

ASSESSMENT OF FETAL CEREBROPLACENTAL RATIO IN 3RD TRIMESTER PREGNANCIES AND ITS RELATION TO ADVERSE EARLY NEONATAL OUTCOME

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ABSTRACT

Objective: The objective of this study was to assess the cerebroplacental ratio in 3rd trimester pregnancies and its role in the prediction of adverse early neonatal outcome.

Materials and methods: In this study, 97 antenatal women were subjected to Doppler studies at 26 to 40 weeks of gestations. CPR was calculated and less than 1.08 was taken as predictor of adverse early neonatal outcome. Adverse early neonatal outcome was evaluated by Preterm babies, Low birth weight (LBW), Caesarian delivery, Apgar score <7 at 5 minutes, NICU admissions and Perinatal mortality.

Results: Of 97 antenatal women, 56 women had abnormal CPR and 41 women had normal CPR. Women with an abnormal CPR had higher incidence of Preterm babies, Low birth weight, caesarian delivery, Apgar score <7 at 5 minutes, NICU admissions and Perinatal mortality, 23.2%, 73.2%, 41%, 39.2%, 50% and 21.4% respectively as compared to women with normal CPR who had 4.9%, 14.6%, 7.3%, 12.2%, 7.3% and 2.4% respectively. With the use of an abnormal CPR, the sensitivity, specificity, positive and negative predictive values for predicting an adverse outcome were 88.8%, 54.6%, 41.4% and 91.8% respectively.

Conclusion: An abnormal CPR is associated with adverse early neonatal outcomes, especially in hypertensive mothers and growth-restricted fetuses.

Keywords: Adverse early neonatal outcome, Cerebroplacental ratio, Umbilical artery Pulsatility Index, Middle cerebral artery Pulsatility Index.

INTRODUCTION

The antenatal assessment of fetus plays a major role in the management of high risk pregnancies and fetal well being. Recently, the cerebroplacental ratio (CPR) is emerging as an important predictor of fetal well being and adverse pregnancy outcomes. CPR is the ratio of doppler indices of the middle cerebral artery (MCA) to doppler indices of the umbilical artery (UA). The umbilical arterial circulation is normally a low impedance circulation and represents the placental circulation (Figure 1 and 2). The cerebral circulation is normally a high impedance circulation and represents fetal circulation (Figure 3 and 4). In the presence of fetal hypoxemia, there is central redistribution of blood flow, resulting in increased blood flow to the brain, heart and adrenals and a reduction in blood flow to the peripheral and placental circulations. This blood flow redistribution is known as the brain sparing effect and plays a major role in fetal adaptation to oxygen deprivation. This results in increase cerebral flow and decrease umbilical flow, giving CPR <1.08.

