The Association between Cerebroplacental Ratio (Cpr) And Neonatal Outcome In Small Gestational Fetus

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Abstract

Background: Restriction of fetal growth is one of the major problems in gynecology and obstetrics for which no effective treatment has been proven so far. The disorder is associated with significant morbidity and perinatal mortality.

Methods: In this study, 104 pregnant women with SGA fetuses (3-10%) between preterm (>28 weeks) to full term were evaluated. The patients were divided into two groups: group A, the group with normal CPR as the reference group, and group B with abnormal CPR (ratio <1ref with normal UMA PI and Normal caldopler that were IUGR). Their demographic data including maternal age, gestational age, BMI of the pregnant mother, birth weight, fetal sex, and number of deliveries were examined.

Results: After collecting data and analyzing them, the results showed that the mean neonatal weight was 1432.81 (±560.81) in the abnormal CPR group, and 1845.42 (± 473.32) in the normal group. In addition, the mean Apgar scores of 5 and 1 minutes were significantly different between the groups, being lower in the abnormal CPR group (p-value <0.05). The results also revealed, Apgar scores of one and five minutes were significantly correlated with CPR and gestational age (p-value <0.05).

Conclusion: Finally, according to the data obtained from this study, it has been shown that CPR can be helpful as a predictive index of neonatal outcomes in patients with SGA.

Key Words: Cerebroplacental Ratio (CPR), Middle Cerebral Artery (MCA), Pulsatility Indices (PI), Small for gestational age, Umbilical Artery (UA).

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1- INTRODUCTION

Restriction of fetal growth is one of the major problems in gynecology and obstetrics for which no effective treatment has been proven so far. The disorder is associated with significant morbidity and perinatal mortality (1-3). According to the definition of Battaglia and Lubchenco, small infants are considered to have fetal weight and birth weights below 3-10 % for their gestational age (1, 4, 5). In general, neonates with SGA have impaired growth and development, which exposes them to mortality. The etiology of SGA is different and wide, however, maternal factors as well as disorders in placental cells are known as the most common causes of SGA (6).

Restrictions on intrauterine growth include: small maternal size, poor maternal nutrition, social exclusion, fetal infections, etc. (7-9). Fetal Doppler is a valuable tool in the evaluation and management of high-risk pregnancies. Fetal SGA of 5-10% by weight is associated with non-severe placental insufficiency and that of less than 3-5% is associated with severe placental insufficiency. It has been suggested that the prediction of prenatal adverse events in SGA embryos with delayed-onset intrauterine growth restriction can be improved by a combination of MCA (middle cerebral artery) and umbilical artery (UMA) (10, 11). As a compensatory mechanism for hypoxia, increased placental resistance and brain maintenance can cause abnormal cerebroplacental ratio (CPR), which is the ratio between the pulsatility index (PI) of MCA and UMA. Abnormal blood flow in UMA, MCA or both can show normal PI values while CPR can show abnormal values (12, 13).

The use of these factors can help better manage delivery and postpartum cares of the mother and baby. CPR examination can also be helpful for management decisions in maternal hospitalization and fetal monitoring; and can ultimately, because shortening maternal hospitalization time, reducing costs and patient satisfaction (14). The aim of this study was to evaluate CPR evaluation and its relationship with adverse fetal complications in SGA patients referred to the obstetrics and gynecology ward of Akbarabadi Hospital affiliated with Iran University of Medical Sciences.

2- MATERIALS AND METHODS

In this study, 104 pregnant women with SGA fetuses between preterm to full term were evaluated. In the present study, CPR was evaluated and measured in SGA embryos to predict adverse fetal complications, including the risk of cesarean section for SGA embryonic conditions.

Inclusion criteria included the patients who had informed consent to participate in the study, pregnant women who had SGA fetuses during the ultrasound, and had a singleton pregnancy. Exclusion criteria included stillbirth, multiple pregnancies, presence of underlying maternal diseases (preeclampsia, thrombophilia, hypertension and diabetes), and presence of oligohydramnios, smoking, and sildenafil use.

The patients were divided into two groups: the first group with normal CP was the reference group (n=71); and the second group consisted of abnormal CP patients with CPR index <1. These participants had normal PIU (n = 33). Their demographic data including maternal age, gestational age, BMI, birth weight, fetal sex, gravid, parity, number of abortions, PH, PCO2, length of NICU stay in, PIU, PIMCA, Apgar 1 and 5 min were examined.

2-1. Data Analysis

After collecting data and entering the data into the software, the normality of the data was checked using the Kolmogorov-Smirnov test. T-test and Mann-Whitney were used for univariate analyses. All

analyses were performed using SPSS software version 23. P-value <0.05 was considered as the significance level.

