



A Prospective Study on Correlation of Cerebroplacental Ratio with Perinatal Outcome in Pregnancy with IUGR

*Dr Shilpa Kumari¹, Dr Pawan Agarwal², Dr Aditi Jain³, Dr Neelam Bhardwaj⁴, Dr Gitika Sharma⁵, Dr Harshita Khandelwal⁶, Dr Mili Mehta⁷, Dr Pooja Bairwa⁸

^{1,3,6,7,8}resident, ²Associate Professor, ⁴Senior Professor, ⁵Senior Resident

Department of Obstetrics and Gynecology, SMS Medical College & Attached Hospital Jaipur

DOI: 10.5281/zenodo.7608002

Submission Date: 21 Jan. 2023 | Published Date: 06 Feb. 2023

*Corresponding author: Dr Shilpa Kumari

Department of Obstetrics and Gynecology, SMS Medical College & Attached Hospital Jaipur

Abstract

Background: To evaluate cerebroplacental ratio in pregnancy with IUGR.

Methods: This is a prospective observational study conducted at Department of Obstetrics and Gynecology, SMS Medical College & attached Hospital Jaipur from April 2021 till May 2022 on 65 women admitted in the Department of Obstetrics and Gynecology, SMS Medical College, Jaipur. After applying inclusion and exclusion criteria and taking informed consent, routine investigation and ultrasonography was done and fetal doppler was studied and cerebroplacental ratio was studied

Results: From all our cases we has studied Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), Accuracy were calculated and results combined arriving to an conclusion that UA PI was 37.14% sensitivity, 86.67% specificity, 76.47% positive predictive value, 54.17% negative predictive value and accuracy of 60%. The MCA PI has 22.86% sensitivity, 100% specificity, 100% positive predictive value, and 52.63% negative predictive value and accuracy of 58.63%. The CP Ratio calculates through (MCA PI/ UA PI) has sensitivity of 37.14%, specificity 100%, positive predictive value 100%, negative predictive value 57.69% and accuracy of 66.15%.

Conclusion: Abnormal CP ratio is a better predictor of adverse perinatal outcome in IUGR. Doppler ultrasound plays a significant role in the management of growth restricted fetuses by early identification and thus helps in line of management and obstetrical surveillance.

Keywords: CP ratio, UA, PI, IUGR

INTRODUCTION

Intrauterine growth restriction (IUGR) undoubtedly is one of the most challenging areas of research for obstetricians today. It is considered as a major contributor to perinatal morbidity and mortality. IUGR affects 3-10% all pregnancies. It has been described as etiologically responsible for about 50% of perinatal death occurring at preterm and 20% at term. In addition, growth restriction is associated with intrapartum distress and hypoxia, fetal demise, birth asphyxia, meconium aspiration, neonatal hypoglycemia, hypothermia which are in turn contributors to hypoxic encephalopathy and intraventricular hemorrhage. There is increasing evidence of the association between fetal growth restriction and fetal death.

The fetal cerebroplacental ratio (CPR) emerging as an important predictor of adverse pregnancy outcome, and this has implications for the assessment of well-being in fetuses.¹ Before the advent of ultrasound, assessment of fetal growth during pregnancy was limited by measuring the uterine size, assessing the fetal size by palpation and looking at the infant after delivery but now-a-days.² Doppler velocimetry provides a sensitive, non-invasive and safe method for surveillance of fetal hemodynamics and fetomaternal circulation.² This modality is based on the premise that an insufficient uterine, placental or fetal circulation results in adverse perinatal outcome.² Uterine artery doppler is the

most evaluated tool among non-invasive tests of fetal well-being. It serves as both a prognostic and diagnostic tool in assessment.³ An abnormal waveform of umbilical artery.⁴ (Absent or reversed end diastolic flow) has been demonstrated to predict fetal compromise.⁴ 12 days prior to acute fetal deterioration.⁴ In pregnancies with prolonged fetal hypoxia, there is redistribution of blood volume towards vital organs (i.e. heart, adrenal glands, spleen, brain and kidney), which causes vasodilation of the MCA, with an increase in diastolic flow hence decrease in its PI.⁵⁻⁸ Cerebroplacental ratio remains constant during last 10 weeks of gestation and so it is having a better diagnostic accuracy.⁹ The purpose of this study was to assess the efficacy of Cerebroplacental ratio to predict perinatal outcome. Objectives of this study were to evaluate the role of umbilical artery Doppler and MCA Doppler indices in growth restricted fetuses, to evaluate the significance of Doppler flow velocimetry in prediction of adverse perinatal outcome and to establish the role of color Doppler in management of pregnancy.

