Al-Azhar International Medical Journal

Volume 4 | Issue 4 Article 9

2023

Cerebro-placental Ratio's Role In Perinatal Outcome Prediction In High-risk Pregnancies With Intrauterine Growth Restriction

AbdelMonem Mohamed Zakaria
Obstetrics & Gynecology department, Faculty of Medicine, Al-Azhar University, Egypt

AbdelMonsef Abdel Ghaffar Mostafa
Obstetrics & Gynecology department, Faculty of Medicine, Al-Azhar University, Egypt

Khalid Abdel hakim Shehata
Resident of obstetrics and gynecology Sohag teachingl Hospital, Egypt, khaledshehata2025@gmail.com

How to Cite This Article

Zakaria, AbdelMonem Mohamed; Mostafa, AbdelMonsef Abdel Ghaffar; and Shehata, Khalid Abdel hakim (2023) "Cerebro-placental Ratio's Role In Perinatal Outcome Prediction In High-risk Pregnancies With Intrauterine Growth Restriction," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 4, Article 9.
DOI: https://doi.org/10.58675/2682-339X.1750

ORIGINAL ARTICLE

Cerebro-Placental Ratio's Role in Perinatal Outcome Prediction in High-Risk Pregnancies with Intrauterine Growth Restriction

AbdelMonem Mohamed Zakaria, AbdelMonsef Abdel Ghaffar Mostafa, Khalid Abdel Hakim Shehata*

Department of Obstetrics & Gynecology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

Abstract

Background: **The established method of antenatal monitoring known as Doppler ultrasonography velocimetry of utero-placental umbilical and foetal vessels. Studies on the cerebral-placental ratio have been done to anticipate neonatal achievements.**

Aim and objectives: **To assess the impact of intrauterine growth retardation on pregnancy outcomes in the high-risk partureints using the cerebro-placental ratio.**

Patients and methods: **A case control trial, whereas 100 of conceived females shared and similarly distributed to paired collections, each collection includes 50 of women first group: about high-risk conceived females suffering IUGR and the second is control group: about50 high-risk conceived females with no IUGR. At the time of the research.**

Results: **Cerebro-Placental relation demonstrated importance at cut-off point of 1.03 in the prediction of IUGR with 87.2% in sensitivity, 71.6% of specificity, and the values as the +ve Predictive Value of 83%, and the -ve Predictive Value of 79%.**

Conclusion: **The cerebro-placental value considers a great prediction method for the perinatal results when there is an intrauterine growth restriction and the pregnancy is in high risk.**

Keywords: Cerebral-placental ratio, Growth restriction, High-risk pregnancies, Intrauterine, Perinatal outcome

1. Introduction

An intrauterine growth retardation (IUGR) exists if the estimated weight of the foetus on sonograms is underneath the 10th percentile age gestation.[1]

The Obstetricians and Gynecologists of the Royal College rules that the IUGR is ‘one of the utmost frequent and difficult complications in recent obstetrics.[2]

This description makes sense in view of the multiple published definitions, low recognition rate, dearth of gravid women or curative measures, numerous associated diseases, and elevated hazard of perinatal mortality associated with IUGR. The Adult obesity diseases including hypertension and poor cognitive function are all linked to inadequate growth during birth.[3]

Accurately identifying the foetus that is truly growth-restricted, choosing the best foetal surveillance, and coordinating delivery times are recent contests in the scientific diagnosis of the IUGR. But the ante-natal of the IUGR and identification may improves the outcomes.[4]

To make recommendations in the most recent studies for the antepartum care of these pregnants, particularly for one single foetus, it is absolutely essential to synthesise and evaluate the strength of the evidence as regards the usage of Doppler velocimetry of the umbilical and middle cerebral

Accepted 16 October 2022.
Available online 27 June 2023

* Corresponding author.
E-mail address: khaledshehata2025@gmail.com (K.A.H. Shehata).

https://doi.org/10.58675/2682-339X.1750

arteries for non-abnormal foetuses with assumed IUGR.[5]

