

Association of Cerebro-Placental Ratio with Fetal Outcome in Gestational Hypertensive Kashmiri Pregnant Women

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Abstract:

Introduction: The cerebroplacental (CP) ratio is a known indicator of adverse pregnancy outcomes. In the third trimester, CPR should be viewed as a means of evaluation for fetuses. The aim of our study was to determine the association of cerebro-placental ratio with fetal outcome in pregnant Kashmiri women with gestational hypertension.

Materials and Methods: This prospective research was carried out on 750 patients in the Postgraduate Department of Obstetrics and Gynaecology at the Lalla Ded Hospital, which is affiliated with the GMC Srinagar, over the course of 1.5 years (2019-2021). After getting informed consent, enrolled patients underwent a detailed medical history, examination and Ultrasound scanning was performed transabdominally to evaluate foetal weight, biometrics, and Doppler studies.

Results: The mean maternal age at presentation was 28.1 SD 4.78 years with maximum number of cases seen between the age group of 25-29 years (56.4 %). 68.5 % were primigravida and majority of cases belonged to rural area (68.4%). Majority of cases 407 (54.3%) delivered by Caserean Section and about 97.3% of babies were live births. The one-minute APGAR score was <7 in only 28.4% and the five minutes APGAR score was <7 in only 23.2%. Most of newborns (75.2%) had been of average gestational age and 507 (67.6%) had Normal CPR. Among 750 patients with Abnormal CPR, 67.5% had Caesrean Section. Among patients with abnormal CPR, 8.2% had still-birth, 57.4% were small for gestational age, 58.7% had APGAR SCORE <7 at 1 min, 48.9% had an APGAR SCORE of 7 at 5 minutes, 40.4% necessitate admission to the NICU, and 13.9% died. The difference between those with Normal CPR and those with Abnormal CPR was of statistical significance for all of the aforementioned parameters.

Conclusion: - CPR evaluates parameters on both placental side and also foetal response. They help us to identify fetuses that are at higher risk of adverse perinatal outcomes and therefore such fetuses can be closely monitored during delivery.

Keywords:- cerebroplacental ratio, gestational hypertension, APGAR SCORE.

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Introduction

Hypertension in pregnancy (pre-eclampsia and gestational hypertension) is a condition characterised by decreased organ perfusion due to vasospasm and endothelial dysfunction. [1] Gestational hypertension leads to IUGR (intrauterine growth restriction) and premature labour by interfering with the development of the uteroplacental and fetoplacental circulation, hence compromising the normal pregnancy outcome. In order to prevent perinatal mortality, morbidity, and unwarranted interventions during pregnancy and delivery, it is essential that the foetal condition of high-risk pregnancies be assessed accurately. Doppler ultrasound of the uteroplacental and fetoplacental circulation provides the opportunity to study the functional and, consequently, physiological changes in these circulatory systems and can aid in identifying circulatory problems underlying placental insufficiency and chronic foetal hypoxia, which is activated to protect the foetal brain under unfavourable conditions. [2] The cerebroplacental (CP) ratio is a known predictor of worse pregnancy outcomes [3,4]. CPR should be regarded as an evaluation method for foetuses in the third trimester. The ultrasound examination is performed independently of the results of the separate measures of the umbilical artery and middle cerebral artery. CPR is quantified as the ratio of the absolute Doppler pulsatility indices (PIs) of the foetal middle cerebral artery (MCA) and umbilical artery (UA) or as the ratio of the corresponding multiples of the median (MoM) for gestational age.

$CPR = \frac{\text{Index of middle cerebral artery pulsatility (MCA PI)}}{\text{Index of umbilical artery pulsatility (UT PI)}}$. Our research aimed to examine the relationship between cerebro-placental ratio and foetal outcome in pregnant Kashmiri women with gestational hypertension.

Materials and Procedures:

This 1.5-year prospective study was conducted on 750 patients at the Lalla Ded Hospital's Postgraduate Department of Obstetrics and Gynecology, which is associated with the GMC Srinagar (2019-2021). Using a semi-structured questionnaire, all essential obstetrical information was collected (maternal age, parity, gestational age at birth, presence or absence of medical conditions). Except for women with foetal anomalies, multiple pregnancies, or intrauterine mortality, all pregnant women with a gestational age of at least 34 weeks and gestational hypertension were included in the research. These ladies were scanned within a week of their anticipated due date. After receiving informed consent, the recruited patients had a comprehensive medical history and physical, as well as basic laboratory testing such as a complete blood count (CBC), liver function tests, and kidney function tests. To analyse foetal weight, biometrics, and Doppler tests, a transabdominal ultrasound examination was done using an ultrasound machine fitted with a convex 3.5 MHz probe. The patient's ultrasound picture was obtained using a SIEMENS ACUSON X 300 USG instrument. With colour Doppler ultrasonography and pulse wave Doppler, the umbilical artery (Um A), middle cerebral artery (MCA), and uterine artery (Ut A) were evaluated. After obtaining waveforms with a distinct envelope, at least three waveforms were averaged and impedance indices were determined, with all values over 1 being regarded normal and those below 1 as abnormal. On the basis of this cutoff value, the study population was divided into two groups: those with a normal ratio (>1.0) and those with an abnormal ratio (≤ 1.0). In connection to emergency caesarean surgery for foetal distress, low birth weight, Apgar at 5 minutes, and newborn mortality, adverse foetal outcomes were examined. The gathered and inputted data were then

exported to SPSS Version 20.0 Data Editor (SPSS Inc., Chicago, Illinois, USA. CPR was correlated with stillbirth, birth weight, 1-minute APGAR score, 5-minute APGAR score, and neonatal mortality using the chi-square test.

Results: The range of maternal ages at presentation was 18 to 37 years, with a mean of 28.1 SD 4.78 years. Maximum number of cases were seen between the age group of 25-29 years (56.4 %). 68.5% of 750 pregnancies were primigravida, while 31.5% were multigravida. 348 births occurred between 34 and 37 weeks of gestation, while 402 births occurred at or above 37 weeks. 37.2±3.91 was Mean gestational age. The majority of cases belong to rural area (68.4%) than urban area (31.6%). Of 750 patients, most of the babies 407 (54.3%) were born via caesarean section, while the remaining 343 (45.7%) were born vaginally. Approximately 97.3% of infants were delivered alive, while 2.7% were stillborn and were unable to be

resuscitated at birth. Only 28.4% of infants had an APGAR score of <7 at one minute, while others had a score of ≥7 (71.6%). Only 23.2% of infants had an APGAR score of <7 at five minutes, while the others had a score of ≥7 (76.8%). The majority of infants (75.2%) were of average size for their gestational age, while 24.8% were small for their gestational age. Although 24.4 % babies required NICU care while as 8.6% case study neonates expired. Among 750 patients, 507 (67.6%) had Normal CPR. Among 750 patients with Abnormal CPR, 67.5% had Caesrean Section as in Table 1-2.

Among patients with abnormal CPR, 8.2% had still-birth, 57.4% were small for gestational age, 58.7% had APGAR SCORE <7 at 1 min, 48.9% had an APGAR SCORE of 7 at 5 minutes, 40.4% required admission to the NICU, and 13.9% died. Statistically significant differences were found between those with Normal CPR for all of the aforementioned factors.

Table 1: Association of Cerebroplacental ratio (CPR) with fetal outcome

| Fetal outcome | | Abnormal CPR | | Normal CPR | | P-value |
|-------------------|-----|--------------|------|------------|------|---------|
| | | No. | %age | No. | %age | |
| Still birth | Yes | 20 | 8.2 | 0 | 0.0 | <0.001* |
| | No | 223 | 91.8 | 507 | 100 | |
| SGA | Yes | 128 | 57.4 | 53 | 10.5 | <0.001* |
| | No | 95 | 42.6 | 454 | 89.5 | |
| 1 min Apgar score | < 7 | 131 | 58.7 | 76 | 15.0 | <0.001* |
| | ≥ 7 | 92 | 41.3 | 431 | 85.0 | |
| 5 min Apgar score | < 7 | 109 | 48.9 | 60 | 11.8 | <0.001* |
| | ≥ 7 | 114 | 51.1 | 447 | 88.2 | |
| NICU Admission | Yes | 90 | 40.4 | 88 | 17.4 | <0.001* |
| | No | 133 | 59.6 | 419 | 82.6 | |
| Neonatal death | Yes | 31 | 13.9 | 32 | 6.3 | 0.0008* |
| | No | 192 | 86.1 | 475 | 93.7 | |

*Statistically Significant Difference (P-value<0.05); P-value by Chi-square test

Table 2: Diagnostic accuracy of Cerebroplacental ratio (CPR) in predicting abnormal fetal outcome

| Variable | Value | 95% CI |
|-------------|-------|-------------|
| Sensitivity | 60.4 | 53.59-66.80 |
| Specificity | 81.3 | 77.69-84.37 |
| PPV | 56.1 | 49.59-62.41 |
| NPV | 73.8 | 70.37-86.68 |
| Accuracy | 75.3 | 72.09-78.33 |

