

Association between Foetal Middle Cerebral Artery and Umbilical Artery Doppler ratio with Foetal distress in 38-40 weeks of Gestational age

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ABSTRACT

Background : Identifying foetal distress is of utmost important to prevent neonatal morbidity and mortality. A colour Doppler forms an essential non invasive tool capturing change in flow velocity waveforms in the fetal vascular beds to detect inadequate oxygen or nutrient supply.

Aims and Objectives : The study aim was to determine the relationship between Middle cerebral artery, pulsatile index and Umbilical artery Doppler ratio with fetal distress at 38-40 weeks of gestation.

Materials and Methods: The study was a prospective cohort study, 100 pregnant women with 38-40 weeks of gestation age who came to OPD were selected during the period of June 2020 to June 2021. Colour Doppler was done for all of them, and the association of this ratio with fetal distress was assessed.

Results: Among 100 women, cerebroplacental ratio less than fifth centile was seen in 84 of cases, there is also significant correlation between cerebroplacental ratio less than fifth centile and low APGAR score. Fetal outcomes for cerebroplacental ratio less than fifth centile were observed such as low birth weight (75%), emergency cesarean section (97%), NICU admission (80%), low APGAR score (100%), Meconium aspiration syndrome (70%), Respiratory distress syndrome (75%), Oligohydramnios (73%), IUGR (70%), were also observed.

Conclusion: Cerebro-placental ratio i.e; fetal Middle cerebral artery and Umbilical artery Doppler ratio less than fifth centile is significant in predicting fetal distress at 38-40 weeks and can help to reduce the risk of perinatal mortality by timely intervention at delivery.

Keywords: Cerebroplacental ratio, middle cerebral artery, umbilical artery, fetal distress, Doppler.

INTRODUCTION

Fetal distress refers to the compromise of the foetus leading to hypoxia related neural tissue injury due to inadequate oxygen or nutrient supply. This can occur due to maternal, fetal or placental factors. At its most severe it may lead to neonatal injury or still birth.

Disordered fetal oxygen during labor may be affected by different mechanisms aggravated due to hypertension, diabetes mellitus, inflammatory diseases, chorioamnionitis, preterm labor, and fetal growth retardation leading to the exacerbated fetal distress.^[1]

Fetal distress leading to hypoxia related neural tissue injury is a bothersome issue in the prenatal period.^[2] Immediate delivery has to be considered, because neurological damage may occur when the fetal brain is deprived of oxygen.^[3] Doppler assessment of impedance to flow in the umbilical artery (UA), fetal middle cerebral artery (MCA) and the ratio of the pulsatility index (PI) in these vessels, or cerebroplacental ratio (CPR), are used for assessment of fetal oxygenation.^[4, 5] Fetal distress suspicion can be made when there is decreased perception of fetal movements.

There are different prenatal tests to determine the optimal

fetal oxygen supply such as biophysical profile, amniotic fluid index (AFI), non-stress test (NST), contraction stress test (CST), and Doppler assessment of umbilical and middle cerebral arteries.^[6, 7, 8] CPR ratio is ratio of Middle cerebral artery and pulsatile index to the umbilical artery and pulsatile index. Redistribution of cerebral blood flow or brain sparing effect can be indicated by low CPR. The brain sparing effect can be seen when circulatory adaption occurs with chronic hypoxia in the form of cerebral vasodilation to pressure blood flow to the brain.^[9]

The Cerebroplacental ratio is gaining much interest as a useful tool in differentiating the at-risk fetus in both intrauterine growth restriction and the appropriate-for-gestational-age setting.^[10] Doppler evaluation of maternal, fetal, and umbilical vessels has been used in the management of suspected FGR to aid in timing of delivery and theoretically could separate the fetus with a placental problem from the constitutionally small normal fetus.^[11, 12]

Hence; this prospective study was undertaken to study the association of fetal Middle cerebral artery and umbilical artery Doppler ratio with fetal distress at 38-40 wks of gestation age.

MATERIALS AND METHODS

Study Design: Prospective observational study in CAIMS.

Study Duration : From june 2020 to june2021.

Sample Size : 100 Singleton pregnant women with 38-40weeks of gestation age with fetal distress attending our hospital after taking an informed consent.

Inclusion Criteria :

- Singleton pregnancy 38-40weeks.

Exclusion Criteria :

- Women with labour pain, Fetal congenital or chromosomal abnormality.
- Patients who opted for caesarean delivery for Fetal distress were excluded from the study.

A non-stress test (NST) and amniotic fluid index (AFI) were assessed weekly until pregnancy termination. Color Doppler ultrasonography assessment of middle cerebral and umbilical arteries was done , and then, pulsatility

index of the middle cerebral artery to umbilical artery was determined. It was compared according to the other variables, especially fetal distress. The umbilical artery was measured with color Doppler ultrasonography, and the wave- forms were detected at the free loop portion of the umbilical cord. The middle cerebral artery was determined by color flow mapping at a transverse section of the fetal head at the level of the lesser wing of the sphenoid bone. All of the records were measured in the absence of fetal breathing and movement with the fetal heart rate between 120 and 160 bpm. Each record was calculated by at least three consecutive waves.

