

Assessment of Cerebroplacental Ratio at 35 to 38 Weeks Gestation and Its Correlation to Perinatal Outcomes: A Two Step ApproachPriya Singh Suryvanshi¹, Pratibha Chadar², Juhi Agrawal³, Ashwani Narnoure⁴¹Senior Resident, Department of Obstetrics & Gynecology, Kamla Raja Hospital & Gajra Raja Medical College, Gwalior, Madhya Pradesh, India²Senior Resident, Department of Obstetrics & Gynecology, Kamla Raja Hospital & Gajra Raja Medical College, Gwalior, Madhya Pradesh, India³Professor, Department of Obstetrics & Gynecology, Gandhi Medical College, Bhopal, Madhya Pradesh, India⁴Consultant Gynaecologist, Department of Obstetrics & Gynecology, District Hospital, Chhindwara, Madhya Pradesh, India

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Abstract:**Background:** Cerebroplacental ratio (CPR) is a reliable indicator of foetus health, measured by colour Doppler. CPR is calculated as ratio of pulsatility index of middle cerebral artery (MCA) and umbilical artery (UA). When blood is redistributed in the early stages of hypoxia in favor of cerebral circulation, the diastolic flow amplitude increases above normal levels in MCA while umbilical flow in diastole decreases, providing CPR**Aim:** objective of this study is to investigate the relationship between CPR and adverse perinatal outcomes in a tertiary care hospital.**Methods:** A total of 300 pregnant women of age group 18-35 years with singleton pregnancies at 34-37 weeks were enrolled. Cerebroplacental ratio was calculated using a Doppler scan on each patient. When the Cerebroplacental ratio is <1 it is deemed abnormal. The perinatal outcomes were observed and their associations were evaluated.**Results:** Out of total majority of the participants (37.7%) belongs to 18-24 years of age group. Majority of the participants (87%) were multigravida. Most of them (36.7%) belonged to very low risk category. Most of the women (77.7%) delivered vaginally. 92.7% of born baby was alive and healthy and 76.7% of newborn had birth weight >2.5 kg. there is no statistically significant difference was found between gestational age, mode of delivery with CPR. Statistically significant association was found between perinatal outcomes (hypoxia, Stillborn and NICU admission) and CPR ($p < 0.05$).**Conclusion:** CPR is important tool in predicting an unfavorable perinatal outcome.**Keywords:** Cerebroplacental Ratio, Mode of Delivery, Perinatal Outcomes, Gestation Age.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Globally, it has been observed that intrauterine complications are major cause of adverse perinatal outcomes, including stillbirth, hypoxic-ischemic brain injury and consequent long term disability. Worldwide, of the 7.6 million deaths under 5 years of age, approximately 9.4% occur primarily in low-income and middle-income countries as a result of intrauterine related complications, and it is found that globally approximately 45% of stillbirths (about 1.3 million per year) occur during the intrauterine period [1].

In term infants, intrauterine fetal compromise or hypoxia occurs as a result of uncertain acute events such as uterine rupture, placental prolapse or placental abruption. Doppler ultrasound

velocimetry of uteroplacental umbilical and fetal vessels has become an established method of antenatal fetal surveillance which allows a noninvasive assessment of fetal circulation. The Cerebroplacental ratio (CP ratio), the ratio of the pulsatility index (PI) of the MCA to that of the UA, can detect fetal hypoxemia occurring via two different mechanisms [2].

Instruments used in ante partum foetal surveillance include the foetal kick count, non-stress test, biophysical profile, amniotic fluid index, and arterial and venous Doppler. Different Dopplers and their proportions in turn reflect the future foetal growth pace. The cerebral circulation is normally a high-impedance circulation with continuous

forward flow throughout the cardiac cycle [3]. When a foetus has persistent hypoxia, total blood flow to the foetus is preferentially redistributed to vital organs like brain, heart, and kidney [4]. A drop in the middle cerebral artery's pulsatility index (PI) often known as the "brain sparing effect," arises from compensatory vasodilation with an increase in diastolic flow [5]. We can forecast the perinatal prognosis and adjust the obstetric care as appropriate by performing a Doppler assessment of the MCA and UA in the foetus. The Cerebroplacental ratio measures the ratio of blood flow supplying the brain and placenta. In the early stages of hypoxia, when blood redistribution favours cerebral circulation, the diastolic flow amplitude exceeds normal and the umbilical cord flow is low, giving a CPR<1. In a 1980 study of fetal blood obtained by umbilical cord small for gestational age (SGA), an increased impedance to fetal flow, reflected in a higher pulsation index (PI) in the umbilical artery (UA), and midbrain of the fetus There is a decrease in PI in the middle cerebral artery (MCA) has been associated with fetal hypoxemia and academia [6, 7]. It was later shown that in SGA fetuses the Cerebroplacental ratio (CPR) was a better predictor of adverse 2 perinatal outcome than MCA-PI or UA-PI alone and that low CPR is associated with increased rates of perinatal death, fetal distress [8, 9].

