

33% of patients with absent end-diastolic flow in the umbilical artery have intrauterine death compared to 100% for Reverse flow in the umbilical artery (Table 4). (Image- A,B,C)



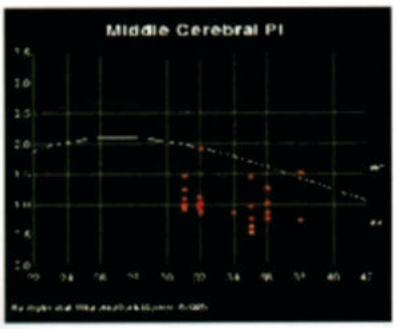
Distribution of MCA PI Values with gestation for pregnancies with favourable outcome.

Image A- Distribution of MCA PI values with gestation for pregnancies with adversed outcome



Distribution of UA PI Values with gestation for pregnancies with adverse outcome.

Image B- Adverse UA PI value with gestation for pregnancies with favarable outcome



Distribution of MCA PI Values with gestation for pregnancies with adverse outcome.

Image C- Distribution of MCA PI value for gestation with adverse outcome

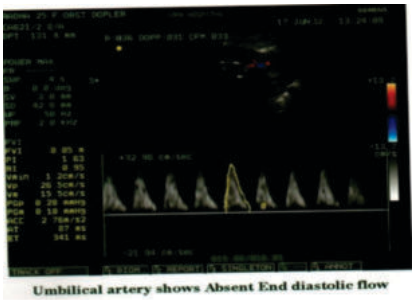
Table-4: Perinatal Mortality Vs Absent/Reversal of umbilical Artery Diastolic Flow

Spectral Characteristics	No. of Cases	IUD	Mortality
Absent EDF	09	03	33%
Reversed EDF	04	04	100%

Abnormal venous waveforms have a decrease of forwarding diastolic peak and increase of peak reverse velocities with atrial contraction. The maximum forward velocity of a-nadir of ductus venosus waveform was decreased/absent or reversed in severe cases.

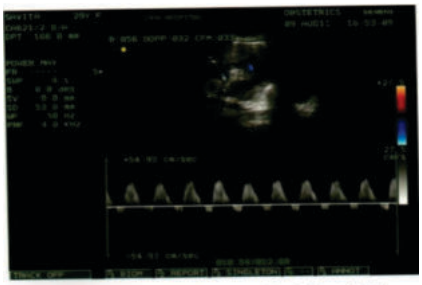
There is a significant correlation between DV PI value with adverse perinatal outcome ($p<0.05$) (Table 5). 14% of intrauterine death occur in patients with pulsatile Umbilical Vein.

DV PI values effectively identify those IUGR fetuses that are at high risk for the adverse outcome (particularly stillbirth) at least 1 week before delivery. The nomogram we have been chosen from Hecher et al. (Image D,E)



Umbilical artery shows Absent End diastolic flow

Image D- Umblical Artery shows Absent End Diastolic Flow (AEDF)



Umbilical artery shows Reversed End diastolic flow

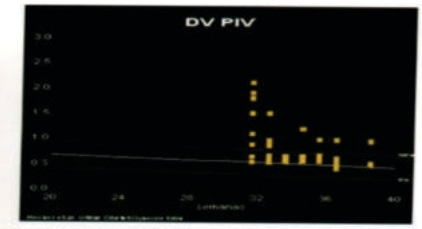
Image E- Umbilical Artery shows Reversed End Diastolic Flow (REDF)

Table-5: Relation between DVPI values with perinatal outcome

Outcome	Abnormal PI	Normal PI
Uneventful	-	26
IUD	7	-
CS For Distress	4	4
Low APG, NICU Admi.	2	3
Intubation	2	-
MAS	2	-

(MAS-meconium aspiration syndrome; DVPI : Ductus Venosus Pulsatility Index), Chi-squire value = 43.036, degree of freedom=5 and p value < 0.05. Since $p<.05$ therefore there is signification correlation between DV PI value with adverse Perinatal outcome.

