



The Reliability of the Cerebroplacental Ratio in the Prediction of Perinatal Outcome in IUGR Babies

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Abstract

Introduction: *IUGR complicates up to 10% of pregnancies. Cerebroplacental ratio (CPR-MCA PI/ Umbilical artery PI) is emerging as a good tool for the prediction of perinatal adverse outcomes in IUGR babies. We attempted to study the sensitivity, specificity, positive and negative predictive value of CPR in predicting adverse perinatal outcome.*

Materials and Methods: *It is a prospective study done in the Dept of O&G at Govt Medical College, Thiruvananthapuram. 65 cases of clinically detected ultrasound confirmed cases of IUGR in third trimester were the subjects. Serial Doppler measurements of the umbilical artery, middle cerebral artery at 1-3 weeks interval were recorded till a decision for termination of pregnancy was taken. Last measurement values were taken for statistical analysis. Based on these measurements patients were classified into 3 groups.*

Group 1-IUGR with normal Doppler velocimetry in all 3 vessels

Group 2-IUGR with abnormal UA PI alone, CPR <1

Group 3-IUGR abnormal MCA and UA PI, CPR >1.

Results: *Pregnancy outcome measures included gestational age at delivery, mode of delivery, birth weight, Apgar scores, presence of meconium staining of amniotic fluid and need for NICU admissions more than 24 hours. Data was compared among 3 groups. All outcome measures showed a statistically significant difference among groups ($p < .05$) except mode of delivery ($p > .05$). CPR had a sensitivity of 54.5%, specificity of 87.5%, +predictive value of 81.8 % and negative predictive value of 65% in predicting adverse perinatal outcome.*

Introduction

Small-for-gestational age (SGA) refers to an infant born with a birth weight less than the 10th centile¹. Up to 50-70% of these babies may be constitutionally small. Rest of them will be pathologically growth restricted. Likelihood of pathological growth restriction is high in severe SGA babies. Growth restriction implies a

pathological restriction of the genetic growth potential. As a result, growth restricted fetuses may manifest evidence of fetal compromise abnormal Doppler studies, reduced liquor volume etc¹. These babies are further monitored with Doppler velocimetry of the umbilical and fetal circulations. Various parameters like Pulsatility Index (PI), S/D ratios, Resistance index (RI) etc

have been used in assessing the uteroplacental and foetal circulations of these babies. Reduced diastolic blood flow in the umbilical artery is the earliest Doppler abnormality detected³. Low PI in umbilical artery is associated with adverse outcomes. Low PI in MCA reflects cerebral vasodilatation and brain sparing effect. Brain sparing effect is also associated with adverse perinatal outcomes. Combining MCA PI/UA PI as a ratio is known as cerebroplacental ratio or CPR. It is considered as a better predictor than UA or MCA alone. And CPR is now emerging as a better of foetal outcome in IUGR babies as well as normal term babies⁴. We assessed the sensitivity and specificity of CPR in predicting an abnormal perinatal outcome in IUGR babies.

Objectives

To assess the reliability of cerebroplacental ratio in predicting perinatal outcome.

Study design: Prospective Study

Study setting: Done by Department of obstetrics and gynaecology, and department of Radio diagnosis, Medical College, Thiruvananthapuram.

Study Period: 1 year from 2011 sep-2012 September

Materials and Methods

The present study is a part of the project titled correlation between Doppler and perinatal outcome in IUGR babies. 65 cases of clinically and sonographically confirmed cases of IUGR admitted in hospital in third trimester of pregnancy were recruited into the study after informed consent from patients. Study was conducted for a period of one year from September 2011 to September 2012. Clinical criteria was fundal height < period of gestation by 4 weeks. And grey scale USS criteria was those patients with EFW < 10th centile for the gestational age. Patient details including LMP, dating USS, medical history details including pregnancy induced hypertension, chronic hypertension, other chronic diseases like renal disease, SLE, diabetes etc were recorded.

Serial Doppler parameters were obtained from Umbilical artery, Middle cerebral artery were recorded for all patients till a decision for termination of pregnancy was taken. For IUGR with normal Doppler values serial evaluation was done at 3 weeks intervals. For patients with abnormal Doppler values, serial evaluation was done at weekly and less frequent intervals depending on the severity. Doppler values of the last measurement were taken for statistical analysis. Based on the measurements patients were classified into 4 categories.