This clinical opinion does not primarily address the issue that there are significant differences between employing universal populace charts and customised charts to define the small for age gestation (10th percentile foetus weight for gestational period).[6]

The placenta is the only source of nutrition for the developing foetus. Developmental issues result from the placenta's limited capacity to give the foetus adequate nutrition during IUGR.[7]

Any failure to adjust results in the development of abnormal vascular resistance patterns, which may ultimately damage the health of the foetus and cause IUGR.[8]

2. Patients and methods

This was a case-controlled trial in which made in the on 100 partureints visiting Al-Hussein Hospital, Al-Azhar University from May 2021 to May 2022.

The established candidates were selected into double collections: the first (case collection) included 50 IUGR-positive high-risk pregnant women and the second (control collection) about50 high-risk conceived females with no IUGR whereas the coloured Doppler of the obstetrics could be assessed.

All conceived women in both collections involved in the research were aged from twenty years or more with single foetus only and Fetal Gestational age was in the third trimester. All under effect of the high-risk pregnants, such as elevated blood pressure due to pregnancy, smoking, knowing their first date of the last menses (LMP), but fetal IUGR in case collection and No fetal IUGR in Control collection, diagnosed by ultrasonography estimated foetal weight for gestational age.

Except the ones whom had Congenital malformations in the current foetus, anaemic patients, polyhydraminos, multi fetal pregnancy, diabetes mellitus with pregnancy, and an uncertain LMP date.

2.1. Ethical considerations

The department of obstetrics and gynaecology at El-Hussien University Hospital. The research ethic committee has accepted the research before presentation.

All cases were examined using the following research techniques:

All study participants were given their informed consent orally and in writing after being informed of the study's specifics, as determined by the ethical committee.

2.2. Obstetric history

Calculate the gestation age constructed on the last date of the menses, identify a viable singleton pregnancy, and rule out gestational diabetes. Medical and surgical background: asthma, diabetes, herpes simplex infection, chronic hypertension, renal disease, previous myomectomy, and asthma.

2.3. An examination of the body included

Vital signs such as pressure of blood, temperature, pulse, and mass index of body are examined generally. Examining the abdomen reveals a scar from a previous procedure.

2.4. Ultrasound Doppler evaluation

Everyone involved in this traial, estimation of gestational age was determined by ultrasonography (USG) or routine foetal biometry in the first trimester or early second trimester. The middle cerebral and the umbilical arteries underwent Doppler velocimetry.

Doppler velocimetry of the umbilical vessel was accomplished on a freely-floated portion of the center of the umbilicus cord, far of the placenta and the enrollment of the foetus cord.

The umbilicus cord were examined with coloured Doppler flow and the waveforms of each artery's flow velocity were recorded. Color flow Doppler was used to pinpoint the MCA in the Sylvian sulcus that extends from the Circle of Willis. A stream velocity waveform was obtained after the Doppler sample was positioned in the middle cerebral artery's first third. It was decided to conduct pulsed wave Doppler ultrasound tests without foetal breathing or movement.

2.4.1. Scanning with ultrasound

Was carried out *trans*-abdominally using an ultrasound scanner made by Medison R5 that has a 3.5 MHz Convex probe to assess the following: foetus biometrics: as Gestational age (GA), foetal size (FS), femur length (FL), and biparietal diameter (BPD), Foetus Weight.

2.4.2. Doppler studies of the following arteries

The middle cerebral and the umbilical arteries were examined using coloured Doppler sonography and pulsed waved Doppler. All Doppler tests were performed using the 3.5 MHz Convex probe of the

Medison R5 ultrasound equipment. Doppler indices were calculated by the machine's internal software programmes. S/D is the formula for the systolic/diastolic ratio, whereas S represents the peak systolic frequency and D denotes the finale diastolic frequency. The simplest of all indexes is S/D. This indicator, also referred to as Pourcelot's ratio, is derived by comparing the peak systolic and end diastolic velocities: as follow:

Resistant Index = (S–D) / S

Pulsatility index (PI): This index is calculated by:**PI = (S–D)/velocity$_{mean}$**

Cerebrop-lacental ratio (CPR) (middle cerebral artery to umbilical artery PI ratio) was estimated. (CPR) ratio is designed on the chart; <5th percentile was considered abnormal Fig. 1.