Aims and Objectives:

The objective of this study is to screen Cerebroplacental ratio at 36-38 week gestation and its association with the adverse perinatal

Materials and Methods

This was a prospective observational study conducted in the Department of Obstetrics and Gynaecology, Sultania Zanana Hospital, Gandhi Medical College, Bhopal (M.P.) from 1st February 2020 –30 January 2021 (01 year duration).

Inclusion Criteria:

- Patients with gestational age between 34+6 to 37+6 weeks
- Singleton pregnancy
- Patients who provide consent for the study

Exclusion Criteria:

- Gestational age <34+6 weeks and ≥38 weeks
- Multiple pregnancies
- Congenital anomalies in the foetus
- Patients who not provide consent for the study

A total of 300 women meeting inclusion criteria were enrolled in this study Using a premed Performa, Sociodemographic information, patient characteristics, risk Factor, maternal and neonatal parameters were noted.

Routine ultrasound examination will be done at 34+6 to 37 +6 weeks gestation including Measurement of umbilical artery pulsatility and middle cerebral artery pulsatility index for all women

Depending on the estimated fetal weight pregnancies will be categorized into

- Very low risk (≥40 percentile)
- Low risk (40 -20 percentile)
- Intermediate risk (10-20 percentiles)
- High risk (<10 percentile)

The following outcome measures will be considered

- Adverse perinatal outcome consisting of still birth, neonatal death, or hypoxic ischaemic Encephalopathy
- Presence of surrogate markers of perinatal hypoxia consisting, 5 minute Apgar score <7 or admission to the neonatal intensive care unit for >24 hours
- Caesarean delivery for presumed fetal compromise in labor
- Neonatal birth weight less than third percentile for gestational age

Statistical Analysis: Statistical analysis was performed using IBM statistical package for the social sciences (SPSS) statistics (version 20.0). Descriptive analysis was done to show the distribution in the form of frequency and percentage P-value <0.05 was considered as statistically significant.

Results

A total of 300 women with 34-37 weeks of gestational age were analysed in this study, majority of the participants (37.7%) belong to 18-24 years of age group, most of them (54%) residing at urban area. Maximum no of participants (37.4%) were educated up to high school and most of them (47%) belong to middle class.

Majority of the participants (87%) were multigravida and 13% participants were primigravida.

Table 1: Distribution of study participants according to Sociodemographic variables

Sociodemographic variables		Frequency	Percentage
Age Group	18-24	113	37.70%
(In years)	25-30	94	31.30%
	31-35	93	31%
Residential Status	Urban	162	54%

	Rural	138	46%
Education	Illiterate	47	15.70%
	Primary	52	17.30%
	High School	112	37.40%
	Secondary	47	15.70%
	Graduate and above	42	14%
Socio economic status	Upper Class	49	16.30%
	Middle Class	141	47%
	Lower Class	110	36.70%
Parity	Primigravida	39	13%
	2nd Gravida	74	24.70%
	3rd Gravida	90	30%
	4th Gravida	52	17.30%
	5th Gravida	45	15%

Majority of the patients (36.7%) belonged to very low risk category, 30.7% intermediate risk, 29.3% low risk and 3.3% were belonged to high risk category according to foetal weight.