Group 1-IUGR with normal velocimetry in all 3 vessels

Group 2-abnormal Doppler velocimetry in umbilical artery only (elevated UA PI and or S/D ratio). CPR >1

Group 3—abnormal Doppler velocimetry in MCA (MCA PI & or S/D ratio < 2 SD below the gestational age mean) in addition to abnormal UA PI. CPR < 1

Outcome of these cases including mode of delivery, gestational age at delivery, APGAR scores, meconium staining of amniotic fluid, neonatal ICU admissions were recorded.

Method of statistical analysis

Mean and standard deviations for UA and MCA(S/D and PI values) were calculated for each group. Statistical comparisons between the outcomes in the groups were done using analysis of variance test and students T test. For qualitative data chi-square test was applied. Statistical significance was assigned to p < 0.05 level. Sensitivity and specificity of cerebroplacental ratio in predicting abnormal outcome was calculated.

Study group consisted of 65 patients diagnosed with IUGR assessed with periodic duplex Doppler evaluation

Maternal demographics (n=65)

Maternal age	Number	Percentage
<20	1	1.54
20-24 yrs	21	32.3
25-30yrs	29	44.62
>30	14	21.5

Maternal complications

Maternal complication	Number	Percentage
Pre eclampsia	31	47.7
Chronic hypertension	2	3
Gestational diabetes	5	7
Heart disease	1	1
No underlying complication	26	40

Groups according to Doppler measurements

Group 1(normal Doppler)	30	46.5%
Group2(abnormal UA)	14	21.5%
Group3(abnormal UA+MCA)	21	32%

Umbilical and MCA spectral waveforms were analysed and mean S/D ratio and PI were calculated.

Mean values for UA PI

	Group 1	Group 2	Group 3
mean UA PI	1	1.46	1.57
Std.devn	0.2	0.4	0.4
n	30	14	19

Mean values for MCA PI

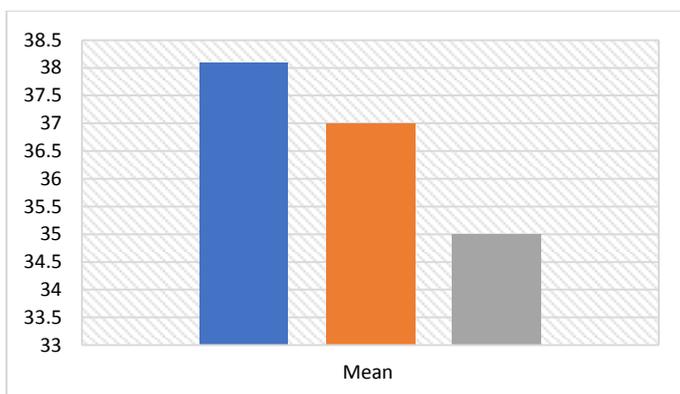
	Group 1	Group 2	Group 3
Mean MCA PI	1.72	1.48	1.04
Std.devn	0.2	0.2	0.16
n	30	14	19

Cerebroplacental ratio was calculated by taking ratio of MCA PI/UA PI

Pregnancy outcome was analysed by recording the mode of delivery, gestational age at delivery, birth weight, Apgar score at 5 minutes, meconium staining of amniotic fluid, neonatal ICU stay and neonatal complications.

Average gestational age at delivery (in weeks)

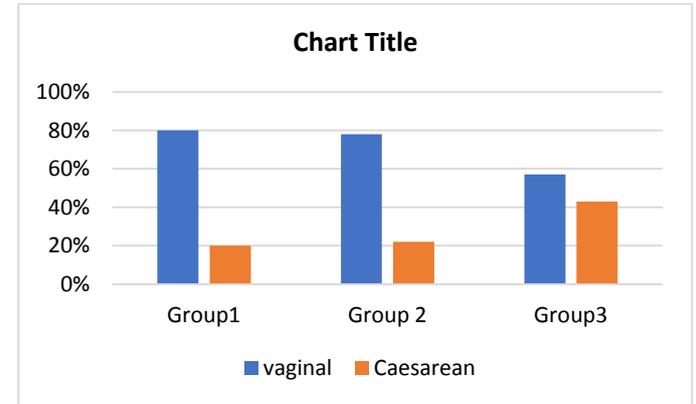
	Group 1	Group 2	Group 3
Mean	38.1	37	35
Stddevn	0.9	1.2	1.7