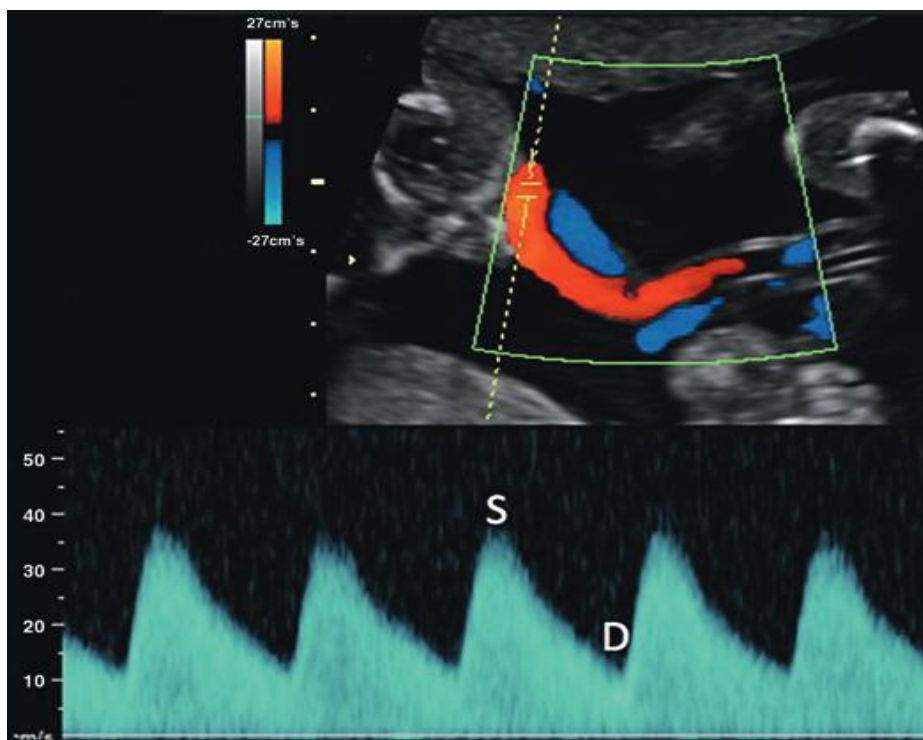


Figure 1: Doppler waveforms of the umbilical artery in a normal fetus in the third trimester of pregnancy. Note the increased end-diastolic velocity (D), consistent with a low impedance circulation. (S) peak systolic velocity.

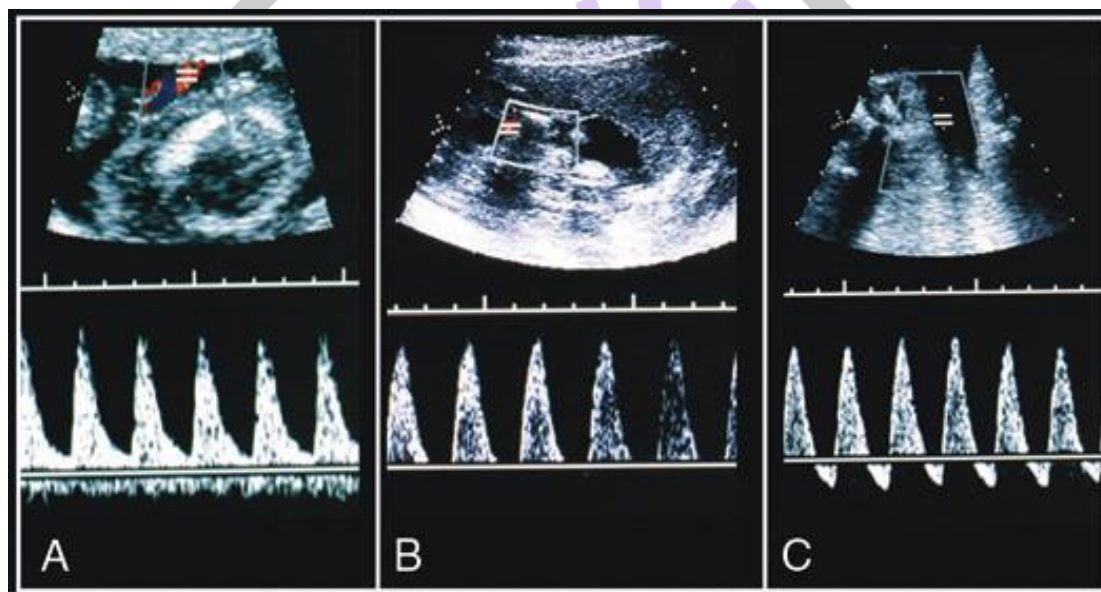


Figure 2: Abnormal umbilical artery Doppler waveforms; decreased end-diastolic velocity (A), absent end-diastolic velocity (B), reversed end-diastolic velocity (C).