MATERIAL & METHODS

TYPE OF STUDY: Observational study

STUDY DESIGN: Prospective study

STUDY PLACE: Department of Obstetrics and Gynecology, SMS Medical College & attached Hospital Jaipur.

DURATION OF STUDY: From April 2021 till May 2022.

STUDY UNIVERSE: Women admitted in the Department of Obstetrics and Gynecology, SMS Medical College, Jaipur.

SAMPLING TECHNIQUE: Simple random sampling

INCLUSION CRITERIA

1. Gravid singleton live cephalic presentation at term pregnancy with IUGR.
2. Normal fetal anatomical survey.

EXCLUSION CRITERIA

1. Women who is not giving consent.
2. Women participating in other study.

STATISTICAL ANALYSIS

Continuous variables were summarized as mean and were analyzed by using unpaired t test. Nominal / categorical variables were summarized as proportions and were analyzed by using chi-square/ Fischer exact test. p-value <0.05 was taken as significant.

OBSERVATIONS

Table-1

Distribution According to Age

Age in yrs	28.42 ± 3.34 yrs
Hindu : Muslim	53:12
Primi : Multi	36:29

The above table shows distribution of cases according to age. Maximum number of cases 64.62% belonging to group of 26-30 years. The mean (SD) of Age (Years) in the study population is 28.42 yrs.

Table-2

Doppler Findings in IUGR Pregnancy

Doppler Findings	Normal	Abnormal
CP RATIO	52	13
UA PI	48	17
MCA PI	57	8

In our study all patients underwent Doppler studies and out of 64 patients mostly patients are with normal colour Doppler studies where as there are 13 patients with CP ratio <1.08 and 17 patients with high pulsatility index in UA and 8 cases with high pulsatility index in MCA Doppler.

Table-3
UA PI in Determining Fetal Risk

UA PI	Good Prognosis		Poor Prognosis		Total	
	No.	%	No.	%	No.	%
Abnormal	4	23.53	13	76.47	17	26.15
Normal	26	54.17	22	45.83	48	73.85

$$\chi^2 = 4.7415$$

$$p\text{-value} = 0.02944$$

Out of 64 patients 17 patients has abnormal UA PI among which 13 patients has poor fetal outcome that is 76.47% and patients with normal UAPI 45.83% has poor fetal prognosis with *p value* of 0.029.

Table-4
Role of MCA PI in Fetal Prognosis

MCA PI	Good		Poor		Total	
	No.	%	No.	%	No.	%
Abnormal	0	0.00	8	100.00	8	12.31
Normal	30	52.63	27	47.37	57	87.69

$$\chi^2 = 5.1618$$

$$p\text{-value} = 0.02308$$

Out of 64 patients 8 patients has abnormal MCAPI (<5 centile at particular gestational age) that is 12.31% and 87.69% has normal MCA PI with other doppler changes with *p-value* of 0.023.

Table-5
CP Ratio in Prediction of Fetal Prognosis

CP Ratio	Good		Poor		Total	
	No.	%	No.	%	No.	%
Abnormal	0	0.00	13	100.00	13	20.00
Normal	30	57.69	22	42.31	52	80.00

$$\chi^2 = 10.926$$

$$p\text{-value} = 0.0009$$

Out of 64 patients 13 patients has abnormal CP RATIO among which all patients has poor fetal outcome that is 100% and patients with CP RATIO >1.08 has poor fetal prognosis of 42.31% with *p value* of 0.0009.

Table-6
CP Ratio in Determining Adverse Outcome

Adverse Outcome	CP RATIO				Total	p-value
	Abnormal (n=13)		Normal (N=52)			
	No.	%	No.	%		
LSCS for Fetal Distress	8	61.54	8	15.38	16	0.0006
Meconium Stained Liquor	6	46.15	20	38.46	26	0.6007
APGAR at 5 min <7	10	76.92	13	25.00	23	0.0006
NICU Admission	12	92.31	22	42.31	34	0.0014

Out of 64 patients 13 patients were found to have abnormal CP RATIO, among which 8 patient undergone caesarean section for fetal distress that is 61.54%. 6 out of 13 patients with abnormal CP RATIO were found to have meconium stained liquor and APGAR of 10 neonates out of 13 that is 76.92% was below 7 and NICU admission of 12 neonates out of 13 that is 92.31% admission rate in pregnancy with abnormal CP RATIO.