Mode of delivery

Mode of delivery	Group 1	Group 2	Group 3
vaginal	80%	78%	57%
Caesarean	20%	22%	43%

Mode of Delivery



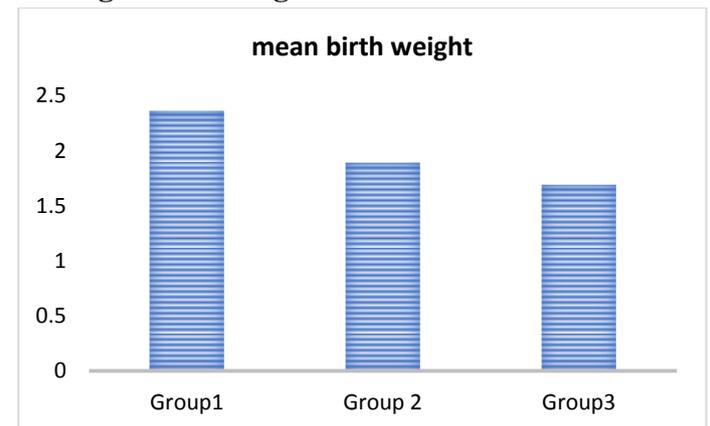
Chi-square value 3.13
p>0.05

The incidence of caesarean sections increased as the severity of Doppler abnormality increased across the groups. But this was not found to be statistically significant.

Average Birth Weight

B.Weight	Group 1	Group 2	Group 3
mean	2.36	1.89	1.69
Std.Devn	0.3	0.4	0.3

Average Birth Weight



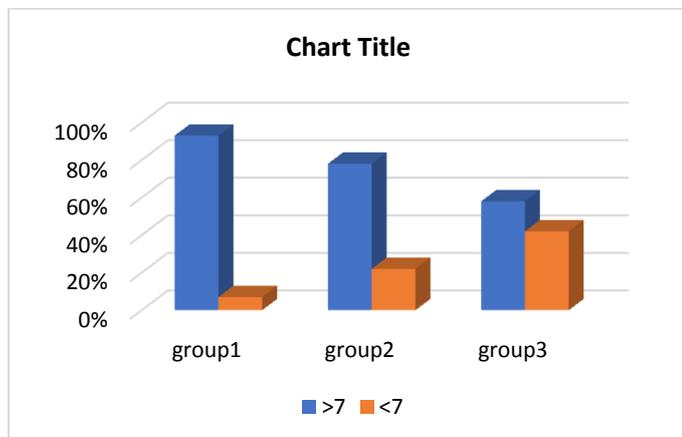
P value<0.01

From this study we observed that mean birth weight decreased across the groups. This difference was found to be statistically significant

APGAR scores at 5 minutes

groups	>7	<7
1	93%	7%
2	78%	22%
3	58%	42%

APGAR score at 5”



Chi-Square Value 8.5

P value<0.05

As we move across the groups the incidence of low APGAR scores and foetal distress became more prevalent. This was found to be statistically significant.

Meconium staining of amniotic fluid

MSAF	Group1	Group 2	Group 3
present	7%	14.3%	47%
Absent	93%	85.75	43%

Chi -square value22.84

P<0.001 Meconium staining of amniotic fluid became more prevalent as the Doppler abnormality increases and this was found to be statistically significant

Neonatal ICU admissions>24 hours

NICU admissions	Group1	Group 2	Group3
Present	4%	21.5%	47%
ABSENT	96%	78.5%	53%

Correlation of CPR with abnormal fetal outcome

	CPR >1	CPR<1
Outcome normal	28	4
Outcome abnormal	15	18

Sensitivity	54.5%
Specificity	87.5%
Positive predictive value	81.8%
Negative predictive value	65%

Discussion

Up to 10%of pregnancies are complicated by reduced fetal growth. Nowadays Sociodemographic factors like late age at marriage, long period of infertility, fibroids, medical disorders complicating pregnancy like pre-eclampsia, SLE and APLA syndrome are seen far more commonly and acts as contributing factors in IUGR. How to monitor these babies in utero and decide on a timely termination to ensure optimum foetal survival is a fascinating area of research.