The presence or absence of pulsation in umbilical vein was studied in all cases. The cases with high ductus venosus PI and absent or reversed diastolic flow in the umbilical artery had significant correlation between critical pregnancy outcome and presence of pulsatile umbilical vein (Table 6). (Image F)



Distribution of DVPI values for pregnancies favourable and adverse perinatal outcome

Image F- Distribution of DVPI values for pregnancies with favorable & adverse perinatal outcomes.

Table-6: Relation between Pulsatile Umbilical Vein with Perinatal Outcome

Outcome	Pusatile	Normal
Uneventful	-	26
IUD	7	-
CS For Distress	4	5
Low APG. NICU Admi.	2	2
MAS	0	2
Intubation	2	-

Chi-square value = 39.644, degree of freedom=5 and p value <0.05. Since $p<0.05$ therefore there is significant correlation between waveform of UV with adverse Perinatal outcome.

Mean birth weight at delivery was 2.43 kg ±0.26 kg (2SD). 60% of neonates (n=30) had birth weight of less than 2.5 kg. There were 7 intra uterine deaths and 43 live births. Of the 43 live births, 8 Neonates were admitted to NICU. 7 neonates had a 5 min Apgar score of less than 7 and 12 babies were born by emergency caesarian section (Table 7).

Table-7: showing Distribution of Adverse Outcomes

Adverse Outcomes	No. of Cases
Intra uterine deaths	7
Emergency CS	12
Low Apgar score	7
Admission to NICU	8

Note: of the live births with adverse outcomes 8 had more than one adverse outcomes. Of the 7 IUDs 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. And all the 4 cases were less than 32 weeks.

Mean gestational age at the first Doppler US examination was 35.2 weeks ±3.46 weeks (2SD). 48% (n=24) fetuses had a least one abnormal outcome, of those; some (n=8) had more than one abnormal outcome. Remaining 26 fetuses had normal outcome (Table 8).

Table-8: showing distribution of Pregnancy Outcome Uneventful Vs Adverse

Placental Maturity	No. of Cases	Percentage
Adverse	24	48
Uneventful	26	52

DISCUSSION

When fetal growth retardation is diagnosed during the third trimester of pregnancy, the obstetrician must decide whether the fetus is "constitutionally" small as a consequence of impaired placental perfusion or not. Doppler flow velocity analysis can be valuable in solving this question. The umbilical-placental and cerebral vascular beds are directly involved in the hemodynamic adjustments of fetal growth retardation. A Doppler index that reflects both of these areas can be useful for identifying fetuses with increased placental and/or decreased cerebral resistance. In the evaluation of the fetal cerebral circulation, the MCA is the most accessible vessel and it can be easily located on colour Doppler, therefore it is a vessel of choice. It is the main branch of the circle of Willis and carries 80% of the blood flow to the lateral cerebral hemisphere, a constant 3%-7% of cardiac output throughout gestation. Hence we used the middle cerebral artery for the evaluation of fetal cerebral circulation.

Results of our studies conform to those of Fong et al [15] that MCA PI had low specificity in predicting adverse perinatal outcomes. There are several possible explanations for the low Specificity of the MCA PI for adverse perinatal outcome. Among several published nomograms for MCA Doppler [16] the cut-off values for an abnormal MCA PI are similar up to about 30 weeks gestational age but differ after 32 weeks. The nomograms we chose for analysis are from the published cross-sectional study by Harrington K et al [17].

Our studies conform to those of Gramellini et al. that best results are obtained when we used MCA/UA PI Ratio, rather than PIs of MCA and DA separately. There were 7 IUDs in whom 4 cases had reversal of diastolic flow and 3 had absent diastolic flow. In all cases with reversal of diastolic flow IUD occurred within one week of diagnosis and all 4 cases were less than 32 weeks.