Vollgraff Heidweiller-Schreurs CA et al (2018)⁸¹ studied prognostic accuracy of UA doppler compared with CPR and MCA Doppler in prediction of adverse perineal outcome in women with singleton pregnancy and found out that CPR outperformed UA Doppler in prediction of composite adverse outcome ($p < 0.001$) and emergency delivery for fetal

distress ($p=0.003$). MCA doppler performed significantly worse than did UA doppler in prediction of low APGAR score ($p=0.017$) and emergency delivery for fetal distress ($p=0.034$). CPR outperformed MCA Doppler in the prediction of composite adverse outcome ($p<0.001$) and emergency delivery for fetal distress ($p=0.013$)

Table-7
Prediction of Adverse Outcome

	UA PI	MCA PI	CP Ratio
Sensitivity	37.14	22.86	37.14
Specificity	86.67	100.00	100.00
PPV	76.47	100.00	100.00
NPV	54.17	52.63	57.69
Accuracy	60.00	58.46	66.15

From all our cases we has studied Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), Accuracy were calculated and results combined arriving to an conclusion that UA PI was 37.14% sensitivity, 86.67% specificity, 76.47% positive predictive value, 54.17% negative predictive value and accuracy of 60%. The MCA PI has 22.86% sensitivity, 100% specificity, 100% positive predictive value, and 52.63% negative predictive value and accuracy of 58.63%. The CP Ratio calculates through (MCA PI/ UA PI) has sensitivity of 37.14%, specificity 100%, positive predictive value 100%, negative predictive value 57.69% and accuracy of 66.15%.

DISCUSSION

In our study all patients underwent Doppler studies and out of 64 patients mostly patients are with normal colour Doppler studies where as there are 13 patients with CP ratio <1.08 and 17 patients with high pulsatility index in UA and 8 cases with high pulsatility index in MCA Doppler.

Unterscheider J et al (2013)¹⁰ evaluated doppler changes in intrauterine growth retardation pregnancy and found out that around 46% had an abnormal UA, 27% had an abnormal MCA and 11% had an abnormal DV doppler. Doppler interrogation of the UA and MCA remains the most useful and practical tool in identifying fetuses at risk of adverse perinatal outcome, capturing 88% of all adverse outcome.

Out of 64 patients 17 patients has abnormal UA PI among which 13 patients has poor fetal outcome that is 76.47% and patients with normal UAPI 45.83% has poor fetal prognosis with p value of 0.029.

Vergani P et al (2010)¹¹ conducted a cohort study to identify independent predictors of adverse perinatal outcome in fetal growth restriction >34 weeks were related to adverse outcome and umbilical artery PI centile predicts adverse neonatal outcome.

Out of 64 patients 8 patients has abnormal MCAPI (<5 centile at particular gestational age) that is 12.31% and 87.69% has normal MCA PI with other doppler changes with p -value of 0.023.

Srirambhatla A et al (2022)¹² studied umbilical artery PI, middle cerebral artery PI and cerebroplacental ratio as well as perinatal outcomes were recorded. Umbilical artery PI was the most sensitive (66%) and CPR the most specific parameter (80%) for predicting adverse perinatal outcome. CP ratio and MCA PI were the most specific (89%) and diagnostically accurate in late onset fetal growth restriction (79%). Cerebroplacental ratio has a high specificity and accuracy and is an important parameter in late onset fetal growth restriction.

Out of 64 patients 13 patients has abnormal CP RATIO among which all patients has poor fetal outcome that is 100% and patients with CP RATIO >1.08 has poor fetal prognosis of 42.31% with p value of 0.0009.

Devore GR (2015)¹³ studies shows fetus with abnormal CPR have a higher incidence of following with a normal CPR: 1) lower gestational age at birth 2) lower mean birth weight 3) lower birth weight 4) birth weight less than 10 centile 5) higher rates of caesarean section 6) higher rates of APGAR score less than 7 at 5 minute 7) an increased rate of neonatal acidosis 8) increased rates of newborn intensive care unit admission 9) higher rate of adverse neonatal outcome 10) a greater incidence of perinatal death. The CPR should be considered as an assessment tool in fetus undergoing third trimester ultrasound examination, irrespective of the findings of individual umbilical artery and middle cerebral artery measurements.

