Original Research Article

Pregnancy Outcome in Intrauterine Growth Retardation with Normal and Abnormal Cerebroplacental Ratio Assessed by Doppler Study

Ghazala Shahid[1], Monojit Chakraborty[2], Satarupa Roy[3], Shyamapada Pati[4]

[1]Postgraduate Trainee, Department of Obstetrics and Gynaecology, Calcutta National Medical College and Hospital, Kolkata, India.

[2]Associate Professor, Department of Radiodiagnosis, CalcuttaNational Medical College and Hospital, Kolkata, India.

[3]Assistant Professor, Department of Radiodiagnosis,Calcutta National Medical College and Hospital, Kolkata, India.

[4]Professor, Department of Obstetrics and Gynaecology, CalcuttaNational Medical College and Hospital, Kolkata, India.

Abstract

Objective: To compare outcome of IUGR pregnancies of two groups – one with normal crebroplacental ratio and another with abnormal cerebro-placental ratio.

Methods: A prospective observational study was performed for a period of one and a half year from February 2020 to June 2021 in a tertiary care hospital in Kolkata, India where 50 IUGR pregnancies were assessed. They were divided into two groups – 1) Normal cerebro-placental ratio, 2) Abnormal Cerebro-placental ratio and were followed up till delivery outcome and perinatal period.

Results: The group with normal Cerebro-placental ratio had a better pregnancy outcome with a lesser perinatal mortality.

Conclusion: Cerebro-placental ratio can be reliably used as a first hand technique with less technical complications to asses and monitor patients with IUGR and provide optimised ante-natal and perinatal care.

Advances in knowledge: This study evaluates the efficiency and association of cerebro-placental ratio with intra-uterine growth retardation and role of cerebro- placental ratio to prognosticate IUGR which makes it a valuable first hand diagnostic parameter to segregate the antenatal mothers who require tertiary medical attention and monitoring their perinatal outcome.

Keywords: Cerebro Placental ratio; Intra uterine growth retardation; Doppler; Foetus.

Introduction

Intrauterine Growth Retardation (IUGR) is one of the most important causes of perinatal morbidity and mortality complicating approximately 7-15 percent pregnancies worldwide. It is termed as birth weight below 10th percentile of the recommended gender-specific birthweight for gestational age references curves and further sub-divided into moderate IUGR (birth weight from 10th to 3rd percentile) and severe IUGR (birth weight below 3rd percentile).

IUGR is also classified into symmetric or primary IUGR and asymmetric or secondary IUGR. In symmetric IUGR there is a symmetrical reduction of organ size owing to an insult in the early stage of fetal growth affecting cellular hyperplasia stage where as asymetric or secondary IUGR is attributed more to maternal factors like placental insufficiency, maternal hypertension, poor nutrition, lack of sleep and chronic diseases.

Cerebro-placental ratio is calculated by dividing the pulsatility index of MCA / pulsatility index of umbilical artery. It is a useful marker for cerebral hypoxia. A value < 1 at term is abnormal. This is the best indicator to pick up vascular insufficiency throughout the pregnancy, irrespective of gestationalage. [1,2]

The present study was done on mothers having IUGR fetus with gestational age 28 weeks and onwards attending antenatal OPD or being admitted directly through emergency in our hospital which is a tertiary medical centre in which we have attempted to corroborate the CPR with IUGR fetuses and asses the relationship of abnormal

cerebro-placental ratio with IUGR

Aims and Objectives

1. To diagnose IUGR pregnancies.

2. To study Doppler velocimetry of Umbilical artery and Middle cerebral artery and to determine the Cerebro Placental Ratio (CPR).

3. To segregate the IUGR pregnancies in terms of normal and abnormal CPR in two groups.

4. To compare the outcome of pregnancies of these two groups

Materials and Methods

Study Area

Department of Radiology and Imaging and Department of Obstetrics and Gynaecology.

Study Design

Prospective Observational study.

Study Period

One and a half year (from February 2020 to June 2021)

Sample Size

All the subjects fulfilling inclusion and exclusion criteria within study period following method of convenience.

Study Population

The cases for the study will include all pregnant women diagnosed with clinically IUGR pregnancy attending antenatal clinic, obstetric emergency and those admitted in the labour room and obstetric wards.