Assessment of the ductus venosus PI values and the waveform of the umbilical vein showed significant correlation with adverse perinatal outcome, particularly stillbirth at least one week before delivery. These findings of our study conform to that of S. Gudmundsson et al [18], Baschat AA et al [26].

We studied the Doppler index of the umbilical artery only after 30th week, because in agreement with Schulman [27], Gramellini [28] we believe that it is difficult to define normal or abnormal umbilical flow velocity before the 30th week, with the exception of absent end-diastolic flow velocity after the 20th week. Furthermore, in most cases clinical issues concerning asymmetrical growth retardation (placental insufficiency) arise after the 30th week. It is possible to use a single cut off value for cerebroplacental ratio after the 30th week because cerebral-umbilical Doppler ratio does not vary significantly between 30th and 40th weeks as reported by Wladimiroff JW et al [19], Arbeille PHet al [20] also found the cerebral-placental ratio constant during the pregnancy and suggested 1 as the cut off value; all values below 1 were considered abnormal.

We chose incidences of perinatal death, an emergency section for fetal distress, NICU admission for complication of the low Apgar score as outcome variables in concurrence with previous studies done. However the choice of "Low 5 min Apgar score" could be debated as only about 15% of newborns affected by cerebral palsy have low Apgar scores.

Arduini D and Rizzo [21] studied the test characteristics of the PI from the UA, MCA, and RA to predict adverse perinatal outcomes in 120 small-for-gestational-age fetuses. In 46.7% (56 of 120) of fetuses, there were at least one of the following adverse outcomes: perinatal death, cesarean section for fetal distress, 5-minute Apgar score below 7, and asphyxia that necessitated admission to the NICU for more than 48 hours. By using the first Doppler US result for analysis, the authors found that the UA/MCA PI ratio was the best test when compared with MCA, UA, and RA pulsatility indices (sensitivity, 89% vs 68%, 66%, and 63%; specificity, 94% vs 91%, 88%, and 91%).

Gramellini D, Folli MC, et al concluded the cerebro-umbilical Doppler ratio provided a better predictor of small for gestational age newborns and adverse perinatal outcome than either the MCA or UA alone. In predicting those newborns that were small for gestational age, the cerebro-umbilical ratio had a 70% diagnostic accuracy compared with 54.4% for the MCA 65.5% for the UA. The results were more encouraging for the prediction of adverse perinatal outcomes; diagnostic accuracy for the cerebral-umbilical ratio was 90%, compared with 78.8% for the MCA and 83.3% for the UA.

Results of our studies confirm that MCA PI had low specificity in predicting adverse perinatal outcomes (Table 9).

Table-9: Comparison of Diagnostic accuracies

	PRESENT STUDY	Gramellini et al. [11]
MCA/UA PI Ratio	84%	90%
UA PI	80.0%	83.3%
MCA PI	68.8%	78.8%

Our study reveals that best results are obtained when we used MCA/UA PI Ratio, rather than PIs of MCA and DA separately.

We have studied 50 pregnancies with clinical suspicion of IUGR. Mean birth weight at delivery was 2.43 kg ± 0.26 kg (2SD). 60% of neonates (n=30) had a birth weight of less than 2.5 kg. 48% (n=24) of fetuses had at least one adverse outcome. Remaining 26 fetuses had favorable outcome. There were 7 IUDs and 43 live births. Of the 43 live births 8 Neonates were admitted to NICU, 7 neonates had a "5 min Apgar score of less than 7" and 12 babies were born by emergency caesarian section. By using the first Doppler US results for analysis, the MCA/UA PI ratio had a higher specificity, Positive predictive value for adverse perinatal outcome than did the MCA PI and the UA PI. Our findings agree with the results of earlier studies that have shown MCA/UA PI Doppler ratio to be more useful than UA PI or MCA PI in predicting adverse outcome.

