Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

ORIGINAL RESEARCH

Effect of Cerebroplacental Ratio on the Neonatal Outcome

[1]Dr. Anjali Dathan

[1]Associate Professor, Department of Radiodiagnosis, Government Medical college (IIMS), Palakkad, Kerala, India.

Corresponding author:Dr. Anjali Dathan

Article History: **Received:** 15.06.2023 **Revised:**07.07.2023 **Accepted:** 21.08.2023

ABSTRACT

Background: Cerebroplacental ratio (CPR) is the ratio of middle cerebral artery pulsatility index to the umbilical artery pulsatility index. It compares the resistance to blood flow in the umbilical artery and middle cerebral artery and thus indicates the proportion of flow supplying the brain and placenta. The cerebroplacental ratio becomes less than one if any flow redistribution in favour of the brain occurs. The S/D of middle cerebral artery/ Umbilical artery <1 and pulsatility index of middle cerebral artery/ Umbilical artery (CPR) <1 are suggestive of brain sparing effect. This study examined the relationship between Doppler abnormalities with respect to cerebral and placental circulation in intrauterine growth retardation and abnormal pregnancy outcome in 100 patients.

Methods: This was a prospective study conducted at Government Medical College, Thrissur, Kerala between July 2003 and September 2004. 100 cases of clinically and sonographically confirmed cases of intrauterine growth retardation, in the age group 18-35 years, beyond 30 weeks of gestation were included. The middle cerebral artery pulsatility index to the umbilical artery pulsatility index, also known as the cerebroplacental ratio (CPR), was calculated and its results were compared to normal values.

Results: In the present study, out of the total 100 patients, 49 had an abnormal CPR of which 28 patients had an abnormal neonatal outcome. 83 had an abnormal Doppler. In 53, the cerebroplacental ratio was < 1.08, with an average of 0.83. In the remaining 30 patients, the ratio was >1.08 with a higher average of 1.36. A positive predictivity in 65% cases was observed with a sensitivity of 76% and only a false negativity of around 24%. The specificity of CPR was 57% with a false predictivity of 43% and a negative predictivity of 70%.

Conclusion: The cerebroplacental ratio is very useful in detecting the brain sparing effect and is highly correlated with the perinatal outcome.

INTRODUCTION

Assessment of the foetal circulation by Doppler analysis of various blood vessels has been utilized in the early diagnosis and management of intrauterine growth retardation. One such assessment is by the cerebroplacental ratio (CPR), which is the ratio of middle cerebral artery pulsatility index to the umbilical artery pulsatility index.[1] It determines the proportion of flow feeding the brain and placenta by comparing the resistance to blood flow in the umbilical artery and middle cerebral artery, and is a measure of the distribution of foetal peripheral blood flow. Cerebroplacental ratio is highly sensitive and specific and confirms flow redistribution seen at an early stage of development of intrauterine growth retardation. Another reliable measure for predicting a poor perinatal outcome is the cerebroplacental ratio. In normal pregnancies, cerebroplacental ratio is >1.08. If any flow redistribution in favour of the brain occurs, the ratio becomes <1.0841. At any gestational age, in healthy pregnancies, the cerebral arteries' diastolic component is lower than that of the umbilical arteries. As a result, the cerebroplacental ratio is more than one and the cerebral vascular resistance continues to be greater than the placental resistance. In the event that there is any flow redistribution in the direction of the brain, the cerebroplacental ratio falls below one. Hence, as the foetus undergoes a compensatory adaptive mechanism, the S/D and pulsatility index of the umbilical artery increase due to decrease in diastolic flow and that of the middle cerebral artery, they will decrease due to increase in diastolic flow. The S/D of middle cerebral artery/ Umbilical artery <1 and pulsatility index of middle cerebral artery/ Umbilical artery (CPR) <1 are suggestive of brain sparing effect. This study examined the relationship between Doppler abnormalities with respect to cerebral and placental circulation in intrauterine growth retardation and abnormal pregnancy outcome. A total of 100 patients with clinical intrauterine growth retardation were studied.