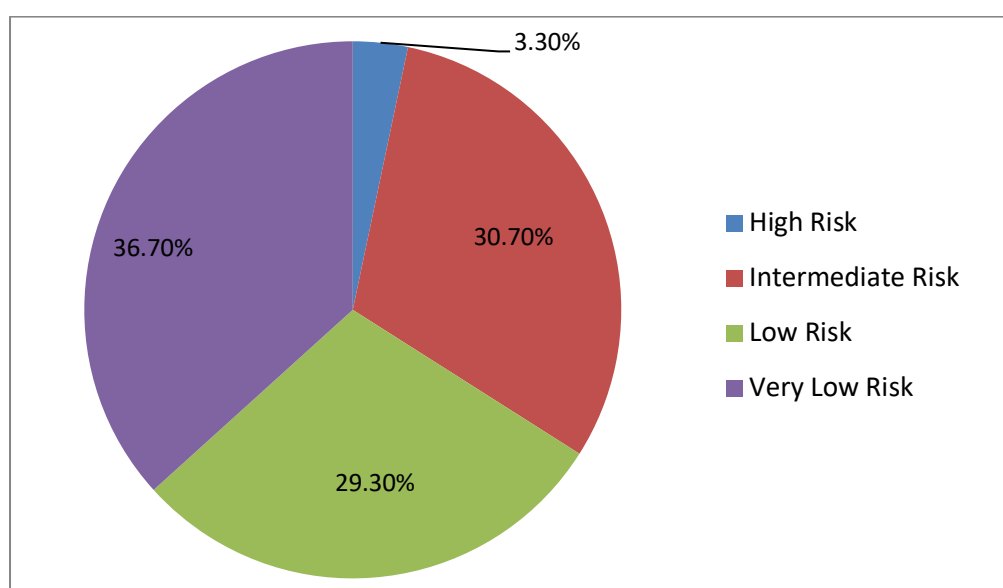


Figure 1: Distribution of study participant according to foetal weight risk categories

Most of the women (77.7%) delivered vaginally. 92.7% of born baby was alive and healthy. 76.7% of newborn had birth weight >2.5 kg, 20.7% and 2.7% recorded as birth weight between (1.5 to 2.5 kg) and birth weight between (1 to 1.5 kg) respectively. 26% newborn needed NICU admission and 4.7% newborn recorded APGAR score.

Table 2: General frequency of determinants of perinatal outcome

Perinatal outcome		Frequency	Percentage
Mode of Delivery	Normal Vaginal Delivery	233	77.70%
	LSCS	67	22.30%
Baby Status	Alive and Healthy	278	92.70%
	*Non reassuring fetal heart rate- Neonatal bradycardia	9	3.00%
	Perinatal Hypoxia	12	4.00%
	Stillbirth	1	0.30%
Birth weight	NBW (> 2.5 kg)	230	76.70%
	LBW (1.5 - 2.5 kg)	62	20.70%
	VLBW (1 -1.5 kg)	8	2.70%
NICU admission	Yes	80	26.70%
	No	220	73.30%
APGAR score	No depression ≥ 7	286	95.30%
	Mild depression ≤ 6	14	4.70%

Among very low risk category, 96.1% of study participants with gestational age <37 weeks had >1 CPR and 100% the participants with \geq 37 weeks of gestation had >1 CPR.

Majority of the participants (98.7%) were normal vaginal delivery had >1 CPR and 97.1% of study participants with LSCS had >1 CPR. Intermediate risk category, 97% of study participants with gestational age <37 weeks had <1 CPR and 100% participants with \geq 37 weeks of gestation had >1 CPR.

98.9% of study participants with normal vaginal delivery had >1 CPR and 100% participants with LSCS had >1 CPR.

High risk category, 50% of study participants with gestational age <37 weeks had >1 CPR and 100% participants with \geq 37 weeks of gestation had >1 CPR 75% of study participants with normal vaginal delivery had >1 CPR, 50% of LSCS had CPR<1. Difference in proportion among the entire group are not significant ($p>0.05$).

Table 3: Association between CPR and gestational age and mode of delivery in different category of EFW

Categories	Variables	Cerebroplacental Ratio		P value
		>1	<1	
Very low risk category of EFW	Gestational Age < 37	49 (96.1%)	2 (3.9%)	0.125
	Gestational Age \geq 37	59 (100%)	0 (0%)	
	Normal Vaginal Delivery	74 (98.7%)	1 (1.3%)	0.577
	LSCS	34 (97.1%)	1 (2.9%)	
Intermediate category of EFW	Gestational Age < 37	42 (97.7%)	1 (2.3%)	0.283
	Gestational Age \geq 37	49 (100%)	0 (0%)	
	Normal Vaginal Delivery	89 (98.9%)	1 (1.1%)	0.881
	LSCS	2 (100%)	0 (0%)	
High risk category of EFW	Gestational Age < 37	3 (50%)	3 (50%)	0.091
	Gestational Age \geq 37	4 (100%)	0 (0%)	
	Normal Vaginal Delivery	6 (75%)	2 (25%)	0.49
	LSCS	1 (50%)	1 (50%)	

Among the very low risk category no significant association between CPR and neonatal bradycardia, whereas significant association was found between perinatal hypoxia, Stillborn and NICU admission with the CPR ($p<0.05$). Among the Intermediate risk category, no significant association between CPR with neonatal bradycardia and NICU admission, whereas statistically significant association

was found between perinatal hypoxia and Stillborn with the CPR ($p<0.05$).

High risk category no significant association between CPR with neonatal bradycardia and NICU admission, whereas statistically significant association was found between perinatal hypoxia and Stillborn with the CPR ($p<0.05$).