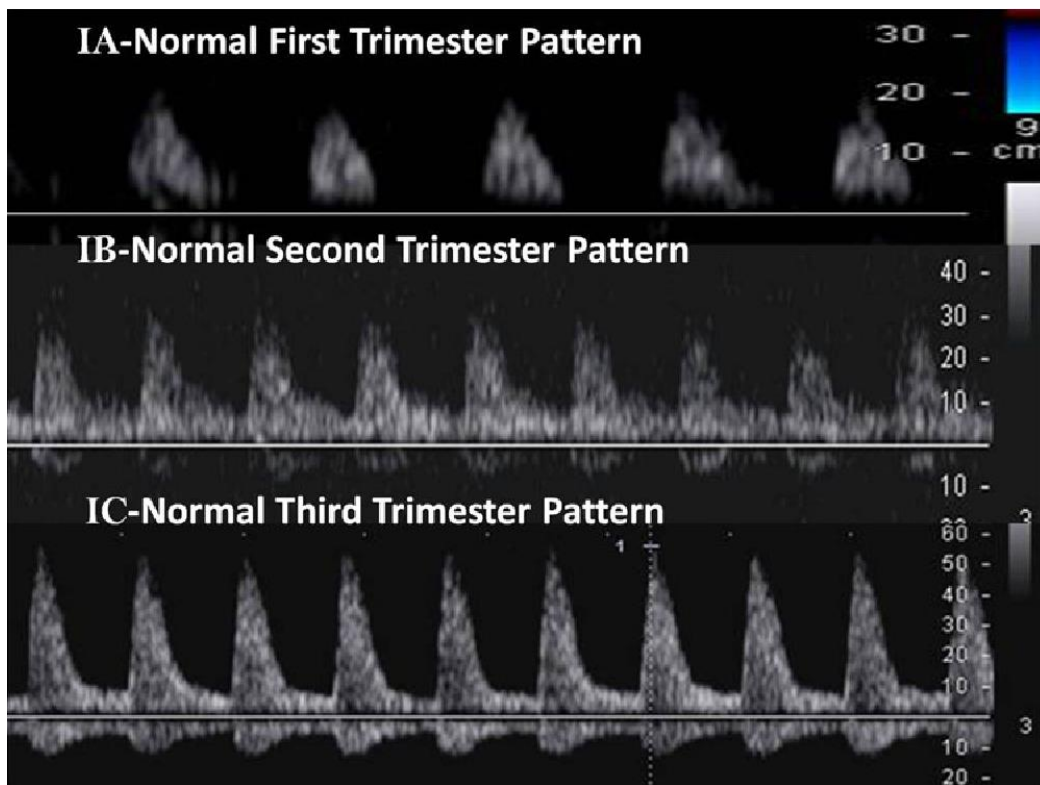


Figure 3. Normal middle cerebral artery doppler waveforms in 3 trimesters

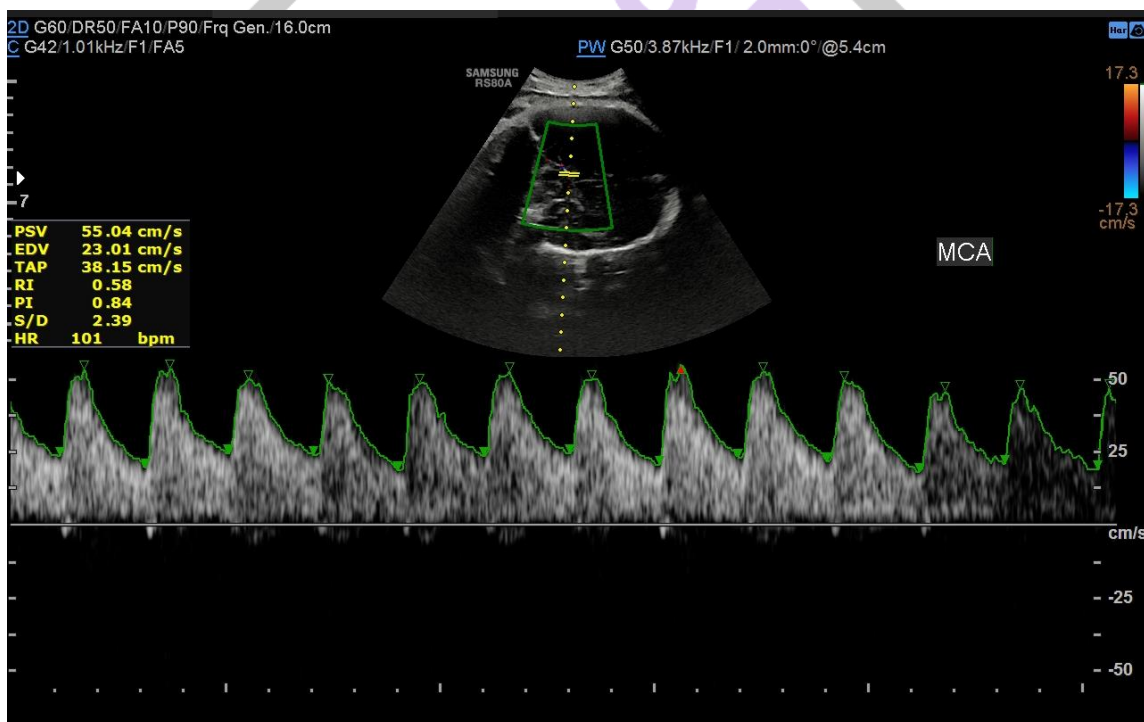


Figure 4: Abnormal middle cerebral artery doppler waveforms with decreased middle cerebral artery pulsatility index (PI) and resistivity index (RI).