MATERIALS &METHODS

This prospective study was conducted from July 2003 to September 2004 at the Government Medical College in Thrissur, Kerala. A total of 100 clinically and sonographically confirmed cases of intrauterine growth retardation, in the age group 18-35 years, beyond 30 weeks of gestation were included. The earliest estimate

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

from menstruation history was used to determine the gestational age. Preferably in the first trimester or the beginning of the second trimester, clinical gestational age or foetal biometry.

Assessment of Umbilical Artery

There was a loop of umbilical artery cord near the placenta. Colour Doppler displayed the flow pattern in the umbilical vessels at the site of Doppler analysis. Doppler sample volume was decreased (2-5mm) and placed over the vessel. The angle between the sample volume and umbilical artery was adjusted to less than 60 degrees. The wall filter was kept as low as possible (50-100) to detect low velocities. In order to minimise relative error, Doppler tracing was maximised by using minimum frequency range (PRF) possible before aliasing occurs. A spectrum was considered optimal if 3-5 consecutive similar appearing waveforms were noted. Spectral analysis of umbilical arteries revealed low impedance waveform. Systolic and diastolic velocities, S/D ratio and pulsatility index were measured after giving angle correction (angle less Uterine artery)

	S/D	**RI**
28 weeks	2.5	0.54
32 weeks	2.2	0.5

Abnormal results were observed as a decrease in diastolic flow with resultant increased values of S/D, resistance index and also the characteristic persistent diastolic notch (less than 60 degrees).

Assessment of Middle cerebral artery (MCA)

The main cerebral arteries were visible running down the sphenoid wings when the transducer was tilted caudally until the slice of the foetal head needed to estimate the biparietal diameter was acquired. Particular care was taken not to use excess pressure with the transducer. Following the placement of the cursor in the artery and the acquisition of the necessary Doppler signals, the sample volume size and insonation angle were modified. Then the systolic/diastolic ratio, resistance index and pulsatility index were measured after giving angle correction (angle less than 60 degrees).

	S/D	**RI**	**PI**
28 weeks	6.8±3	0.85±0.3	1.6±0.4
30 weeks	4.2±0.7	0.8±0.3	1.2±0.4

The predicted aberrant results in intrauterine growth retardation would be an increased diastolic flow as a result of the brain sparing effect. The cerebroplacental ratio (CPR), which is the ratio of the middle cerebral artery pulsatility index to the umbilical artery pulsatility index, would show a decrease in S/D, resistance index, and pulsatility index values. Confidence intervals were considered in S/D, resistance index and pulsatility index at different age groups by taking mean ± standard deviation. Chi – square test was applied to detect the weightage of the variable in multiple outcomes. The probability concept is directly applied to determine sensitivity, specificity and predictive values. They are the percentage probabilities of expected occurrence of outcomes.

RESULTS

In the present study, out of the total 100 patients, 49 had an abnormal CPR of which 28 patients had an abnormal neonatal outcome.

CPR		**Normal**	**Abnormal**	**TOTAL**
Outcome	Normal	39	21	60
	Abnormal	12	28	40
Total		**51**	**49**	**100**

Table 1: CPR and Neonatal outcome

In the present study, out of the total 100 patients, 83 had an abnormal Doppler. In 53, the cerebroplacental ratio was < 1.08, with an average of 0.83. In the remaining 30 patients, the ratio was >1.08 with a higher average of 1.36.

	< 1.08		**>1.08**	
	No. of patients	**Average**	**No. of patients**	**Average**
Normal Doppler	5	0.94	12	1.17
AbnormalDoppler	53	0.83	30	1.36

Table 2: Cerebroplacental Ratio Analysis

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

Considering the CPR values, we can see that the deviation from the normal value 1.08 is very high in the abnormal Doppler cases and it is within the standard deviation in the normal cases. In our study, the cerebroplacental ratio is also highly correlated with the outcome. It shows a positive predictivity in 65% of cases with a sensitivity of 76% and only a false negativity of around 24%. The specificity is shown in 57% with a false positivity of 43% and a negative predictivity of 70%.