Sample Selection

Inclusion Criteria

a. Antenatal woman registered in/referred to our outpatient department and emergency who are detected as Clinically IUGR after gestational age of 28 weeks (calculated & confirmed by LMP and/or first trimester USG).

Exclusion Criteria

Multiple pregnancy, Congenital anomaly of fetus, Normal pregnancy

Methodology

The study was conducted on a total of 50 pregnant women after 28 weeks period of gestation diagnosed with clinically IUGR pregnancy attending antenatal clinic, referred from outside or admitted in the emergency.

- All women fulfilling the inclusion and exclusion criterion and gave consent were enrolled in the study.

- On admission, detailed clinical history was taken including present and past medical illness.

- Gestational age determination was based on estimate from the LMP and by ultrasonography or routine fetal biometry in the first trimester.

- On examination, a clinical note was made about the nutritional status, palor, edema, pulse, blood pressure measured and cardiovascular system, respiratory system, and central nervous system statuses analysed.

- NST was also done in some women as per need.

- The following investigations were sent at the time of admission and repeated if needed: Blood for CBC, Fasting blood sugar, PPBS.

Detailed Obstetric ultrasonography was performed

Equipment - 2-5 MHz convex abdominal probe, Logic IQ P9 and Philips HD 7 machines having colour, power Doppler with spectral analysis of the doppler wave from and M- Mode facilities were used

Ultrasonography was done by routine transabdominal ultrasonography including AFI, Biparietal diameter, head circumference and abdominal circumference for biometric data. Doppler was performed on the umbilical artery and middle cerebral artery. Pulsatility Index (PI) of both the arteries were obtained

Cerebroplacental ratio (CPR) was calculated as CPR= PI of MCA/PI of UA. In the present study, cut-off value of CPR is kept to be 1. Normal CPR-: CPR value equal or more than 1. Abnormal CPR: CPR value less than 1

Study Variables

For the Mother

a) Socio-demographic profile- Age, Pre - pregnancy Weight & Height, Address (Urban/Rural), Prepregnancy Body Mass Index, Socioeconomic status, Education status, Booked/ Unbooked

b) Parity, Gravida, Gestational age, BP, Hb%,

c) Any pre-existing diseases- Hypertension disorders in pregnancy, diabetes mellitus

d) Mode of delivery

e) Examination- General physical examination, thorough obstetrics examination.

For the Baby

a) USG for the fetal growth parameters, Doppler

velocimetry of umbilical artery and middle cerebral artery of the fetus 28 weeks onwards

b) Birth Weight

c) Baby cried immediately after birth or not

d) Resuscitation required or not

e) Apgar Score at 1 min & 5 min

f) Birth asphyxia

g) Use of health service resources: Admission to special care nursery, ventilation, length of stay in hospital.

h) Perinatal death or not.

Statistical Analysis

Continuous variables were compared using Student's t-test. 2 test was used to determine association among categorical variables and a P value

Results and Analysis

The study was conducted from February 2020 to June 2021 among 50 pregnant women diagnosed with IUGR

The result were recorded, tabulated and statistically analyzed by using parameters like Mean ±SEM, percentage, independent students' test. Categorical data were analyzed with contingency tables using Pearson Chi-square test. Statistical test were considered significant when p value <0.05. 50 mothers with IUGR were divided into 2 groups:

1. GROUP A: Normal Cerebroplacental ratio (≥1) 27 IUGR Mothers

2. GROUP B: Abnormal Cerebroplacental ratio (<1) 23 IUGR Mothers

Comparison of Age

Table 1: Comparison of Study Groups According to Age (N=50)

Age Group	Group A	Group B	Total
<20	5 (18.5%)	5(21.8%)	10
20-30	17(63%)	14(60.8%)	31
>30	5 (18.5 %)	4(17.4%)	9
Grand total	27	23	50

The mean age was 24.63±5.54 years in group A and 26.04±7.08 years in group B. It's evident that there was no statistically significant difference between two groups (p=0.432).

Maximum number of mothers were under age group 20-30 years in both groups i.e., 62.9% in Group A and 60.8% in Group B.

