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ON ADMISSION ESTIMATION OF CEREBRO-PLACENTAL RATIO (CPR) IN HYPERTENSIVE MOTHERS IN 3RD TRIMESTER CAN DECREASE PERINATAL MORTALITY IN AN OVERLOADED RURAL BASED TERTIARY CARE CENTRE- A PROSPECTIVE STUDY.

Obstetrics & Gynaecology

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ABSTRACT

Background- The Cerebro-Placental Ratio (CPR) is a Doppler derived fetal ultrasound metric that reflects alterations in cerebral blood flow due to fetal hypoxia and increased placental resistance. It is an important tool for assessment of fetal oxygenation. Therefore CPR is a valuable predictor of adverse perinatal outcome & helps to determine the mode of delivery. **Objective-** The purpose of this study was to find the correlation of CPR with perinatal outcome in hypertensive Mothers during 3rd trimester attending emergency for safe confinement. **Materials And Methods-** It is a prospective observational cohort study that included 124 mothers with a Hypertensive disorders of pregnancy ≥34 weeks of gestation. They were subjected to ultrasound Doppler study in our Emergency admission room to calculate MCA/UA PI (CPR). The CPR < 1 was considered as abnormal and CPR >1 as normal. These results were compared with perinatal outcome and statistically analysed. **Results-** The present study revealed that the incidence of adverse perinatal outcomes in the form of- Apgar score <7 (63.2%), still-births (5.3%), NICU admission (63.2%), and Low-birth –weight (<2500g, 68.4%) were significantly higher in abnormal CPR than normal CPR. **Conclusion-** Abnormal CPR is a strong predictor of perinatal outcome in hypertensive mothers in 3rd trimester.

KEYWORDS

Cerebroplacental ratio, Hypertensive disorders of pregnancy, Middle cerebral artery, Umbilical artery.

INTRODUCTION:

Hypertensive disorders of pregnancy complicate about 3-10% of pregnancies. It contributes a major cause of maternal and perinatal mortality and morbidity [1, 2]. Hypertensive disorders of pregnancy is a medical disorder characterized by increased vascular resistance and decreased uteroplacental circulation resulting in fetal hypoxia.

In response to fetal hypoxia, several modifications occur in umbilical and fetal vessels that are picked up by doppler. The umbilical arterial circulation is normally a low-impedance circulation that reflects the status of placental circulation. The Middle Cerebral Artery (MCA) is the most accessible cerebral vessel for Doppler imaging that carries more than 80% of cerebral blood flow [3]. The cerebral circulation is normally high impedance circulation with continuous forward flow throughout the cardiac cycle. In response to fetal hypoxia, central redistribution of blood flow happens- resulting in increased blood flow to the brain, heart and adrenals and a decreased flow to the peripheral and placental circulations. This redistribution of blood flow is known as brain- sparing effect- the marker of fetal adaptation to oxygen deprivation [4].

The cerebro-placental ratio (CPR) is the ratio of the Pulsatility Index (PI) of the MCA to that of the UA characterized by reduced resistance in the MCA and increased resistance in the UA [5]. Thus CPR is considered to be a better predictor of adverse perinatal outcome than either vessel Doppler study [6]. CPR is a marker of centralization of fetal blood flow as an adaptation to placental insufficiency, as in pre-eclampsia [7]. Several studies are also showing that CPR correlates well with adverse perinatal outcomes and long term neonatal cognitive development [8].

Therefore this study was carried out to find the correlation of CPR with perinatal outcomes in an overloaded tertiary care centre where a significant number of mothers with hypertensive disorders in third trimester are admitted on a daily basis.

MATERIALS AND METHODS:

Study Design- It was a prospective cross-sectional study that was conducted among 124 pregnant mothers having hypertensive disorders in 3rd trimester. It was conducted at a tertiary care centre (Bankura Sammilani Medical College, Bankura, West-Bengal, India) during the study period from March 2023 to March 2024.