Table 4: Association between CPR and adverse outcome in different category of EFW

Categories	variables		Cerebroplacental Ratio		P value
			>1	<1	
Very low risk category of EFW	Neonatal bradycardia	Yes	3 (2.8%)	0 (0%)	0.811
		No	105 (97.2%)	2 (100%)	
	Perinatal Hypoxia	Yes	3 (2.8%)	1 (50%)	0.000
		No	105 (97.2%)	1 (50%)	
	Stillborn	Yes	0 (0%)	1 (50%)	0.00
		No	108 (100%)	1 (50%)	
	NICU admission	Yes	1 (0.9%)	1 (50%)	0.00
		No	107 (99.1%)	1 (50%)	
Intermediate category of EFW	Neonatal bradycardia	Yes	3 (3.3%)	0 (0%)	0.854
		No	88 (96.7%)	1 (100%)	
	Perinatal Hypoxia	Yes	4 (4.4%)	1 (100%)	0.000
		No	87 (95.6%)	0 (0%)	
	Stillborn	Yes	0 (0%)	0 (0%)	
		No	91 (100%)	1 (100%)	
	NICU admission	Yes	66 (72.5%)	1 (100%)	0.539
		No	25 (27.5%)	0 (0%)	
High risk category of EFW	Neonatal bradycardia	Yes	0 (0%)	2 (66.7%)	0.016
		No	7 (100%)	1 (33.3%)	

	Perinatal Hypoxia	Yes	0 (0%)	0 (0%)	
		No	7 (100%)	3 (100%)	
	Stillborn	Yes	0 (0%)	0 (0%)	
		No	7 (100%)	3 (100%)	
	NICU admission	Yes	7 (100%)	3 (100%)	
		No	0 (0%)	0 (0%)	

Discussion

Cerebroplacental ratio is an obstetric ultrasound tool used as a predictor of adverse pregnancy outcome in both small for gestational age (SGA) and it can be also a good tool to predict appropriate for gestational age (AGA) fetuses. The CPR has been a good predictor of the foetal oxygenation status at birth and can be used to identify pregnancies that are at risk for adverse outcomes.

In our study majority of the participants were in the age group of 18-24 years, with mean age was 27 ± 5 years, similar findings were reported by Malik et al [10] and Yuvabala kumaran G, et al [11].

In the present study 90% of the mothers were multigravida who recorded to have estimated fetal weight >10 percentile, in contrast to Anna et al [12] showing that the majority of the cases (60%) were primigravidae. Maternal parity is directly proportional to size of the foetus.

We have reported that Cerebroplacental Ratio Sufficient to Predict Adverse Neonatal Outcome in Small for Gestational Age Foetuses >34 Weeks of Gestation, in agreement with the Jarmila A. et al [13].

A study done by Dall'asta et al [14], reported that women with reduced CPR mother delivered at an early gestational age this study noted that patient having low CPR, increased incidence of operative delivery, results are comparable with the Kumari S et al [15] and Subha S, et al [16]. Current study found high-risk category neonates with EFW were significantly associated with mode of delivery, SGA neonates were delivered by LSCS, similar observation shown by Sachdev et al [17].

No significant association was found between Apgar score and EFW in this study, accordance to the Alanwar et al [18], whereas Bakalis et al [19] in their study reported that adverse perinatal outcome is higher in SGA including Apgar<7 as compared to non-SGA fetuses.

Our study shows that Neonates with EFW < 10th percentile was significantly associated with the neonates NICU admission, our finding were consistent to other researchers also: Sahinaj et al [20] and D Kabiri, et al [21].

Present study reported that abnormal Cerebroplacental ratio were significantly associated with the neonatal hypoxia, concordance with the Sharma K, et al [22]. Current study observed

significant correlation between low Cerebroplacental ratio and still born neonates, constant finding reported by Regan et al [23]. In our study, overall perinatal outcomes (perinatal hypoxia, NICU admission and stillborn) was significantly associated with abnormal CPR, our finding correlates with the Khalil et al [24] and Asta AD, et al [25].

Conclusion

We have concluded that CPR is a marker of impaired fetal growth and thus the adverse fetal outcome. Abnormal CPR necessitated increased need for operative delivery for presumed fetal compromise, low birth weight and admission to the NICU. There is a significant association of CPR with gestational age of delivery, mode of delivery and perinatal outcomes like: low APGAR, intensive care requirement, perinatal hypoxia and stillborn. CPR of >1 reduces the chances of unfavorable prenatal outcome due to its high specificity and negative predictive value

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