Out of 64 patients 13 patients were found to have abnormal CP RATIO, among which 8 patient undergone caesarean section for fetal distress that is 61.54%. 6 out of 13 patients with abnormal CP RATIO were found to have meconium

stained liquor and APGAR of 10 neonates out of 13 that is 76.92% was below 7 and NICU admission of 12 neonates out of 13 that is 92.31% admission rate in pregnancy with abnormal CP RATIO.

Vollgraff Heidweiller-Schreurs CA et al (2018)¹⁴ studied prognostic accuracy of UA doppler compared with CPR and MCA Doppler in prediction of adverse perineal outcome in women with singleton pregnancy and found out that CPR outperformed UA Doppler in prediction of composite adverse outcome ($p<0.001$) and emergency delivery for fetal distress ($p=0.003$). MCA doppler performed significantly worse than did UA doppler in prediction of low APGAR score ($p=0.017$) and emergency delivery for fetal distress ($p=0.034$). CPR outperformed MCA Doppler in the prediction of composite adverse outcome ($p<0.001$) and emergency delivery for fetal distress ($p=0.013$)

From all our cases we has studied Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), Accuracy were calculated and results combined arriving to an conclusion that UA PI was 37.14% sensitivity, 86.67% specificity, 76.47% positive predictive value, 54.17% negative predictive value and accuracy of 60%. The MCA PI has 22.86% sensitivity, 100% specificity, 100% positive predictive value, and 52.63% negative predictive value and accuracy of 58.63%. The CP Ratio calculate through (MCA PI/ UA PI) has sensitivity of 37.14%, specificity 100%, positive predictive value 100%, negative predictive value 57.69% and accuracy of 66.15%.

Bonnevier A et al (2021)¹⁵ studied a retrospective cohort study including singleton pregnancy with doppler examination performed at Lund university hospital in December 2017 and concluded that CPR and MCA PI were equally good in predicting neonatal morbidity, especially in SGA pregnancies and both were significantly better predictors than the UA PI. CPR had a high predictive value for SGA at birth, better than that of its two components, UA PI and MCA PI.

Hemlata D et al (2011)¹⁶ studied that the sensitivity, specificity, positive predictive value and negative predictive value of UA PI was 34%, 93%, 75%, 70% and of MCA PI was 35%, 56%, 35%, 56% and that is CP RATIO (MCA PI/UA PI) was 65%, 93% , 75%, 70%.

Srirambhatla A et al (2022)¹² studied statistical association of PI with adverse perinatal outcome and differences in doppler profile were studied. Umbilical artery PI was the most sensitive (66%) and CPR the most specific parameter (80%) for predicting adverse perinatal outcome. CP ratio and MCA PI were the most specific (89%) and diagnostically accurate in late onset fetal growth restriction (79%). Cerebroplacental ratio has a high specificity and accuracy and is an important parameter in late onset fetal growth restriction.

CONCLUSION

In fetal growth restriction, CP ratio reflects both circulatory insufficiencies of placenta and also adaptive changes that occur in middle cerebral artery, so appear to be a valuable noninvasive modality for maternal surveillance in IUGR.

Abnormal CP ratio is a better predictor of adverse perinatal outcome in IUGR. Doppler ultrasound plays a significant role in the management of growth restricted fetuses by early identification and thus helps in line of management and obstetrical surveillance.

Hence, doppler ultrasound especially CP ratio (MCA UI/ UA PI) should be an integral component of routine evaluation of a suspected IUGR pregnancies and thereby improving adverse outcome.