Table 3: Diagnostic characteristics of CPR for adverse perinatal outcome

| S.No | Year | Study | Sensitivity | Specificity | PPV | NPV |
|------|------|----------------|-------------|-------------|------|------|
| 1 | 2010 | Shahinaj [10] | 98 | 66 | 30.8 | 99.7 |
| 2 | 2018 | EL Guindy [11] | 62.5 | 79.9 | 47.3 | 88.1 |
| 3 | 2019 | Present Study | 60.4 | 81.3 | 56.1 | 73.8 |

Discussion:

It is believed that the brain sparing phenomenon is an adaptation mechanism of the foetus that is engaged to protect the foetal brain under unfavourable situations. [3,4] The cerebroplacental (CP) ratio may be used to predict worse pregnancy outcomes.

These findings were analogous to those of Mallick et al [5] and Lakhute et al [6] in that the mean patient age in our research was 28,1 years, with the majority of cases (56,4%) occurring between the ages of 25 and 29.

Primigravida are considered to have a greater chance of developing gestational hypertension. Similar to the research conducted by Konwar et al., the majority of the primigravida in our sample (68.5%) developed gestational hypertension. [7]

In our research, 97.3% of infants were delivered alive, whereas 2.7% were stillborn infants who could not be resuscitated at delivery. Monica Muti [8] et al. observed a live birth rate of 94.4% and a stillbirth rate of 5.45%, whereas Adiga et al. [9] recorded a live birth rate of 95% and a stillbirth rate of 5%.

In our research, the APGAR score at 1 minute was <7 in 28.4% of infants and >7 in 71.6%. Monica Muti et al. [8] noticed an Apgar score of <7 in 8.9% of infants and >7 in 91.1%. In terms of APGAR SCORE at 5 minutes, 23.2% of infants in our research scored below 7 and 76.8% scored above 7. In Monica Muti et al's [8] research, 8.1% of the infants had an APGAR SCORE <7 and 91.9% had an APGAR Score >7. While we had more infants with a score of <7, the APGAR score at 5 minutes was comparable in both investigations.

Sadhana V Lakhute et al. [6] and Mallick S et al. [5] reported that 21.2% and 20.9% of infants were small for gestational age, respectively, which is close to our findings of 24.8% SGA infants. In our research, 8.6% of newborns died during the first week of life. In their investigation, Shahinaj et al. [10] also reported a neonatal death rate of 5.96%. 67.6% of foetuses exhibited normal CPR, whereas 32.4% exhibited abnormal CPR. In his research, El Guindy [11] found that 34.1% of foetuses had abnormal CPR and 65.9% had normal CPR. Similar outcomes were seen by Eser et al [12]. 67.5 percent of women with abnormal CPR delivered through LSCS and 32.5 percent delivered vaginally. Shahinaj et al. found a comparable LSCS detection rate of 62.5% and vaginal birth rate of 37.5%. [10] In our research of newborns with abnormal CPR, the incidence of stillbirth was 8.2%. This is far less than what Shahinaj et al. [10] reported, who saw 17% stillbirths in their research. In their investigation, Patil et al. [13] recorded 7.8% stillbirths. 57.4% of infants with aberrant CPR had SGA, according to our research. This is comparable to the work of Shahinaj et al [10] and Sirico et al [14]. For infants with inappropriate CPR, 58.7% had an APGAR score of <7 at 1 minute and 48.9% at 5 minutes. Mariam et al. [15] observed that 36% of patients with abnormal CPR had <7 APGAR at 1 minute, Shahinaj et al. [10] reported that 61.9% of infants had <7 APGAR at 5 minutes, and El Guindy [11] et al. reported that 59.5% of infants had APGAR SCORE <7 at 5 minutes. We detected a mortality incidence of 13.9% among infants with abnormal CPR. This is comparable to Shahinaj et al[10] 's finding that 13.6% of infants with abnormal CPR died. In the present investigation, the CP ratio had a sensitivity of 60.4%, a

specificity of 81.3%, a positive predictive value of 56.1%, a negative predictive value of 73.8%, and a diagnostic accuracy of 75.3%, with a positive correlation that was statistically significant. Comparisons with other research are provided in Table 3.

Our research is limited by the fact that the sample size is from a single site and it is a hospital-based study; thus, the findings cannot be extrapolated to the whole community. Further further research is required. The group included solely women with gestational hypertension. Women with pre-eclampsia and the HELLP Syndrome must be researched in order to determine the accurate predictive value of CPR.

