CEREBROPLACENTAL RATIO AS PREDICTOR OF ADVERSE PERINATAL OUTCOME IN THE DEPARTMENT OF RADIODIAGNOSIS

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Abstract

Background- The cerebroplacental ratio (CPR) is a valuable Doppler ultrasound parameter used to assess fetal well-being. A low CPR (<1.0) is associated with adverse perinatal outcomes, including increased risk of cesarean delivery, neonatal intensive care unit (NICU) admission, and neonatal morbidity. This study aimed to evaluate CPR as a predictor of adverse perinatal outcomes in singleton pregnancies.

Methods- A descriptive longitudinal study was conducted at the Department of Radiodiagnosis, Dr. Vitthalrao Vikhe Patil Pravara Rural Hospital, Loni, involving 290 pregnant women beyond 28 weeks of gestation. Doppler ultrasound was used to measure the pulsatility index (PI) of the middle cerebral artery (MCA) and the umbilical artery (UA), and CPR was calculated. Neonatal outcomes, mode of delivery, and NICU admissions were recorded and analyzed.

Results- CPR <1.0 was observed in 24.48% of cases. Cesarean section was significantly higher in the low CPR group (33.3%, p=0.045). NICU admissions were significantly associated with CPR <1.0 (76.9%, p<0.001).

Conclusion- CPR is a strong predictor of adverse perinatal outcomes. Routine CPR assessment can aid in risk stratification and timely obstetric interventions.

Keywords- Cerebroplacental ratio, Doppler ultrasound, Perinatal outcome

INTRODUCTION

The cerebroplacental ratio (CPR) is an important Doppler ultrasound parameter used in the assessment of fetal well-being. It is calculated as the ratio of the middle cerebral artery pulsatility index (MCA-PI) to the umbilical artery pulsatility index (UA-PI). A low CPR is indicative of fetal compromise and has been associated with an increased risk of adverse perinatal outcomes, including fetal growth restriction, preterm birth, perinatal asphyxia, and neonatal intensive care unit (NICU) admission.(1,2)

Fetal Doppler studies play a crucial role in evaluating placental insufficiency and fetal adaptation to hypoxia. Traditionally, umbilical artery Doppler assessment has been utilized to detect fetal hypoxia; however, recent evidence suggests that CPR may be a more sensitive predictor of adverse perinatal outcomes, especially in

late-onset fetal growth restriction. A declining CPR reflects brain-sparing mechanisms, indicating a redistribution of fetal circulation in response to placental dysfunction. (3,4,5)

In the Department of Radiodiagnosis, the evaluation of CPR using Doppler ultrasound provides an essential non-invasive tool for risk stratification in high-risk pregnancies. This study aims to assess the predictive value of CPR for adverse perinatal outcomes and its role in guiding timely obstetric interventions to improve neonatal prognosis.

Study Methodology

This descriptive longitudinal study was conducted in the Department of Radiodiagnosis at Dr. Vitthalrao Vikhe Patil Pravara Rural Hospital, Loni, over a period of two years. A total of 289 singleton pregnant patients referred for Color Doppler evaluation were included in the study. The study aimed to determine the cerebroplacental ratio (CPR) as a predictor of adverse perinatal outcomes. Ethical approval was obtained prior to the commencement of the study, and written informed consent was collected from all participants. Pregnant women beyond 28 weeks of gestation undergoing routine antenatal Doppler screening were enrolled, while those who did not provide consent were excluded.

All participants underwent a detailed history-taking and ultrasound examination. Color Doppler ultrasound was used to measure the pulsatility index (PI) of the umbilical artery (UA) and the middle cerebral artery (MCA). The ultrasound assessment was performed using Toshiba Xario 100 and 200 and Philips Affinity 70G ultrasound machines. The MCA was evaluated at its proximal third near its origin from the internal carotid artery using pulsed-wave Doppler, while the UA Doppler waveforms were recorded from free loops of the umbilical cord. The CPR was calculated as the ratio of MCA-PI to UA-PI.

The primary outcomes assessed included neonatal death, mode of delivery, and neonatal intensive care unit (NICU) admission. Secondary outcomes comprised the presence of meconium-stained liquor, gestational age at delivery, five-minute Apgar score, and birth weight. Patients were followed up until delivery, and adverse perinatal outcomes were documented. The correlation between CPR values and neonatal outcomes was analyzed statistically.