Table 2: Comparison According to Booking Status

Majority of mothers in Group A were Booked (63%) while most of the mothers in Group B were Unbooked

Booking Status	Group A	Group B	Grand Total
Unbooked	10 (37%)	14(60.9%)	24
Booked	17(63%)	9(39.1%)	26
Grand Total	27	23	50

(60.9%).

Table 3: Comparison According to Period of Gestation at Delivery

Period of Gestation at Delivery	Group A	Group B	Grand Total
Less than 37 weeks	14(51.9%)	19(82.6%)	33
Mpre than equal to 37 weeks	13(48.1%)	4(17.4%)	17
Grand total	27	23	50
Parameter	Group A	Group B	P Value
Period of gest atdelivery (weeks)Mean +/- SD	36.63 +/- 2.32	34.26 +/- 2.75	0.002

Data are expressed as mean ±SD. Test done: independent t test. A value of p<0.05 is considered significant. The mean POG was 36.63±2.32 weeks in Group A and 34.26±2.75 weeks in Group B. There was statistically significant difference between the two groups where p value was (0.002).

Table 4: Comparison According to Hypertensive Disorders During Pregnancy

HDP	Group A	Group B	Grand Total	
Yes	7(25.9%)	15(65.2%)	22	P Value0.005
No	20(74.1%)	8(34.8%)	28	
Grand total	27	23	50	

Test done: Fishers exact test. A value of p<0.005 is considered as significant

Result: Statistically there was significant difference (p=0.005) between two groups.

In group A, Hypertensive disorders during pregnancy was found in 25.9% mothers of Group A while in Group B, it was found in 65.2% mothers.

Table 5: Comparison of Presence of Anemia in Study Groups

Anemia	Group A	Group B	Grand Total
No	17 (63%)	18 (78.3%)	35
Yes	10 (37%)	5 (21.7%)	15
Grand Total	27	23	50

Table 6: Comparison of Requirement of Neonatal Resuscitation in Study Group

NEO Resuscitation	Group A	Group B	Grand Total	P Value
No	21 (77.8%)	5 (21.7%)	26	0.00
Yes	6 (22.2%)	18 (78.3%)	24	
Grand Total	27	23	50	Significant

Test done: Fishers exact test. A value of p<0.05 is considered as significant.

Result: Fishers exact test statistically suggested that there was significant difference between two groups where p value was 0.000.

In Group A, Neonatal resuscitation was required in 22.2% while in Group B, it was required in 78.3%.

Table 7: Comparison of Apgar Score At 1 Minute in Study Groups

APGAR Score at 1 Min	Group A	Group B	Grand Total	P- Value
Less than 7	13 (48.1%)	21 (91.3%)	34	0.002
More than equal to 7	14 (51.9%)	2 (8.7%)	16	
Grand total	27	23	50	Significant

Test done: Fishers exact test. A value of p< 0.05 are considered as significant

Result: Fishers exact test statistically suggested that there was significant difference between two groups where p value was 0.002.

In Group A, 48.1% newborns had APGAR < 7 at 1 min of life in comparison of 91.3 % of them in Group B

Table 8: Comparison of Apgar Score At 5 Minute in Study Groups

APGAR Score at 5Min	Group A	Group B	GrandTotal	P- Value
Less than 7	1(3.7%)	8(34.8%)	9	0.001
More than equal to 7	26(96.3%)	15(65.2%)	41	
Grand Total	27	23	50	Significant

Test done: Fishers exact test. A value of p<0.05 are considered significant.

Result: Fishers exact test statistically suggested that there was significant difference between two groups where p value was 0.001.

In Group A, 3.7% newborns had APGAR <7 at 5 min of life in comparison of 34.8 % of them in Group B.

Table 9: Comparison of Birth Weight Between Study Groups

Birth Weight (gms)	Group A	Group B	Grand Total
Less than 1500	1	7	8
1500-2499	25	14	39
>equal to 2500	1	2	3
Parameter	Group A	Group B	P value
Birth Weight (gms) Mean ± SD	2109.2±291	1709.7±524	0.001

Data are expressed as mean ±SD. Test done: independent t test. A value p<0.05 is considered significant.

Statistically Group A had mean birth weight of 2109.2±219 grams and Group B had mean birth weight of 1709 ± 524 grams. There was statistically significant difference between the two groups where p value was (0.001).