Sample Size- 124 pregnant mothers having hypertensive disorders in 3rd trimester.

Inclusion Criteria- Singleton pregnancy having hypertensive disorders (Pre-eclampsia, Eclampsia, Gestational hypertension), gestational age ≥34 weeks, live fetus with cephalic presentation.

Exclusion Criteria- This study excluded multifetal pregnancy, diabetes mellitus, ante-partum haemorrhage, anomalous fetuses, intra-uterine fetal demise, Rh negative pregnancy and polyhydramnios.

Methodology- 124 pregnant mothers attending Gynaecology and Obstetrics Emergency with the fulfillment of inclusion and exclusion criteria were recruited for the study. Detailed history was taken and complete general, systemic and obstetric examinations were performed. Gestational age was determined by assigned EDD as per 1st trimester ultrasound. Then the mothers were subjected to ultrasound scan in the Emergency room and the parameters assessed were- fetal biometry, amniotic fluid index, placental position and maturity, FHR, Umbilical Artery Pulsatility Index (UAPI), Middle Cerebral Artery Pulsatility Index (MCAPI). All the relevant data were recorded in a pre-designed proforma.

A CPR was defined as normal when its value is more than 1 & abnormal when its value is less than 1. Based on that criteria, cases were divided into normal group (CPR>1) and abnormal group (CPR<1). The association of CPR with adverse perinatal outcome was then estimated.

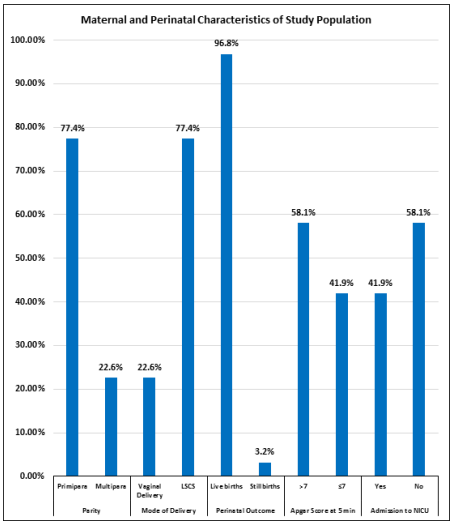
Statistical Analysis- The data were tabulated in Microsoft excel and analysed with SPSS V.24 software. The continuous variables were presented with Mean and Standard Deviation. The categorical variables were presented with Frequency and Percentage. Chi-square test and Pearson's correlation were used for the statistical analysis. The p value ≤0.05 is considered statistically significant.

RESULTS:

- Total 124 pregnant mothers were included in this study. Table 1 shows that 96 (77.4%) were primigravida and 28 (22.6%) are multipara. Out of total delivery, vaginal delivery was 22.6% and caesarean section was 77.4%. The incidence of still-born delivery was 3.2%. 52 babies (41.9%) had apgar score ≤7 and admitted at NICU.

Table 1: Maternal And Perinatal Characteristics Of Study Population (n = 124)

Maternal and Perinatal Characteristics		n (%)
Parity	Primipara	96 (77.4%)
	Multipara	28 (22.6%)
Mode of Delivery	Vaginal Delivery	28 (22.6%)
	LSCS	96 (77.4%)
Perinatal Outcome	Live births	120 (96.8%)
	Stillbirths	4 (3.2%)
Apgar Score at 5 min	>7	72 (58.1%)
	≤7	52 (41.9%)
Admission to NICU	Yes	52 (41.9%)
	No	72 (58.1%)



Graph-1. Maternal and perinatal characteristics of study population (n= 124)

- Table 2 is showing the statistical analysis of MCA PI and UA PI at different gestational age.