Table-10: MCA/UA PI Ratio in Predicting Adverse Perinatal Outcome

	Sensitivity	Specificity	PPV	NPV
Arduini, Rizzo [1] (1992)	89%	94%	-	-
Gramellini et al [2] (1992)	68%	98.4%	94.4%	88.8%
Fong KW et al [3] (1999)	51.3%	80.6%	48.1%	82.2%
Present Study *	76.9%	91.7%	90.9%	78.6%

Table-11: UA PI in Predicting Adverse Perinatal Outcome

	Sensitivity	Specificity	PPV	NPV
Arduini, Rizzo [1] (1992)	66%	88%	-	-
Gramellini et al [2] (1992)	64%	90.7%	72.7%	86.7%
Fong KW et al [3] (1999)	44.7%	80.6%	54%	81.7%
Present Study *	76.5%	87.9%	76.5%	87.9%

Table-12: MCA PI in Predicting Adverse Perinatal Outcome

	Sensitivity	Specificity	PPV	NPV
Arduini, Rizzo [1] (1992)	68%	91%	-	-
Gramellini et al [2] (1992)	24%	100%	100%	77.7%

Fong KW et al [3] (1999)	72.4%	58.1%	37.7%	85.7%
Present Study *	70.8%	69.2%	68.0	72%

Meta-analysis of the previously published randomized controlled studies clearly indicates that UA velocimetry assessment decrease the perinatal mortality from IUGR without any increase in the rate of unnecessary obstetric interventions in high-risk pregnancies. In particular, the frequencies of cesarean section for fetal distress, admission to NICU, and perinatal mortality are all twofold higher in growth-retarded fetuses with abnormal umbilical artery waveforms than in those with normal waveform[22,23].

Table-13: Comparison of Diagnostic accuracies

	PRESENT STUDY	Gramellini et al. [11]
MCA/UA PI Ratio	84%	90%
UA PI	80.0%	83.3%
MCA PI	68.8%	78.8%

Our study reveals that best results are obtained when we used MCA/UA PI Ratio, rather than PIs of MCA and DA separately.

The MCA/UA PI ration (cerebral-placental ratio) is usually constant during the last 10 weeks of gestation. It is possible to use a single cut off value after the 30th week (because cerebral-umbilical Doppler ratio does not vary significantly between 30thand 40thweeks as reported by Wladimiroff et al as observed significant differences in cerebroplacental ratio only between weeks 26-38. After the 26thweek, the statistical comparison showed no significant differences between the intervals considered. Arbeille et alalso found the cerebral-placental ratio constant during the pregnancy and suggested 1 as the cut off value; all values below 1 were considered abnormal. Gramellinie et al as used a single cut off value of 1.08). Therefore, in our study, a single cut-off value (1.08) was used, above which velocimetry was considered normal and below which it was considered abnormal).

CONCLUSION

Fetal Doppler indices, in particular ratios that include measurements obtained from the umbilical and cerebral circulation, help in the recognition of the compromised growth-retarded fetus. In suspected IUGR, cerebroplacental Ratio (MCA PI/UA PI) is a better predictor of adverse perinatal outcome than an abnormal MCA PI or UA PI. Best results are obtained when we use MCA/UA PI Ratio, rather than PIs of MCA and UA separately. Presence of Absent/Reversal of diastolic flow in UA is an ominous sign. These patients show abnormal ductus venosus PI values and pulsatile umbilical vein. DV Doppler and pulsatile umbilical vein are effectively identifies those preterm IUGR fetuses that are at high risk for adverse outcome (particularly stillbirth), independent of the UA waveform. Prediction of adverse perinatal outcome is improved when venous and umbilical artery qualitative waveform analysis is combined. Therefore, the inclusion of venous Doppler into fetal surveillance is strongly suggested for all preterm IUGR fetuses.

Table-13: Comparison of Diagnostic accuracies

	PRESENT STUDY	Gramellini et al. [11]
MCA/UA PI Ratio	84%	90%
UA PI	80.0%	83.3%
MCA PI	68.8%	78.8%

Our study reveals that best results are obtained when we used MCA/UA PI Ratio, rather than PIs of MCA and DA separately.

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