MATERIALS AND METHODS

The study group comprised of indoor and outdoor patients who are referred to Department of Radiodiagnosis and Imaging Sciences, Jorhat Medical college and Hospital for routine obstetric ultrasound scan in 3rd trimester pregnancies from July 2020 to June 2021. We excluded all cases with congenital malformations and Intrauterine Foetal death prior to the time of Doppler examination. In this study, 97 antenatal women were subjected to Doppler studies at 26 to 40 weeks of gestations. All these women were examined clinically and blood flow studies were conducted in MCA and UA. CPR was calculated as MCA Pulsatility Index (PI) divided by UA PI. A CPR of >1.08 are considered normal and a CPR of <1.08 abnormal. Adverse perinatal outcomes was evaluated by preterm babies, birth weight , mode of delivery, 5-minute Apgar scores, NICU admissions and Perinatal mortality.

RESULTS

In this study, 97 antenatal women of 26 to 40 weeks of gestation were examined with Doppler USG and followed up to 7 days after delivery. The maximum number of pregnant women were primigravida in the age group of 21 to 25 years. Maximum no. of patients were examined between 36-40 weeks of gestational age, followed by 31 - 35 weeks. Pregnancy induced hypertension (HTN) is the most common cause for referral in this study followed by IUGR and some having more than one risk factors (Table1). Out of 97 women, 56 were having abnormal CPR and 41 were having normal CPR. Out of 79 women with risk factors, 55 were having abnormal CPR and 24 were having normal CPR. Out of 18 women without risk factor, 1 had abnormal CPR. Forty one with normal CPR, only two (4.9%) delivered preterm babies, six (14.6%) delivered low birth weight babies, three (7.3%) underwent caesarian delivery, five (12.2%) had low APGAR score, three (7.3%) got admitted in NICU and one (2.4%) was expired. But, fifty six women with abnormal CPR, thirteen (23.2%) delivered preterm babies, forty one (73.2%) delivered low birth weight babies, twenty three (41%) underwent caesarian delivery, twenty two (39.2%) had low APGAR score, twenty eight (50%) got admitted in NICU and twelve (21.4%) were expired. Statistical association was found to be statistically significant ($p < 0.05$) in all the parameters in predicting poor perinatal outcome (Table 2).

Comparison of the Sensitivity, Specificity, PPV and NPV of Pulsatility Index of Umbilical Artery, Pulsatility Index of MCA and CPR

The CPR was more sensitive than UA PI for predicting preterm babies, low birth weight babies, caesarian deliveries, low apgar score, NICU admissions and Perinatal mortality. CPR was also more sensitive than MCA PI for predicting all the parameters except for LBW babies where the sensitivity was comparable to MCA PI (Table 3).

CPR was more specific than MCA PI for predicting all the parameters however, UA PI was more specific than CPR for predicting all the parameters (Table 3).

CPR had a higher positive predictive value than MCA PI for caesarian delivery, Low Apgar Score, NICU admissions and Perinatal mortality however it was comparable to MCA PI for preterm babies and LBW babies. CPR had higher positive predictive value than UA PI for predicting low apgar score and NICU admissions. It was comparable to UA PI for caesarian deliveries and UA PI had higher positive predictive value than CPR for Preterm babies, LBW babies and perinatal mortality (Table 4).

CPR had higher negative predictive value than MCA PI for predicting preterm babies, caesarian delivery, low apgar score, NICU admissions and perinatal mortality. It was comparable to MCA PI for LBW babies. The UA PI had least negative predictive value for all (Table 4).

The overall sensitivity, specificity, positive and negative predictive values of CPR for predicting an adverse early neonatal outcome were 88.8%, 54.6%, 41.4% and 91.8%, respectively, with Diagnostic accuracies of 72.7%.

Table1: Distribution of cases according to risk factors in pregnancy

Risk factors	Number	Percentage
1.HTN only	33	34%
2.IUGR only	16	16.5%
3.HTN with IUGR	12	12.3%
4.HTN with Anemia	2	2.0%
5.IUGR with Anemia	3	3.1%
6.Anemia	8	8.2%
7.Gestational diabetes	5	5.1%
8.No Risk factors	18	18.5%
9.Total	97	100%

Table 2: CPR association with adverse early neonatal outcome

Fetal outcome	CPR<1.08		CPR>1.08		p-value
	No (56)	%	No (41)	%	
Preterm babies	13	23.2	2	4.9	<0.05
Low birth weight	41	73.2	6	14.6	<0.05
Caesarian delivery	23	41	3	7.3	<0.05
Apgar score<7 at 5 minutes	22	39.2	5	12.2	<0.05
NICU admissions	28	50	3	7.3	<0.05
Perinatal mortality	12	21.4	1	2.4	<0.05