Table 2: Analysis of MCA PI and UA PI with Gestational Age

Gestational Age (in weeks)	No. of Cases	MCA PI (Mean ± SD)	UA PI (Mean ± SD)
34	8	0.90 ± 0.13	2.56 ± 0.48
35	12	1.15 ± 0.21	1.80 ± 0.66
36	8	1.07 ± 0.14	1.75 ± 0.90
37	12	0.96 ± 0.03	1.18 ± 0.63
38	24	1.14 ± 0.38	1.19 ± 0.68
39	24	1.28 ± 0.25	1.73 ± 1.70
40	12	1.11 ± 0.47	1.03 ± 0.37
41	16	1.17 ± 0.09	1.01 ± 0.27
42	8	1.30 ± 0.34	1.92 ± 1.08

- Table 3 is showing various determinants of perinatal outcome- Mode of delivery (VD/ LSCS), fetal outcome (Live-births/still-bitrhs), Apgar score at 5 min (≤7/>7), NICU admission and birth-weight of newborn (<2500gm/ >2500 gm). These variables were statistically analysed to see their association with CPR. The incidence of caesarean section was more (78.9%) in abnormal CPR than in normal CPR where the incidence was 75% - though the association is not statistically significant (p= 0.608). The incidence of Apgar score <7 was more (63.2%) in abnormal CPR than in normal CPR where the incidence was only 8.3%- this association is statistically significant (p<0.001). Still-births was more (5.3%) in abnormal CPR than in normal CPR where there was no still-births (o %) - this association is statistically significant (p=0.020). The NICU admission rate was more (63.2%) in abnormal CPR than in normal CPR where the incidence was only 8.3%- this association is statistically significant (p<0.001). The incidence of Low-birth weight (≤2500gm) was more (68.4%) in abnormal CPR than in normal CPR, where the incidence was 50%- this association is statistically significant (p=0.040). The incidence of pre-term delivery (≤37 weeks) was more (47.4%) in abnormal CPR than in normal CPR, where the incidence was only 8.3%- this association is statistically significant (p<0.001).

Table 3: Relation of Perinatal Outcome Based on Cerebro-Placental Ratio (CPR)

Determinants of Perinatal Outcome		Abnormal CPR (n = 76)	Normal CPR (n = 48)	p-value
A) Mode of Delivery	Vaginal Delivery	16 (21.05%)	12 (25%)	0.608
	LSCS	60 (78.9%)	36 (75%)	
B) Apgar Score at 5 min	< 7	48 (63.2%)	4 (8.3%)	<0.001 *
	> 7	28 (36.8%)	44 (91.7%)	
C) Fetal Outcome	Alive	72 (94.7%)	48 (100%)	0.020*
	Stillbirths	4 (5.3%)	0 (0%)	
D) NICU Admission	Yes	48 (63.2%)	4 (8.3%)	<0.001 *
	No	28 (36.8%)	44 (91.7%)	
E) Birth Weight	≤ 2500 g	52 (68.4%)	24 (50%)	0.040*
	> 2500 g	24 (31.6%)	24 (50%)	
F) Gestational Age at Delivery	≤ 37 weeks	36 (47.4%)	4 (8.3%)	<0.001 *
	> 37 weeks	40 (52.6%)	44 (91.7%)	

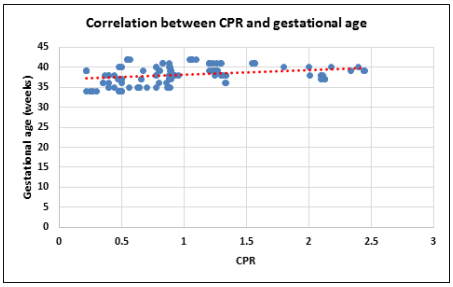
*The association is statistically significant.

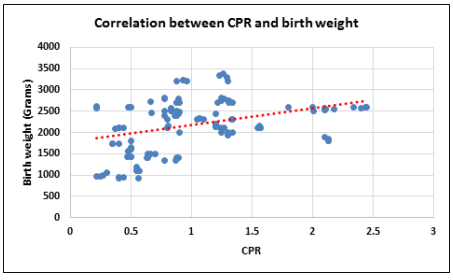
Table 4 is showing the correlation between CPR and adverse variables of perinatal outcome in the present study. The study population showed significant correlation of CPR with gestational age at the time of delivery, birth-weight and Apgar score at 5 minutes. All the values are statistically significant.