REFERENCES

1. Yuvabalakumaran G, Ranjeeta K. Prospective study of role of cerebro placental ratio in predicting perinatal outcome in appropriate for gestation age (AGA) babies at 35- 37 weeks. *MedPulse – International Journal of Radiology*. August 2019;11(2):55-60.
2. Shand AW, Buckle JH, Nathan E, Dickinson JE, Fench NP. Small for gestational age, preterm infants and relationship of abnormal artery Doppler blood flow to perinatal mortality and neuro development outcome. *Aust N Z J Obstet Gynecol*. 2009;49(1).
3. Figueras F, Gratacos E. Update on the diagnosis and classification of fetal growth restriction and proposal of a stage-based management protocol. *Fetal Diagn Ther*. 2014;36:86-98.
4. Bekedam DJ, Visser GH, Vander Zee AG, Snijders RJ, Poelmann-Weesjes G. Abnormal velocity waveforms of umbilical artery in growth-retarded fetuses; relationship to antepartum late hr decelerations and outcome. *Early Hum Dec*. 1990;24:79-89.
5. Campbell S, Vyas S, Nicolaidis KH. Doppler investigation of fetal circulation. *J Perinat Med*. 1991;19:21-6.
6. Mari G, Uerpairjkit B, Abuhamad AZ, Copel JA. Adrenal artery velocity waveforms in appropriate and small for gestation fetuses. *Ultrasound Obstet. Gynecol*. 1996;8:82-6.
7. Abuhamad AZ, Mari G, Bogdan D, Evansep. Doppler flow velocimetry of the splenic artery in human fetus; is it a matter of chronic hypoxia? *Am J Obstet Gynaecol*, 172, 1995, 820-825.

8. Hecherk, Campbell S, Doyle P, Herrington K, Nicolaides KM. Assessment of fetal compromised by Doppler ultrasound investigation of the fetal circulation: Arterial, intracranial and venus blood flow velocity studies. *Circ.* 1995;91:129-38.
9. Giles WB, Trudinger BJ, Baird PJ. Fetal umbilical flow velocity waveform and placental resistance pathological correlation. *Br J Obstet Gynaecol* 1985;92:31-8.
10. Unterschieder J, Daly S, Geary MP, Kennelly MM, McAuliffe FM, O'Donoghue K et al. Predictable progressive Doppler deterioration in IUGR: does it really exist? *Am J Obstet Gynecol.* 2013 Dec;209(6):539.e1-7. doi: 10.1016/j.ajog.2013.08.039. Epub 2013 Aug 30.
11. Vergani P, Roncaglia N, Ghidini A, Crippa I, Cameroni I, Orsenigo F, Pezzulo J. Can adverse neonatal outcome be predicted in late preterm or term fetal growth restriction? *Ultrasound in Obstetrics & Gynecology.* August 2010;36(2):166-170.
12. Srirambhatla A, Mittal S, Vedantham H. Efficacy of Pulsatility Index of Fetal Vessels in Predicting Adverse Perinatal Outcomes in Fetuses with Growth Restriction - Differences in Early- and Late-Onset Fetal Growth Restriction. *Maedica (Bucur).* 2022 Mar;17(1):107-115. doi: 10.26574/maedica.2022.17.1.107.
13. DeVore GR. The importance of the cerebroplacental ratio in the evaluation of fetal well-being in SGA and AGA fetuses. *Am J Obstet Gynecol.* 2015 Jul;213(1):5-15. doi: 10.1016/j.ajog.2015.05.024.
14. Vollgraaf Heidweiller-Schreurs CA, Boer MAD, Heymans MW, Schoonmade LJ, Bossuyt PMM, Mol BWJ, De Groot CJM, Bax CJ. Prognostic accuracy of cerebroplacental ratio and middle cerebral artery Doppler for adverse perinatal outcome: systematic review and meta-analysis. *Ultrasound Obstet Gynecol.* 2018 Mar;51(3):313-322. doi: 10.1002/uog.18809. Epub 2018 Feb 5.
15. Bonnevier A, Marsal K, Brodzki J, Thuring A, Kallen K. Cerebroplacental ratio as predictor of adverse perinatal outcome in the third trimester. *Acta Obstet Gynecol Scand.* 2021 Mar;100(3):497-503. doi: 10.1111/aogs.14031. Epub 2020 Nov 4.
16. Hemlata D, Kumar KH, anupama D. Middle Cerebral Artery Doppler Indices Better Predictor for Fetal Outcome in IUGR. *The Journal of Obstetrics and Gynecology of India.* March / April 2011; pg 166 - 171.

CITE AS

Shilpa K., Pawan A., A. Jain, Neelam B., G. Sharma, Harshita K., Mili M., & Pooja B. (2023). A Prospective Study on Correlation of Cerebroplacental Ratio with Perinatal Outcome in Pregnancy with Iugr. *Global Journal of Research in Medical Sciences*, 3(1), 35–40. <https://doi.org/10.5281/zenodo.7608002>