2.4.3. Neonatal evaluation

Data on the perinatal outcome was gathered.

Involved conclusion differences are: decreased APGAR rating (1 min, 5 min and APGAR score<7).

2.4.4. Neonatal evalauation based on score of APGAR

The Apgar scoring technique is a helpful clinical tool to determine which newborns need resuscitation and to evaluate the efficacy of any resuscitative measures. Neonatal Death, Admission to NICU: When the above-mentioned complications weren't existing, the pregnancy's conclusion was viewed as Without incident or Favorable. Each pregnancy's outcome was ascertained by reviewing the records from the labour ward, the neonatal intensive care unit, and, when applicable, the CS for foetal distress, meconium aspiration, and stillbirth.

2.5. Statistical analysis

Using SPSS 22.0 for Windows, all data were gathered, tabulated, and statistically examined (Chicago, IL, USA). Using the Shapiro Walk test, the distribution of the data was examined for normality. Multi-Frequencies and relative percents were employed to represent qualitative information. The difference between the qualitative variables was calculated using the chi square test ($\chi 2$) and Fisher exact, as shown. For parametric and non-parametric data, respectively, the mean and SD (standard deviation) were used to express quantitative data. Every statistical comparison used a two-tailed significance test. *P* values below 0.05 indicate a significant difference, those above 0.001 a highly significant difference, and those below 0.05 a non-significant difference.

3. Results

Tables 1–5.

With a cut-off point of 1.03 and a sensitivity is 87.2%, specificity is 71.6%, PPV of 83%, and NPV of 79%, CPR successfully predicted IUGR Fig. 2, Tables 6 and 7.

4. Discussion

The established method of antenatal monitoring known as Doppler ultrasonography velocimetry of utero-placental umbilical and foetal blood vessels. Studies on the cerebro-placental ratio have been done to anticipate neonatal achievements.

We wanted to determine how the cerebro-placental ratio affected the prognosis for perinatal

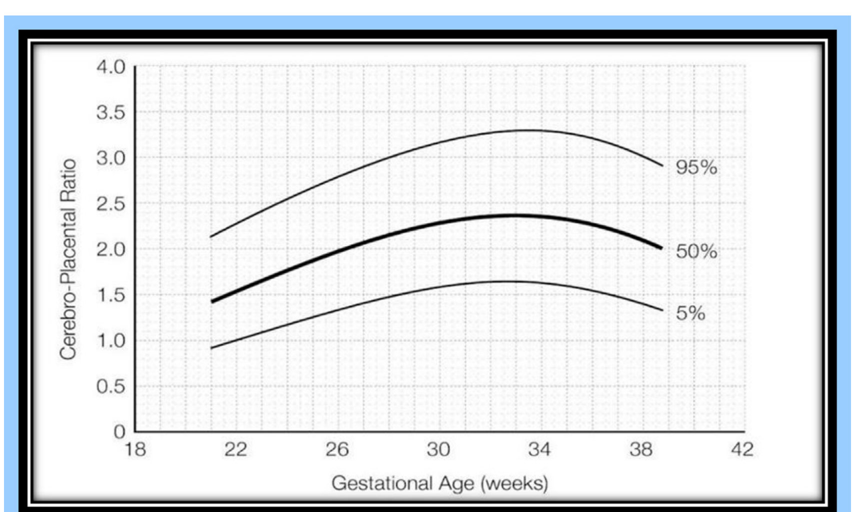

Fig. 1. Values of CPR recognition (Ebbing et al., 2007).

Table 1. Cerebro-placental ratio in all candidates that were being studied According to this table, CPR in cases was significantly lower than it was in controls.