Sensitivity	specificity	positive pred.	Neg pred.	% false negetive	% false positive
76.47	57.14	65	70	23.52	42.85

Table 3: Sensitivity, Specificity and Predictive values of Cerebroplacental ratio on the outcomes

DISCUSSION

In our study, it is noted that the cerebroplacental ratio is highly correlated with the outcome with a positive predictivity in 65% of the cases, a sensitivity of 76% and only a false negativity of 24%. Specificity was 57% with a false positivity of 43% and a negative predicivity of 70%. This implies that the cerebroplacental ratio is powerful in detecting the outcome in normal and abnormal Doppler and it is also powerful in detecting brain-sparing effect. Thus the high sensitivity of cerebroplacental ratio is effective in predicting adverse neonatal outcome.When utilised as a predictor of a poor prenatal outcome, the cerebroplacental ratio was shown to have a sensitivity of 90% by Gramellini et al. [2] The sensitivity of the middle cerebral artery was 78%, and the sensitivity of the umbilical artery was 83%. The cerebroplacental ratio had a sensitivity of 76.4%, a specificity of 57.1%, a positive predictive value of 65%, and a negative predictive value of 70% in our study. For the cerebroplacental ratio, which was 67% in our study, Grame llini's accuracy was 90%, and for the umbilical artery, it was 83%, which was 53% in our study. Mari and Deter et al [3] found that the sensitivity and positive predictive value of an abnormal middle cerebral artery pulsatility index in predicting adverse outcome was 60 and 70%, while Hadjiev et al[4] observed values of 88 and 91% respectively. A middle cerebral artery pulsatility index <2 SD from the mean for gestational age represents the compensated stage of the foetus. Fong KW et al [5] noted a sensitivity of 62.5% and a specificity of 75.5% for the cerebroplacental ratio in relation to perinatal outcome. T O zcan et al [6] have found that the cerebroplacental ratio has a higher sensitivity of 100% when compared to the pul satility index of middle cerebral artery alone. Therefore, in our investigation, we took into account the cerebro placental ratio rather than the middle cerebral artery pulsatility index and the umbilical artery pulsatility index independently. The cerebro placental ratio's high sensitivity and specificity as a predictor of intrauterine growth retardation, even in cases of moderate intrauterine growth retardation without foetal distress, confirms that even at the earliest stage of the development of intrauterine growth retardation, the foetal flow redistribution in favour of the brain is always present and can be detected by Doppler USG.

CONCLUSION

The cerebro placental ratio is very useful in detecting the brain-sparing effect and is highly correlated with the perinatal outcome with sensitivity – 76.4%, specificity 57%, positive predictive value – 65% and negative predictive value of 70%.

REFERENCES

1. Bahado-Singh RO, Kovanci E, Jeffres A, Oz U, Deren O, Copel J, et al. The Doppler cerebroplacental ratio and perinatal outcome in intrauterine growth restriction. Am J Obstet Gynecol 1999;180(3):750-6.
2. Gramellini D, Folli MC, Raboni S, Vadora E, Merialdi A. Cerebral umbilical Doppler ratio as a predictor of adverse perinatal outcome. Obstet Gynecol 1992;79(3):416-20.
3. Cope lJA, Reed KL. Doppler ultrasound in obstetrics and gynaecology. Raven Press Ltd New York 1995
4. Sepulveda W, Shennan AH, Peek MJ. Reverse end diastolic flow in the middle cerebral artery: an agonal pattern in the human fetus. Am J Obstet Gynecol 1996;174(6):1645-7.
5. Woo JS, Liang ST, Lo RL, Chan FY. Middle cerebral artery Doppler flow velocity waveforms. Obstetrics and Gynecology 1987;70(4):613-6.
6. Ozcan T, Sbracia M, d'AnconaRL, Copel JA, Mari G. Arterial and Venous Doppler velocimetry in the severely growth restricted fetus and associations with adverse perinatal outcome. Ultrasound in Obstetrics and Gy necology 1998;12(1):39-44.