3- RESULTS

3-1. Evaluation of patients' demographic information

The patients' demographic information is shown in **Table 1**. As shown in the table, it was found that only Primigravid was significantly different between the two groups (p=0.036). No significant relationship was found between the other variables. Based on the statistical analyses, it was revealed that the mean gestational age in the abnormal group was lower than that in the normal group, and a significant relationship was observed between them. Also, the mean Apgar score of one and five minutes was lower in the abnormal group compared to the normal group, and a significant relationship was observed between them. Also, the mean neonatal weight and PCO2 were, respectively, lower and higher in the abnormal and normal group. However, no significant relationship was observed between the two groups in the mean pH and duration of hospitalization in NICU (**Table 2**).

Table-1: Maternal and obstetric characteristics

Variables	Normal (N=71)	abnormal (N=33)	P value
Maternal age (year)	30.34 (±6.08)	30.94 (±6.56)	0.648
Primigravid	37 (53.62%)	10 (31.25%)	0.036
Nulliparous	37 (53.62%)	11 (34.37%)	0.072
Abortion history	7 (10.14%)	3 (9.37%)	0.904
BMI (kg/m²)	24.12 (± 2.30)	24.25 (±2.53)	0.797
Hb	12.68 (±1.03)	12.73 (± 1.16)	0.862

Data are presented as Mean (+ SD, range) or n (%) or Median (range).

Table-2: Clinical information of the patients

Variables	normal (N=71)	abnormal (N=33)	P value
Gestational age (weeks)	35.46 (±2.32)	32.97 (±3.25)	<0.0001
Apgar score at minute 1	8.35 (±1.06)	5.85 (±2.45)	<0.0001
Apgar score at minute 5	9.49 (±1.57)	8.36 (±1.78)	0.001
Baby weight (g)	1845.42 (± 473.32)	1432.81 (±560.81)	<0.0001
PH	7.26 (±0.37)	7.30 (±0.15)	0.492
Pco2 (mmHg)	54.09 (±9.51)	49.20 (±7.04)	0.011
NICU admission	3.50 (11.75, 0-38)	8.00 (14.75, 2-25)	0.092

3-2. The relationship between Doppler ultrasound indices and neonatal outcomes

The results revealed a direct relationship between PIMCA and Apgar scores at minutes 1 and 5 in the patients; as PIMCA levels in patients increased, the mean Apgar scores at minutes 1 and 5 also increased. Statistically, a significant relationship was observed between them. The results also showed a significant indirect relationship between PIU and Apgar scores at minutes 1 and 5 in patients, so that in line with the increase in the patients' PIU, their mean Apgar scores at minute 1 and 5 decreased. A significant correlation was also found between gestational age and PIU in patients (**Fig. 1**).
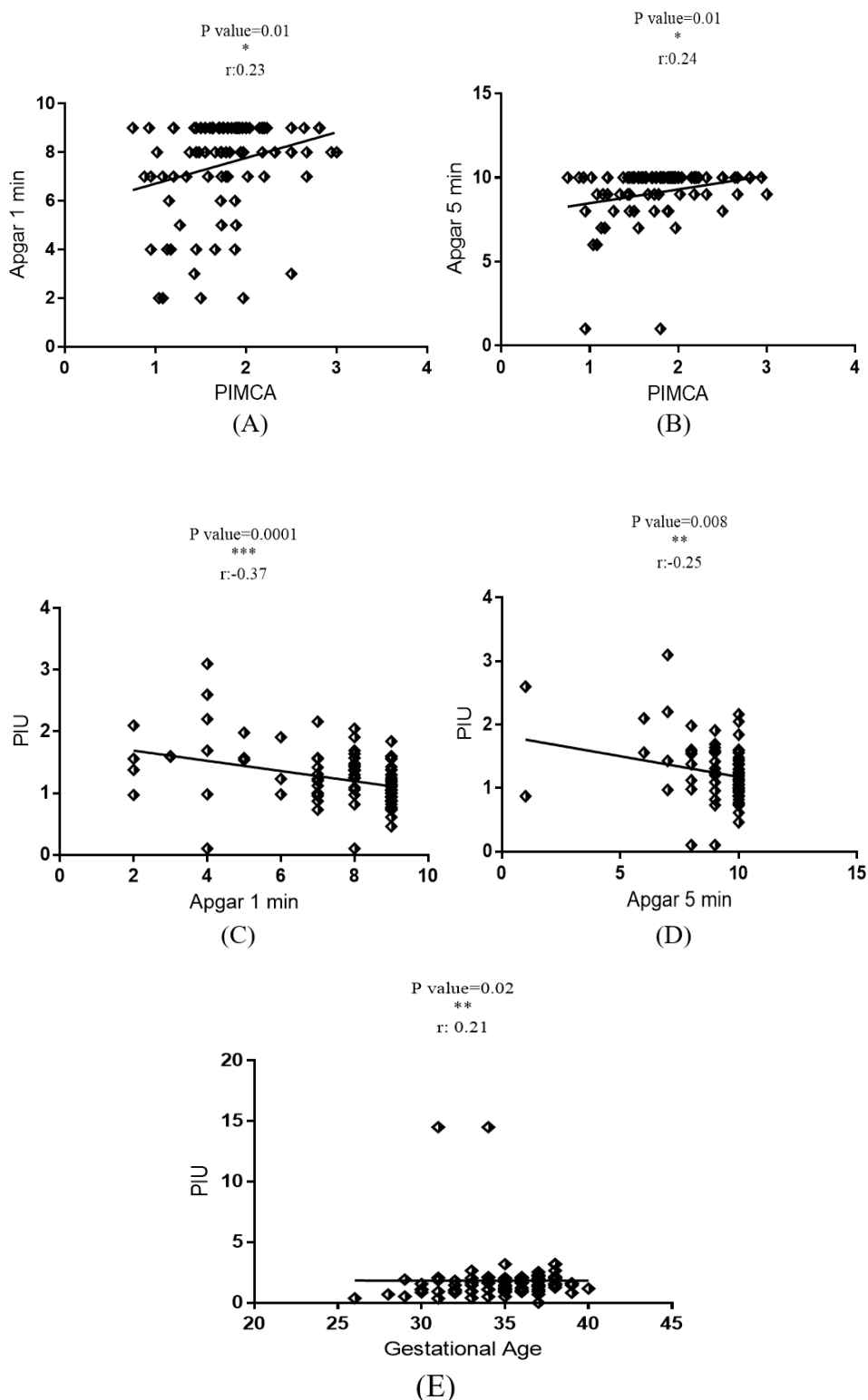
Fig. 1: PIMCA (A and B) and PIU (C and D) in relation to Apgar score at 1 and 5 min and gestational age (E).