	Case-group ($n = 50$)	Control -group ($n = 50$)	T	*P*
CPR				
Mean ± SD	1.01 ± 0.215	1.1 ± 0.228	2.1	0.039

results in the high risk pregnants involving intrauterine growth retardation.

The analysis of our data showed that there were no statistical significance alteration between the collections as regard to parturients age, BMI, or parity. The mean age of the case group was 27.33 ± 4.28 years, and the mean age of the control group was 25.77 ± 4.54.

The current study revealed that there is no significant difference between the studied groups regarding IUGR of high-risk pregnants. Which was supported by study of (**El-Kady** ***et al.***)[9] as they reported that there was no significant difference as regard patient characteristics (age, weight, BMI, and gestational age) between study and control groups whereas mean age being 28.8 ± 3.0 and the control group's mean age being 29.2 ± 2.8.

Furthermore, (**Tolu** ***et al.*****,**)[10] who included 170 pregnant women with growth-restricted foetuses and found that 133 of them had typical umbilical vessel Doppler results and 37 had defective umbilical vessel Doppler, nearly corroborated our findings. 4 (3%) of the standard and 9 (24.3%) of the atypical umbilical artery Doppler examinations with a value of 0.001 showed neonatal mortality.

Twenty umbilical arteries (15%) and 24 abnormal umbilical arteries (64.9%) were discovered. Doppler study newborns must be reserved to the hospital of neonatal intensive care unit (value: 0.002). (95% CI: 1.449–2.926; OR = 2.059; *P*-value = 0.002). Complicated growed-retareded foetuses with defective Doppler were doubled as likely to need hospitalizations in newborn intensive care units as growth-restricted foetuses with acceptable Doppler flow of the umbilical vessel.

Table 2. Fetal biometry in the two groups under investigation.

	Case-group ($n = 50$)	Control -group ($n = 50$)	T	*P*
Bipareital diameter				
Mean ± SD	73.62 ± 4.65	77.16 ± 3.86	2.97	0.004
Abdominal circumference				
Mean ± SD	23.51 ± 3.92	25.32 ± 3.68	2.38	0.019
Femur length				
Mean ± SD	54.58 ± 3.98	56.4 ± 3.49	2.43	0.017

The table demonstrates that foetal biometrics were noticeably lower in cases than in controls.

Table 3. Neonatal specifications in the two groups of the research.

	Control -group ($n = 50$)	Control -group ($n = 50$)	t/χ^2	*P*
GA (weeks)				
Mean ± SD	37.39 ± 1.08	37.86 ± 0.927	2.34	0.022
Foetus weight (kg)				
Mean ± SD	2.47 ± 0.845	3.08 ± 0.563	3.97	0.000
Apgar on 1 min				
Mean ± SD	6.32 ± 2.37	7.23 ± 0.918	2.53	0.012
Apgar on 5 min				
Mean ± SD	8.81 ± 2.75	9.7 ± 1.09	2.13	0.036

The neonatal features of the groups differ significantly from one another. As a result, cases had significantly lower GA, foetus weight, and score of APGAR at 1 and 5 min comparing to controls.

While conducting the study by Contro *et al.*,[11] they retrospectively retrieved 1000 controls and 53 cases. Both gestational age and IUGR were functions of the regression line with log10 UtA-PI as the reliant variable. In both groups UtA-PI lowered with age gestation. From 20 weeks on, UtA-PI was higher in the IUGR group, and the variance from controls grew with age gestation. Actually, the UtA-PI ratio between the case participants and the control participants at 20 weeks was 1.84, but at 30 weeks it increased to 2.05. Lastly, the IUGR group's labour weight had an adverse correlation with the UtA-PI values.

In the current study, CPR was significant decreased in case candidates when compared to control candidates, with the CPR Mean SD in the IUGR group being 1.01 ± 0.215 and 1.1 ± 0.228 in the control group.

According to **El-Kady** ***et al.*** **study's**[9] which supports our findings, patients with IUGR had low CPR in 20 cases (66.7.0%) and normal CPR in 10 cases (33.3%), while patients without IUGR had low CPR in 11 cases (36.7%) and normal CPR in 19 cases (63.3%). This demonstrates that CPR in the IUGR candidates was, decreased statistical significance, most publicity.