Conclusion:

Gestational hypertensive pregnancy problems have a substantial influence on the fate of the foetus. CPR examines characteristics on both the placental and foetal sides. They enable us identify foetuses with a greater risk of bad perinatal outcomes, allowing for intensive monitoring of these foetuses throughout delivery. This is very helpful at a high-risk, high-volume hospital like ours, since it detects foetuses that may be at danger during labour.

Declarations

Funding: This study was not funded by any organization.

Ethical Approval:

This study was approved by the institutional ethical committee.

Informed Consent:

Informed consent was taken from all the participants of the study.

Bibliography

1. Mohan S, Natarajan P, Madineni S, Rajasekhar K. Study of Triple Vessel Wave Pattern by Doppler Studies in Low Risk and High Risk Pregnancies and Perinatal Outcome. IOSR Journal of Dental and Medical Sciences. 2017;

16: 14-23.

2. Gomez O, Martínez JM, Figueras F, Del Río M, Borobio V, Puerto B,.
3. Uterine artery Doppler at 11-14 weeks of gestation to screen for hypertensive disorders and associated complications in an unselected population. *Ultrasound Obstet Gynecol.* 26: 490-494.
4. Campbell S, Griffin D, Pearce JM. New Doppler technique for assessing uteroplacental blood flow. *Lancet* 1983, 1: 675r 677.
5. Trudiger BJ, Giles WB, Cook CM, Bombardieri J, Collins L. Fetal umbilical artery flow velocity waveforms and placental resistance: clinical significance. *Br J ObstetGynecol* 1985, 92:23-30.
6. Snehalatha Mallick. Nandita Barik, Susanta Pradhan. Gestational hypertension and fetal outcome: A prospective study in a tertiary care centre. *Indian Journal of Obstetrics and Gynecology Research.* (2019): page 595-99.
7. Sadhana V Lakhute, VarsharaniKendre, Jagannath Dixit. A study of epidemiological factors in antenatal mothers with pregnancy-induced hypertension at the tertiary care hospital. *Medical journal of DR. D. Y. Patil Vidyapeeth* (2021):14:52-6
8. Ranjomoni Konwar, Bharati basumatari, Malamoni Dutta et al. Role of Doppler Waveforms in Pregnancy-Induced Hypertension and Its Correlation with Perinatal Outcome. 2021. DOI:10.7759/cureus.18888
9. Monica Muti , MufutaTshimanga, Gombe T Notion Donewell Bangure Prosper Chonz. Prevalence of pregnancy induced hypertension and pregnancy outcomes among women seeking maternity services in Harare, Zimbabwe. *BMC Cardiovasc Disord.* 2015 Oct 2;15:111. doi: 10.1186/s12872-015-0110-5.
10. Prashanth Adiga, IndumathiKantharaja, Shripad Hebbar, *Lavanya Rai, Shyamala Guruvare, and Anjali

- Mundkur. Predictive Value of Middle Cerebral Artery to Uterine Artery Pulsatility Index Ratio in Hypertensive Disorders of Pregnancy. *Int J Reprod Med*. 2015; 2015:614747.
11. RozetaShahinaj, Nikita Manuko, EnriketaKroi. The value of the middle cerebral to umbilical artery Doppler ratio in the prediction of neonatal outcome in patient with preeclampsia and gestational hypertension. *Pub Med*. 2010.
 12. El Guindy AE, Nawara M, ElSanter O. Cerebroplacental Ratio and Cerebrouterine Ratio in Predicting Neonatal Outcome in Preeclamptic Pregnant Women. *Int J Reprod Med Gynecol*. 2018;4(1):022-02.
 13. Ahmet Eser, Suleyman Eserdag. Predictive value of middle cerebral artery to uterine artery pulsatility index ratio in preeclampsia. 2011. *Archives of gynaecology and Obstetrics*.
 14. Vikram Patil. Cerebro-Placental Ratio in Women with Hypertensive Disorders of Pregnancy: A Reliable Predictor of Neonatal Outcome. *Journal of Clinical and Diagnostic Research* May 201913(5):TC06-TC10.
 15. A. Sirico, ADiemert, P. Glosemeyer, K. Hecher. Prediction of adverse perinatal outcome by cerebroplacental ratio adjusted for estimated fetal weight. *Ultrasound in Obstetrics & Gynecology*; 2017: / Volume 51, Issue 3 / p.381-386
 16. Mariam Lotfy Mohamed, Salwa Adel Mohamed* and Amal Mohamed Elshahat. Cerebroplacental ratio for prediction of adverse intrapartum and neonatal outcomes in a term uncomplicated pregnancy. *Middle East Fertility Society Journal* (2021)26:45.