Table 3: Comparison of sensitivity and specificity of UA PI, MCA PI and CPR

Adverse early neonatal outcome	Sensitivity			Specificity		
	UA	MCA	CPR	UA	MCA	CPR
Preterm babies	46.7%	82.3%	86.6%	82.9%	45%	47.5%
Low birth weight	36.7%	87.5%	87.2%	93.7%	67.3%	70%
Caesarian delivery	34.6%	76.9%	88.4%	83.0%	46.4%	53.5%
Apgar score<7 at 5 minutes	29.1%	77.7%	88.0%	80.8%	47.1%	51.4%
NICU admissions	29.0%	50.0%	90.3%	81.8%	50.0%	57.5%
Perinatal mortality	69.2%	44.0%	92.3%	85.7%	44.0%	47.6%

Table 4: Comparison of positive predictive value and negative predictive value of UA PI, MCA PI and CPR

Adverse early neonatal outcome	Positive predictive value			Negative predictive value		
	UA	MCA	CPR	UA	MCA	CPR
Preterm babies	33.3%	24.1%	23.2%	89.4%	92.3%	95.1%
Low birth weight	85.7%	72.4%	73.2%	59.2%	84.6%	85.4%
Caesarian delivery	42.8%	34.5%	41.1%	77.6%	84.6%	92.7%
Apgar score<7 at 5 minutes	33.3%	36.2%	39.2%	77.6%	84.6%	87.8%
NICU admissions	42.8%	43.1%	50.0%	71.0%	84.6%	92.6%
Perinatal mortality	42.8%	19.0%	21.4%	5.2%	94.9%	97.5%

DISCUSSION

Doppler is a rapid non-invasive test that provides valuable information about the hemodynamic situation of the fetus and is an efficient diagnostic tool of fetal jeopardy and helps in the management of high risk pregnancy.

In our study CPR had the highest sensitivity of 92.3% when compared to other indices in predicting perinatal mortality which is comparable to the study made by Rozeta et al. where CPR had the highest sensitivity of 98% in predicting perinatal mortality.¹

Among women with abnormal CPR, 73.2% had LBW babies which is comparable to the study of Varsha Deshmukh et al. where 92.5% women with abnormal CPR had LBW babies.²

In our study, caesarian deliveries for fetal distress was seen in 41% women with abnormal CPR and 7.3% women with normal CPR. Varsha Deshmukh et al. also noted higher number of caesarian deliveries in women with abnormal CPR.²

Low Apgar Score was also higher with abnormal CPR which was comparable to Gramellini et al. who found Low Apgar Score in abnormal CPR cases.³

In our study, 50% of babies with abnormal CPR and 7.3% of babies with normal CPR required NICU admission which is similar to the study made by Varsha Deshmukh et al. (2013) and Gramellini et al. where NICU admission were more common in women with abnormal CPR.

Therefore, All the adverse early neonatal outcomes like Preterm births, Low Birth Weight, Low Apgar Score, NICU admission and perinatal mortality are more common with abnormal CPR group than with normal CPR cases.

In our study, the sensitivity, specificity, PPV and NPV of CPR for predicting adverse early neonatal outcome was 88.8%, 54.6%, 41.4% and 91.8% respectively. In the study made by Ebrashy A and co-workers, the sensitivity, specificity, PPV and NPV of CPR for predicting adverse early neonatal outcome is 64.1%, 72.7%, 89.2% and 63% respectively.⁴

In our study CPR is also more sensitive and specific for neonatal outcome than Pulsatility Index of UA and MCA, which is comparable to study by Yalti et al.⁵

Thus CPR is a better prognostic indicator than individual vessels like UA PI and MCA PI for the prediction of adverse fetal outcomes. Because CPR incorporates data not only on the placental side but also the fetal response, CPR is better predictor than PI of UA and MCA. The CPR has been shown to be a good predictor of the fetal oxygenation status at birth and can be used to identify pregnancies that are at risk for adverse outcomes.⁶⁻⁷

Our study has some limitations as it is a single site study and our sample size was small, with the possibility of hidden biases.

CONCLUSIONS

Our study found that CPR is an important predictor of adverse early neonatal outcomes, especially in hypertensive mothers and growth-restricted fetuses. CPR is a better prognostic indicator than individual vessels like UA PI and MCA PI for the prediction of adverse early neonatal outcome. Further studies are needed to confirm our findings.

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