Table 4. Relationship of CPR to other factors in the cases group.

	Cerebro-placental ratio(CPR)	
	r	*P*
GA	0.300	0.062
Foetus weight	0.371	0.006
APGAR on 1 min	0.332	0.009
Umbilical RI	−0.315	0.012
Middle cerebral RI	0.421	0.003

This table demonstrates a significantly positive correlation between CPR and middle cerebral artery RI, APGAR at 1 min, and foetus weight. while there a significance negative relation in between CPR and umbilical vessel RI.

Table 5. Neonatal outcomes (APGAR, foetal distress, Aspirate Meconium, hypoxic-ischaemic encephalopathy, and NICU admission) decreased all candidates and significantly different in between the groups.

	Case participants ($n = 50$)	Control participants ($n = 50$)	χ^2	*P*
Low APGAR	23 (46%)	9 (18%)	9	0.003
Fetal distress	30 (60%)	17 (34%)	6.78	0.009
Aspirate Meconium	20 (40%)	8 (16%)	7.14	0.008
Hypoxia- ischaemic encephalopathy	7 (14%)	1 (2%)	4.89	0.027
NICU Admission	27 (54%)	10 (20%)	12	0.000
Still birth	2 (4%)	0	2.04	0.153
Death	5 (10%)	1 (2%)	2.84	0.092

Furthermore (**El Ktatny *et al.***)[12], they demonstrated that assessing the capable utility of the CPR assessed at 34–37 weeks of gestation in prediction the perinatal outcomes of the gravid females with FGR, In 50% of the patients, the mean UAD-PI was normal; in the other 50%, it was abnormal. It varied from 0.47 to 2.5. The mean MCD PI was 1.330.38, normal in 47.5% of patients and abnormal in 52.5%, with a range of 0.71–2.

Ebrashy *et al.*,[13] reported abnormal cerebroplacental ratio in 84.2% of preeclampsia cases with IUGR and 41.8% of preeclampsia cases without IUGR.

Bernstein ***et al.***,[14] revealed that foetus fat and lean body mass have different growing features and the calculation of the foetus fat might be a more sensitive and specific technique of recognition of atypical foetal growth when comparing with lean body mass index indices due to the accelerated growing rate of late gestation.

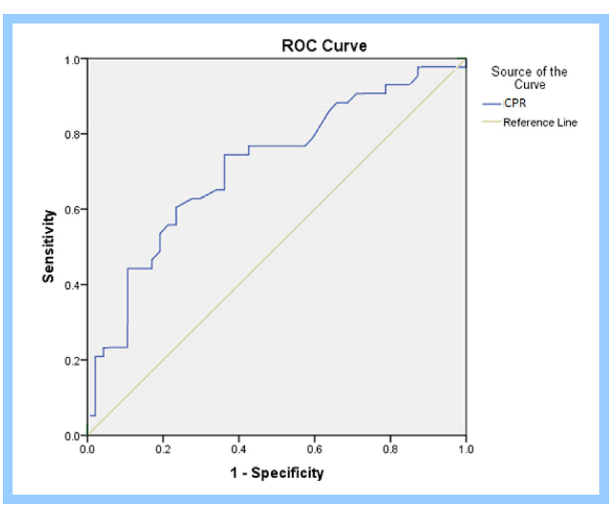

Fig. 2. CPR - ROC curve such as a predictor for intrauterine growing retardation.

Table 6. CPR's diagnostic value in predicting low APGAR values According to this table, low CPR accurately predicts low APGAR in the IUGR group with a 66% accuracy rate and low APGAR in the non-IUGR group with a 72% accuracy rate.