The results showed a significant indirect relationship between CPR and Apgar score at 1 and 5 minutes in patients; so, as the amount of CPR in patients increased, the mean Apgar score at 1 and 5 minutes also increased. A significant relationship was also found between gestational age and PIU in patients (**Fig. 2**).
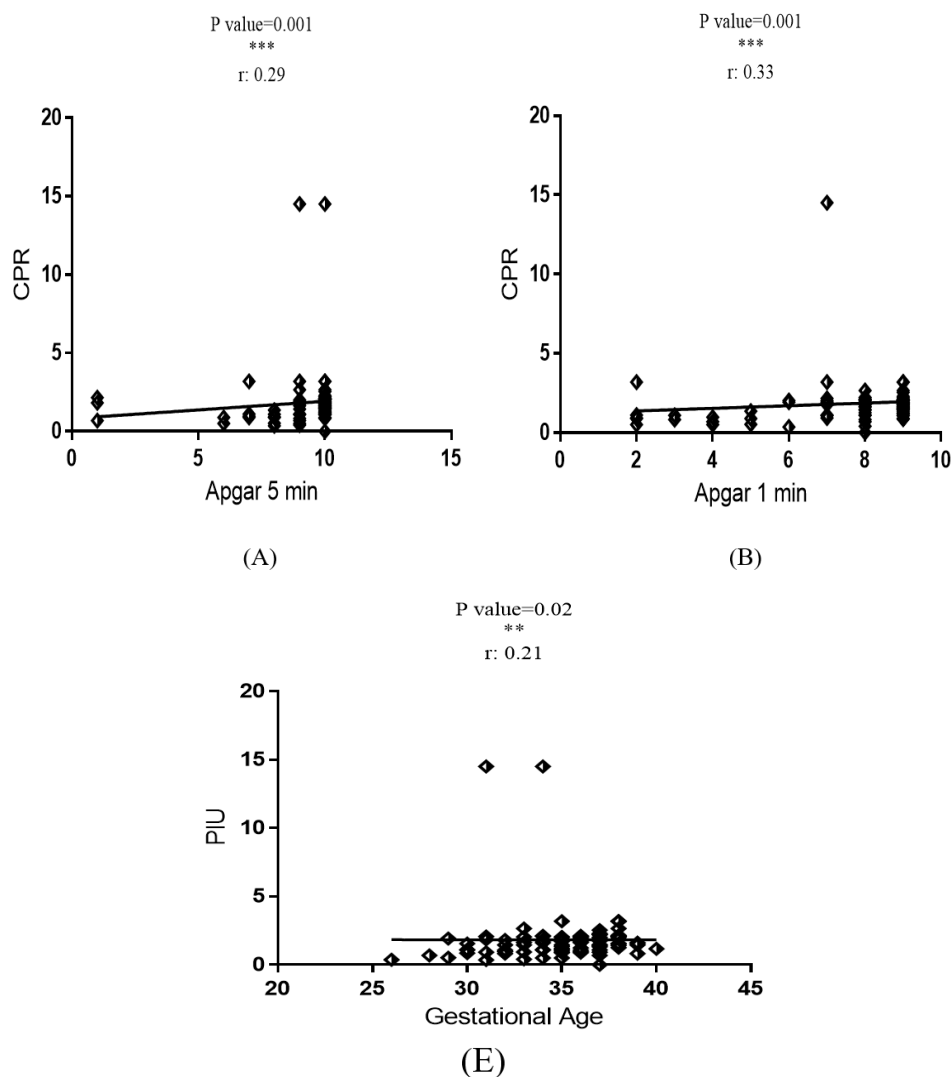