Several studies are done in this regard and different foetal and placental vessels like middle cerebral artery ,foetal aorta, ductus venosus, umbilical artery etc. were examined widely and various indices like S/D ratio, Pulsatility index(PI) resistive index (RI) were compared as to which is the best predictor regarding fatal outcome. Recently PI is considered as a better measure and combining Foetal and umbilical artery Doppler waveforms were combined in the single ratio that is cerebroplacental ratio (CPR or C/U ratio.⁵

Though this concept was put forth in 1980s research is still on and recently there is a renewed interest in CPR as a predictor of neonatal outcome in AGA foetuses as well as IUGR babies⁴. Several attempts are carried out at constructing the normogram reference ranges^{5,6}.

In the present study the whole cohorts were cases diagnosed as IUGR by clinical and greyscale USS. And group 1 (with normal Doppler findings in all vessels studied) served as our control. In group 2 in addition to reduction in baby weight to <10thcentile, abnormal umbilical artery wave forms were present. And in our study group 3 contained babies with abnormal CPR. We compared the outcomes like gestational age at delivery, mode of delivery, average birth weight, Apgarscores, Meconium stained amniotic fluid, and need for NICU admissions more than 24 hours among groups. We could find that all the above outcome measures showed a statistically significant difference in outcome measures.

According to a study conducted by Gregory De Vore⁴ et al Foetuses with abnormal CPR that are AGA (appropriately grown for gestational age) or late onset SGA have a higher incidence of adverse perinatal outcome. According to him CPR is also an earlier predictor than biophysical profile, Umbilical artery or Middle cerebral artery alone. They recommends to calculate the CPR irrespective of the value of individual UA or MCA alone.

Relationship between CPR and intrapartum CTG abnormalities in SGA and AGA fetuses has also been studied by susumu murata and colleagues in Japan⁷. According to Susumu Murata The incidences of non-reassuring FHR patters were significantly higher in SGA (27.8%) infants compared with term in AGA infants (18.0%). Their study shows that those babies with non-reassuring FHR pattern had significantly lower CPR values compared to those without non reassuring FHR patterns.

Ray. O .Bahadosingh⁸ and colleagues conducted a study to verify the efficacy of CPR in the prediction of adverse perinatal outcome. Their study population included 203 fetuses with IUGR. Middle cerebral and umbilical artery pulsatility index values were measured in 203 fetuses at risk for intrauterine growth restriction, their follow up and perinatal outcomes were measured. They concluded that brain sparing effect in IUGR babies predisposes them for adverse perinatal outcomes. According to them this prediction of adverse outcome was more significant in fetuses <34 weeks of gestation. Sensitivity and specificity of CPR in the prediction of adverse perinatal outcome was calculated. We compared our data with the data of Ray Bahado Singh⁸.

	Present study	Ray. O.B. Singh
Sensitivity	54.5	63
Specificity	87.5	90
+pred. value	81.5	81
Neg. pred value	65.1	77

We can see that the data are comparable.

An interesting observation in the study by Ray. O B Sing⁸ is that an abnormal CPR predicted the

adverse perinatal outcome in only in fetuses <34 weeks of gestation. According to him this prediction was not statistically significant after 34 weeks of gestation. This might reflect an exuberant attempt by preterm fetuses to compensate for cerebral hypoxia. It is known that mechanism favoring cerebral blood flow is immature in preterm fetuses. Asphyxia insults further reduce the ability to auto regulate cerebral blood flow in these infants and may contribute to increased intracranial hemorrhage in the preterm neonate. But in our study such a prediction could not be made.

PORTO study⁹ is a multicentric study from Ireland to assess the reliability of CPR. From their data, CPR<1 had a sensitivity of 66% and specificity of 85% in predicting abnormal perinatal outcome. This data is also comparable to ours. Studies have shown that there is high incidence of respiratory distress syndrome, hypoglycemia and anemia in this group¹⁰ due to large number of preterm infants in this group. There is also increased incidence of necrotizing enterocolitis due to diversion of blood from intestines to vital organs.

Conclusion

Cerebroplacental ratio has a sensitivity of 54.5% and specificity of 87.5%, positive predictive value of 81.5 and negative predictive value of 65.1 in predicting adverse perinatal outcomes in terms of very low birth weight, low APGAR scores, meconium staining of amniotic fluid, and NICU admissions more than 24 hours.

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