IUGR	Value	95% CI
Sensitivity	86.957%	66.411%–97.225%
Specificity	48.148%	28.667%–68.050%
Positive Predictive Value (PPV)	58.824%	49.006%–67.986%
Negative Predictive Value (NPV)	81.25%	58.440%–93.033%
LR+	1.677	1.128–2.493
LR-	0.271	0.088–0.835
Accuracy	66%	51.235%–78.795%
Non-IUGR		
Sensitivity	77.778%	39.991%–97.186%
Specificity	70.732%	54.463%–83.87%
Positive Predictive Value (PPV)	36.842%	24.43%–51.281%
Negative Predictive Value (NPV)	93.548%	80.785%–98.04%
LR+	2.657	1.473–4.795
LR-	0.314	0.091–1.084
Accuracy	72%	57.509%–83.769%

The current study says, we discovered that foetal biometrics were significantly decreased in case candidates than in controls.

These results agreed with the results of **Larciprete *et al.***,[15] whereas they revealed that the humerus and abdominal circumferences of IUGR foetuses were

Table 7. CPR's diagnostic value in predicting neonatal mortality.

IUGR	Value	95% CI
Sensitivity	100%	47.818%–100%
Specificity	35.556%	21.686%–51.22%
Positive Predictive Value (PPV)	14.706%	12.187%–17.641%
Negative Predictive Value (NPV)	100%	–
LR+	1.552	1.249–1.928
LR-	0	–
Accuracy	42%	28.188%–56.794%
Non-IUGR		
Sensitivity	100%	2.5%–100%
Specificity	63.265%	48.288%–76.578%
Positive Predictive Value (PPV)	5.263%	3.705%–7.427%
Negative Predictive Value (NPV)	100%	–
LR+	2.722	1.885–3.931
LR-	0	–
Accuracy	64%	49.193%–77.084%

This table demonstrates that low CPR accurately predicts neonatal death in the IUGR group 42% of the time, and accurately predicts neonatal death in the non-IUGR group 64% of the time.

significantly smaller than those of controls, which is consistent with our findings. Most of the SCTT readings were varied between the compared collections.

In furthermore to our research results, Between the groups, we found a substantial variation in neonatal features, also we revealed that there is positive significance relation among foetus weight CPR, score of APGAR at 1 min and MCA RI. While there is negative Significance variations exist between the groups for decreased APGAR score, foetal distress, aspirated meconium, hypoxic-ischaemic encephalopathy, and NICU hospitalisation.

The neonatal outcomes were all examined in the study by **Sengodan and Mathiyalagan.**[16] including foetus weight, Apgar scores at one and 5 min, the need and the length of stay for NICU hospitalzation, and perinatal death.

Natthicha and Chusana[17] conducted prospective-cohort research, and they clarified the conclusion that the -ve predictive value of CPR was significantly in elevation. As a result, it could be used to stratify gravid females whom may actually got benefits from continued monitoring of her foetus cardiac rate.

Finally, CPR demonstrated significancy in the current study for prediction the intrauterine growth retardation with sensitivity 87.2%, specificity 71.6%, PPV 83%, and NPV 79% at cut-off point of 1.03.

The **El-Kady *et al.*,**[9] The results of the study demonstrated that lower cerebro-placental ratio in the IUGR case candidates had 100.0% sensitivity, 41.7% specificity, 53.3% diagnostic accuracy, 30.0% positive predictive value, and 100.0% negative predictive value to predict hypoxic ischemic encephalopathy. However, lower CPR in non IUGR candidates had 100% sensitivity, 100% negative predictive value, 100% positive predictive value, 65.5% specificity, 66.7% diagnostic accuracy, and 9.1% positive predictive value to predict hypoxic ischemic encephalopathy, too.

Therefore, in study groups, low CPR displayed sensitivity elevation and a low specificity for predicting hypoxic-ischaemic encephalopathy.

4.1. Conclusion

The only approved effective intervention for IUGR pregnancies is delivery at the moment. In our study, low CPR is closely connected to a poor pregnancy outcome, particularly when combination with IUGR. The cerebro-placental relationship has a important inspective value for the perinatal outcomes when there is an intrauterine growth restriction and the pregnancy is at high risk.

Conflicts of interest

None declared.