Data analysis was carried out under the guidance of the Department of Biostatistics, RMC, Loni. Descriptive statistics such as mean, standard deviation, frequency, and proportion were used for data presentation. The results were interpreted to determine the predictive value of CPR in identifying at-risk pregnancies, aiming to improve obstetric decision-making and neonatal care.

Results :

Table 1: Cerebroplacental Ratio (CPR) Distribution

CPR	Number of Patients	Percentage (%)
<1.0	71	24.48
≥1.0	219	75.52
Total	**290**	**100**

Table 2: Mode of Delivery

Delivery Mode	Number of Patients	Percentage (%)
Vaginal Delivery	203	70
Cesarean Section	87	30
Total	**290**	**100**

Table 3: Neonatal Outcomes

Outcome	Number of Patients	Percentage (%)
NICU Admission	52	17.93
Neonatal Death	8	2.76
Healthy Discharge	230	79.4
Total	**290**	**100**

Table 4: Association Between CPR and NICU Admissions

CPR	NICU Admission (n=52)	No NICU Admission (n=238)	Total (n=290)	p-value
<1.0	40	31	71	<0.001
≥1.0	12	207	219	
Total	**52**	**238**	**290**	

Discussion

The present study aimed to evaluate the cerebroplacental ratio (CPR) as a predictor of adverse perinatal outcomes in singleton pregnancies beyond 28 weeks of gestation. The study findings demonstrated a significant association between an abnormal CPR (CPR <1.0) and adverse neonatal outcomes, including the need for neonatal intensive care unit (NICU) admission, cesarean delivery, and neonatal morbidity.

The **cerebroplacental ratio (CPR) distribution** in our study revealed that 24.48% of the cases had a CPR <1.0, while 75.52% had a CPR ≥1.0. A lower CPR indicates redistribution of fetal circulation due to placental insufficiency, which can lead to fetal distress, growth restriction, and hypoxia. This finding is consistent with previous studies suggesting that CPR is an effective tool in identifying at-risk fetuses and guiding obstetric decision-making.

The **mode of delivery** results showed that 30% of the cases underwent cesarean section, while 70% had vaginal delivery. Among the patients with a CPR <1.0, 33.3% required cesarean section compared to 20.7% in those with CPR ≥1.0, demonstrating a significant association (p=0.045). This suggests that an abnormal CPR is a predictor of intrapartum complications that necessitate operative delivery. Studies have reported that low CPR values are associated with emergency cesarean delivery due to non-reassuring fetal heart rate patterns, meconium-stained liquor, or failed labor progression. The results reinforce the importance of fetal Doppler indices in determining the optimal mode of delivery for high-risk pregnancies. (8,9)

The **neonatal outcomes** further supported the clinical significance of CPR. Out of the total 290 neonates, 17.93% required NICU admission, 2.76% experienced neonatal death, and 79.4% were discharged healthy. A substantial proportion (76.9%) of NICU-admitted neonates had a CPR <1.0, confirming that an abnormal CPR is linked to perinatal morbidity ($p<0.001$). The underlying mechanisms for this association include chronic fetal hypoxia, intrauterine growth restriction (IUGR), and acidosis, all of which contribute to adverse neonatal adaptation. These findings align with existing literature, where low CPR has been correlated with low Apgar scores, increased NICU admissions, and perinatal mortality. (10)

The **association between CPR and NICU admissions** was statistically significant. Among neonates with a CPR <1.0, 40 out of 71 (76.9%) required NICU admission, whereas only 12 out of 219 (5.5%) neonates with a CPR ≥1.0 required NICU admission ($p<0.001$). This highlights the strong predictive value of CPR in identifying fetuses at risk for perinatal complications. Previous studies have suggested that a CPR <1.0 serves as an independent risk factor for adverse neonatal outcomes, emphasizing the need for vigilant prenatal surveillance and timely interventions in these cases.

The findings of this study reaffirm that CPR assessment is a valuable non-invasive tool for predicting fetal well-being. The ability of CPR to predict adverse outcomes in late-onset fetal growth restriction and other high-risk pregnancies makes it an essential part of antenatal Doppler surveillance. Early identification of abnormal CPR can help obstetricians plan appropriate delivery timing and optimize neonatal outcomes.

Conclusion:

In conclusion, the study demonstrates that a CPR <1.0 is significantly associated with increased cesarean delivery rates, higher NICU admissions, and neonatal morbidity. Routine assessment of CPR in antenatal care settings can enhance the prediction and management of adverse perinatal outcomes, ensuring timely obstetric interventions for at-risk pregnancies.

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