Table 10: Comparison of Birth Asphyxia Between Study Groups

Birth Asphyxia	Group A	Group B	Grand Total	P- Value
No	21 (77.8%)	5 (21.7%)	26	0.000
Yes	6 (22.2%)	18 (78.3%)	24	
Grand total	27	23	50	Significant

Test done: Fishers exact test. A value of p< 0.05 are considered significant.
Result: Fishers exact test statistically suggested that there was significant difference between two groups where p value was 0.000.

Table 11: Comparison of NICU Admission Between Study Groups

NICU ADM	Group A	Group B	Grand Total	P Value
NO	21 (77.8%)	6 (26.1%)	27	0.001
YES	6 (22.2%)	17 (73.9%	23	
Grand Total	27	23	50	Significant

Test done: Fishers exact test. A value of p<0.05 are considered significant.

Result: Fishers exact test statistically suggested that there was significant difference between two groups where p value was 0.001.

In group A, 22.2% newborns needed NICU admission for some reasons in comparison of 73.9% in Group B.

Table 12: Comparison of Perinatal Death Between Study Groups

Perinatal Death	Group A	Group B	Grand Total	P Value
No	26 (96.3%)	20 (86.96%)	46	0.32
Yes	1 (3.7%)	3(13.04%)	4	
Grand Total	27	23	50	Not Significant

Test done: Fishers exact test. A value of p< 0.05 is considered significant.

Result: Fishers exact test suggested that there was no statistically significant difference (p=0.32) between two groups.

In group A, Perinatal death was 3.7% in while group B, it was 13.04%.

Discussion

The present study was conducted on 50 IUGR mothers. Various outcome like period of gestational age at delivery, mode of delivery, birth asphyxia, neonatal resuscitation, NICU admission, APGAR score at 1 minutes, APGAR score at 5 minutes, birth weight, perinatal morbidity and mortality was assessed.

Pregnancy Outcome

Gestational age at delivery

In the present study, mean gestational age was noted to be 36.6 weeks in Normal CPR group at the time of delivery while it was 34.2 weeks in abnormal CPR group. Most of the studies agrees with the difference in the mean gestational age.

Table 13: Comparison of gestational age at delivery

Study	Mean Gestage at delivery in Normal CPR group (weeks)	Mean Gest age at delivery in Abnormal CPR group (weeks)	P-Value	Remarks
Monteith Cathy et al. (2019)[3]	36.8	33.6	<0.001	Significant
Bahado Singh R O (1999)[4]	35.7	31.6	<0.0001	Significant
Gramellini et al. (1999)[5]	39.4	34.9	< 0.001	Significant
Makhseed et al. (2000)[6]	37.3	35.4	<0.05	Significant
Flood et al. (2014)[7]	38.3	34.6	<0.001	Significant
Kamalarani AE et al. (2020)[8]	38.5	37.1	0.003	Significant
Present Study	36.6	34.2	.002	Significant

Birth weight in the present study, mean birth weight of the neonates in normal CPR group was 2109.2±291 grams while that was 1709.7±524 grams in another group. And the difference was statistically significant.

Table 14: Comparison of birth weight between different studies

Study with comparison group	Mean Birth weight in Normal CPR group (g)	Mean Birth weight in Abnormal CPR group (g)	P Value	Remarks
Monteith Cathy et al. [3] Normal CPR, n=136 Abnormal CPR, n=41	2336	1603	<0.001	Significant
Bahado Singh RO [4] Normal CPR, n=87 Abnormal CPR, n=36	2098	1138	<0.001	Significant
Gramellini et al. [5] NormalCPR, n=72 Abnormal CPR, n=18	3031	1659	<0.001	Significant
Makhseed et al [6] Normal CPR, n=35 Abnormal CPR, n=35	2351	1835	<0.001	Significant
Flood et al. [7] Normal CPR, n=735 Abnormal CPR, n=146	2611	1763	<0.001	Significant
Kamalarani AE etal. [8] Normal CPR, n=69 Abnormal CPR, n=69	2383	1872	<0.001	Significant
Present Study Normal CPR, n=27 Abnormal CPR, n=23	2109.2	1709.7	0.001	Significant

Neonatal outcome

The neonatal outcome of our study resembles and agrees with the outcome of most of the studies with respect of need of neonatal resuscitation, 5 min APGAR score, NICU admission, perinatal death. In the present study, 22.2% and 78.3% neonates required neonatal resuscitation in Normal and Abnormal CPR group respectively.