References

1. Sharma D, Shastri S, Sharma P. Intrauterine growth restriction: antenatal and postnatal aspects. *Clin Med Insights Pediatr*. 2016;10. CMPed–S40070.
2. ACOG (American College of Obstetricians and Gynecologists). Intrauterine growth restriction. *Practice Bulletin*. 2000;12: 300–308.
3. Devaskar SU, Chu. A Intrauterine growth restriction: hungry for an answer. *Physiology*. 2016;31(2):131–146.
4. McCowan LM, Figueras F, Anderson NH. Evidence-based national guidelines for the management of suspected fetal growth restriction: comparison, consensus, and controversy. *Am J Obstet Gynecol*. 2018;218:S855–S868.
5. Tamblyn JA, Katie Morris R. 'Small for gestational age and intrauterine growth restriction'. In: Lusely DM, Kilby MD, eds. *Obstetrics & Gynecology an Evidence Based Text for MRCOG*. third ed. London UK: Taylor& Francis Group; 2016:281–288.
6. Schlaudecker EP, Munoz FM, Bardají A, et al. Small for gestational age: case definition & guidelines for data collection, analysis, and presentation of maternal immunisation safety data. *Vaccine*. 2017;35:6518–6528.
7. Zhang S, Regnault TR, Barker PL, et al. Placental adaptations in growth restriction. *Nutrients*. 2015;7:360–389.
8. Castel A, Frank YS, Feltner J, Karp FB, Albright CM, Frasch MG. Monitoring fetal electroencephalogram intrapartum: a systematic literature review. *Front Pediatr*. 2020;8:584.
9. El-Kady M, Hamdy E, Eltaieb E. Role of cerebro-placental ratio in prediction of perinatal outcome in high-risk pregnancies with intrauterine growth restriction. *Evidence Based Women's Health Journal*. 2020;10:162–169. https://doi.org/10.21608/ebwhj.2020.22950.1075.
10. Tolu LB, Ararso R, Abdulkadir A, Feyissa GT, Worku Y. Perinatal outcome of growth restricted fetuses with abnormal umbilical artery Doppler waveforms compared to growth restricted fetuses with normal umbilical artery Doppler waveforms at a tertiary referral hospital in urban Ethiopia. *PLoS One*. 2020;15, e0234810.
11. Contro E, Cha DH, De Maggio I, et al. Uterine artery Doppler longitudinal changes in pregnancies complicated with intrauterine growth restriction without preeclampsia. *Prenat Diagn*. 2014;34:1332–1336. https://doi.org/10.1002/pd.4476. Epub 2014 Aug 27. PMID: 25098960.
12. El Ktatny HHM, Khaled MA, Mostafa AA. Umbilical and middle cerebral artery Doppler indices at late third trimester in the prediction of perinatal outcome in growth restricted fetuses the Egyptian. *J Hosp Med*. 2020;81:1426–1431, 1426 Received: 22/6/2020 Accepted:21/8/2020.
13. Ebrashy O, Azmy O, Ibrahim M. Middle cerebral umbilical artery resistance index ratio as sensitive parameter for fetal well-being and neonatal outcome in patients with the eclampsia. Case Control Study. *Croat J Med J*. 2005;46:826–831.
14. Bernstein IM, Goran MI, Amini SB, Catalano PM. Differential growth of fetal tissues during the second half of pregnancy. *Am J Obstet Gynecol*. 1997;176:28–32.
15. Larciprete H, Valensise G, Di Pierro B, et al. *Intrauterine Growth Restriction and Fetal Body Composition*. First published; 2005.
16. Sengodan SS, Mathiyalagan S. Doppler study (cerebroplacental ratio) as a predictor of adverse perinatal outcome. *Int J Reprod Contracept Obstet Gynecol*. 2020;9:5068–5074.
17. Natthicha C, Chusana P. The relationship between intrapartum cerebroplacental ratio and adverse perinatal outcomes in term fetuses. *Eur J Obstet Gynecol Reprod Biol*. 2018; 228:82–86.