Table 4: Correlation of CPR with Adverse Perinatal Outcome

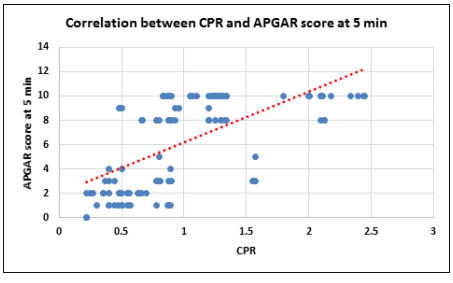
Principal parameter	Adverse Variables in the Study	Correlation Coefficient	P-value
CPR	Gestational age at the time of delivery	0.292	0.001*
	Birth weight	0.376	<0.001*
	APGAR score at 5 minutes	0.635	<0.001*

*CPR is found to have significantly positive correlation with Gestational age at the time of delivery, birth weight and APGAR score at 5 minutes.





Graph 2 (A, B) - Correlation of CPR with adverse perinatal outcome.



Graph-2 (C) - Correlation of CPR with adverse perinatal outcome.

DISCUSSION:

CPR is a reliable indicator to monitor fetal oxygenation as the single cut-off value does not alter significantly between 30-40th weeks of gestation as reported by Waldimiroff et al [9]. This review was also agreed by Arbeille et al [10]. He suggested 1 as the cut-off value and all values below 1 were considered normal. I classified the cases according to CPR based on Arbeille et al [10].

In this present study, it is shown that, the majority of the study population were primigravida. The association of emergency caesarean section was more (78.9%) in abnormal CPR – though it was not statistically significant (p= 0.608).This is comparable in a study by Sahinaj et al. which showed that the association between emergency caesarean section and abnormal CPR was 71.9%. [11]. In this study, it

is shown that a statistically significant correlation ($p<0.001$) between abnormal CPR and Apgar score <7 at 5 minutes (63.2%). This finding is comparable in a study by Alanwar et al. [12].This study is showing a statistically significant association ($p=0.040$) between abnormal CPR and birth weight <2500 gm which is comparable with literature review [13].This study is showing a statistically significant association ($p<0.001$) between abnormal CPR and NICU admission (63.2%). This finding is similar to the study by Alanwar et al. [12] and Sahinaj et al. [11].This study is showing a statistically significant association ($p=0.020$) between abnormal CPR and still-births (5.3%). This is similar to the study by Sahinaj et ai. [11] This study is showing a statistically significant association ($p<0.001$) between abnormal CPR and pre-term delivery <37 weeks (47.4%). This similar result was reported by Regan et al [14].

A statistically significant positive correlation was observed between CPR and gestational age at the time of delivery ($r^2=0.292$, $p=0.001$); birth-weight ($r^2= 0.376$, $p<0.001$); Apgar score at 5 min ($r^2=0.635$, $p<0.001$). The present study revealed that abnormal CPR had highest sensitivity for predicting low-birth weight (68.4%), Apgar score <7 (63.2%), NICU admission (63.2%) and highest specificity (100%) for predicting still-births. This finding is comparable with the study by Gramellini et al, Fong et al and Srilakshmi [15-17].

CONCLUSION:

CPR is a valuable tool to predict perinatal outcome at the earliest specially in high-risk pregnancies. It is simple, inexpensive, less time taking and highly sensitive and specific tool to detect fetal hypoxia at the earliest. Our teaching Institute is rural based tertiary care centre, covering 22000 deliveries per year. So many mothers from remote area get admitted with hypertensive disorders in 3rd trimester. So just CPR estimation during admission of these mothers can guide us about the fetuses at risk to achieve a successful perinatal outcome.

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