Table 15: Comparison of 5 min APGAR score between different studies

Study	5 min APGAR < 7 in normal CPRgroup (%)	5 min APGAR <7 in abnormal CPRgroup (%)	P Value	Remarks
Monteith Cathy et al. [3]	0.7	7.3	0.002	Significant
Bahado Singh R O[4]	7.2	19.4	>0.05	Not Significant
Gramellini et al.[5]	2.7	16.6	<0.05	Significant
Makhseed et al.[6]	11.4	25.7	NS	Not Significant
Kamalarani AE et al.[8]	8.69	6.25	NS	Not Significant
Present study	3.7	34.8	0.001	Significant

Table 16: Comparison of NICU admission between different studies

Study	NICU admission in Normal CPR group (%)	NICU admission in Abnormal CPR group (%)	P-Value	Remarks
Monteith Cathy et al. [3]	32	83	<0.001	Significant
Bahado Singh R O [4]	41.4	77.8	<0.001	Significant
Gramellini et al. [5]	11.1	77.7	<0.001	Significant
Makhseed et al. [6]	31.4	74.3	<0.001	Significant
Flood et al. [7]	22	64	<0.0001	Significant
Kamalarani AE et al. [8]	30.4	87.5	<0.001	Significant
Present Study	22.2	73.9	0.001	Significant

In our study, 22.2% neonates needed NICU admission in Normal CPR while 73.9% of them needed in another group. The study by Singh et al. also showed that 75% of babies of the abnormal group stayed in the nursery for > 10 days. 16 Other studies also represent similar results.

Table 17: Comparison of perinatal death between different studies

Study	Perinatal death inNormal CPR group (%)	Perinatal death inAbnormal CPR group (%)	P-Value	Remarks
Bahado Singh R O [4]	0	8.3	<0.05	Significant
Flood et al. [7]	0	2	<0.0001	Significant
Arias F. [9]	01	18	<0.05	Significant
Present Study	**3.7**	**13**	**.32**	**Not Significant**

Study shows 3.7% perinatal mortality in 1st group and 13% in another one which included still birth and early neonatal deaths.

Summary

The study included 50 pregnant women having IUGR from February 2020 to June 2021 according to inclusion and exclusion criteria already stated in the methodology were taken for this observational study who were subjected to trans-abdominal ultrasonography and color Doppler velocimetry.

They were segregated according to the cerebroplacental ratio-: IUGR with Normal Cerebroplacental ratio (27) and IUGR with Abnormal Cerebroplacental ratio (23) and were followed up till delivery.

The result obtained are summarised as follows

- 63% mothers with Normal CPR were booked case while only 39% in Abnormal CPR group as most of the cases were referred from peripheral hospitals.

- Majority of mothers with Normal CPR were normotensive (74%) while 65% mothers of Abnormal CPR group were found to be suffering from hypertensive disorders during pregnancy.

- Most of the neonates (78.3%) of Abnormal CPR group needed neonatal resuscitation immediately after birth while only 22% neonates of Normal CPR group needed neonatal resuscitation.

- At 1 min of birth, APGAR score was less than 7 in most of the neonates of Abnormal CPR group (91%) and almost half (48%) of another group.

- 5 min APGAR was found to be improved than earlier in both groups being less than 7 in 3% of Normal CPR group and 34% Abnormal CPR group.

- Birth weight of both the groups majorly fell between 1500 grams to 2499 grams. Mean birth weight of group A was 2109.2±291 gms and that of group B was 1709.7±524 gms which was found to be significant.

- Birth asphyxia was found in 22% babies of normal CPR group and 78% babies of abnormal CPR group.

- Among all newborns, 22% of group A and 73% of group B needed NICU admission after birth.

- On follow up, we got 3% perinatal deaths in Normal CPR group and 13% in abnormal one which included still births and neonatal deaths.

Conclusion

In an attempt to improve peri-natal mortality and morbidity by providing good antenatal care and wide application of doppler ultrasound Cerebroplacental ratio is being utilised by many obstetricians in our country for detection and diagnosis of FGR in last decade. Presently this modality of investigation is giving optimum result in improving the perinatal outcome.

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