(A)

(B)

(E)

Fig. 2: The relationships between CPR and Apgar score at 1 and 5 minutes (A and B) and gestational age (C).

4- DISCUSSION

SGA is one of the disorders in which the weight and growth of the baby are less than the normal amounts. The etiology of this disease is unknown and various factors are involved in its occurrence (15). However, it has been shown that genetic disorders, infectious agents and the occurrence of placental dysfunction can play a role in the development and progression of SGA (16). Doppler ultrasonography plays an important role in the diagnosis and management of patients. Studies have shown that the use of Doppler ultrasonography can be a good option for monitoring patients due to its low invasiveness and safety (16). However, there are very few studies on

Doppler ultrasonography indices with clinical outcomes in SGA. Therefore, in this study, we investigated the relationship between CPR and the outcomes of SGA.

Studies have shown that acidic conditions of the arteries can affect neonatal and maternal outcomes. For this purpose, Pérez-Cruz et al. showed that the mean umbilical artery pH of SGA was 7.24 ± 0.06 while the mean of the control group was 7.23 ± 0.08, and no significant difference was observed between them (13). In another study, it was found that the number of patients with acidic pH was almost equal compared to the control subjects, but no significant relationship was observed between them (14). In the present study, no significant difference was observed in terms of mean pH between the two groups (p-value> 0.05).

Doppler ultrasound evaluations can be helpful in determining neonatal outcomes in SGA patients. In the study by Pérez-Cruz et al., it was found that the means of PI-MCA and PI-U in IUGR and SGA patients were significantly higher than those in the control subjects (17). The study by Crestelo et al., also demonstrated that the number of people with abnormal PI-MCA and PI-U was higher in the SGA group compared to the control group (18). Studies have shown that CPR can be used as a predictor of neonatal outcome in SGA patients (13). For this purpose, the study of Monteith et al. showed that the number of patients with Apgar score 5 minutes less than 7 in the group with abnormal CPR was higher than that in the other group (19). Also, in the study by Leavitt et al., it was shown that the reduction in the 5-minute Apgar score in patients with abnormal CPR was correlated with an increase in adverse outcomes among neonates (10). In the present study, the results showed that the mean Apgar scores at 1 and 5 minutes in patients with normal CPR were significantly higher than those in the abnormal group. There were also significant direct relationships between Apgar scores at 1 and 5 minutes and CPR in patients (p <0.05).

Neonatal weight is another consequence that can be assessed based on CPR. For this purpose, the studies by Monteith et al. and Leavitt et al. showed that the mean neonatal weight in abnormal CPR patients was lower than that in the normal group (10, 19). In the present study, in line with these two studies, the mean weight of neonates in the abnormal CPR group was lower compared to the normal group.

Gestational age is another neonatal outcome associated with CPR. For this purpose, in the studies of Monteith et al. And Leavitt et al., It was shown that the mean gestational age in abnormal CPR was lower than normal, which was consistent with the present study (10, 19).

4-1. Limitations and future perspective

It is better to conduct more statistical studies on the population in future studies. Also, the diagnostic value of Doppler ultrasound indices should be compared with other diagnostic tools.

5- CONCLUSION

Finally, according to the data from this study, it has been shown that the use of CPR can be helpful as a predictive index for neonatal outcomes in SGA.

6- ETHICAL CONSIDERATIONS

This study was approved by the ethics committee of Iran University of Medical Sciences (IR.IUMS.FMD.REC.1398.550), Tehran, Iran. Informed oral consent was obtained from each patient participating in the study.

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