Pregnancy was terminated when NST was inactive, AFI less than 5 cm, BPS less than 8/10, and gestational age more than 40 weeks. Fetal monitoring was done routinely. Fixed labor room protocols were followed as per institutional guidelines. A number of normal vaginal deliveries, cesarean sections via forceps, induced, or spontaneous were recorded. The newborn Assessment included fifth minute Apgar, NICU admission, umbilical pH, cesarean for fetal distress, abnormal NST, meconium aspiration, and respiratory distress. Also, the association between these findings with CPR was assessed.

Written informed consent was obtained from the women agreeing to participate in this study on adverse pregnancy outcome.

Ethics Approval : This study was approved by the ethics committee, CAIMS, Karimnagar.

RESULTS

The study group comprised of 100 women with 38 to 40 weeks of gestation with fetal distress. Doppler velocimetry wave forms and pulsatile index, resistance index values are obtained. CPR ratio is calculated. Mean gestational age was 38.8 years; mean cerebroplacental ratio in our study group is 1.23. In our study group out of 100 patients with fetal distress; 84 patients patients had CPR ratio <5th centile. Serial Doppler parameters were assessed.

Table 1.shows: out of 100 patients 72 patients underwent emergency C-section and 28 patients had vaginal delivery, out of 72 patients who went emergency C-section 70 patients had Cerebroplacental ratio <5th centile

Table-1 : Mode of Delivery

Mode of Delivery	Cerebroplacental Ratio		Total
	> 5th Centile	< 5th Centile	
Vaginal	14 (50%)	14 (50%)	28(100%)
LSCS	2 (3%)	70 (97%)	72 (100%)
Total	16	84	100

Table 2: Association with Low Birth Weight

Birth Weight	Cerebroplacental Ratio		Total
	> 5th Centile	< 5th Centile	
< 2.5 kg	1(25%)	3 (75%)	4 (100%)
> 2.5 kg	15 (16%)	81(84%)	96 (100%)
Total	16	84	100

Table 2 shows: Association of cerebroplacental ratio and low birth weight. Cerebroplacental ratio <5th centile is seen in 3 cases out of 4 low birth weight babies born; this shows a strong Association of low birth weight in Cerebroplacental ratio <5th centile.

Table 3 shows perinatal outcome of the study group. Cerebroplacental ratio <5th centile is observed in 75% of patients with fetal distress with low birth weight suggesting strong Association.

Cerebroplacental ratio <5th centile seen in 80% of patients with fetal distress with NICU admission for an average of 3.2 days suggestive of strong correlation. Almost all patients with low 5 minutes APGAR(<7) had cerebroplacental ratio <5th centile. Meconium aspiration is seen in 10 patients out of 7 cases had Cerebroplacental ratio <5th centile and 3 cases had cerebroplacental ratio >5 centile.

Respiratory Distress is seen in total 12 cases out of which

9(75%) had cerebroplacental ratio <5th centile. In our study group oligohydramnios (AFI<5cm) was seen in around 26 cases.

Out of which seven were also associated with IUGR and immediate termination was done. 70% of cases with IUGR had Cerebroplacental ratio <5th centile which has significant Association.

Table 4 shows medical disorders association in our study group like hypertensive disorders of pregnancy, Diabetes mellitus, others like systemic lupus erythematosus, anti phospholipid syndrome, jaundice present in 9%, 3%, 3% respectively.

As only 38-40 weeks gestational age is included in our study, medical disorders complicating pregnancy cannot be studied in detail for which large population studies is required.

Table 5 shows reference ranges for Cerebroplacental ratio according to weeks of gestation.

Table 3: Perinatal Outcome

Perinatal outcome	Cerebroplacental Ratio		Total
	> 5th Centile	< 5th Centile	
Low birthweight	1(25%)	3 (75%)	4
NICU admission	3 (20%)	12(80%)	15
Low 5th min APGAR (<7)	0	4 (100%)	4
Meconium aspiration syndrome	3 (30%)	7 (70%)	10
Respiratory distress	3 (25%)	9 (75%)	12
Oligo <5cm	7(27%)	19 (73%)	26
IUGR	3 (30%)	7 (70%)	10

Table 4 : Association with Medical Disorders

Medical Disorder	Cerebroplacental Ratio		Total
	> 5th Centile	< 5th Centile	
Hypertensive disorders of pregnancy	4	5	9
Diabetes mellitus	1	2	3
Others	1	2	3
Total	6	9	15

Table 5: Longitudinal reference ranges for the cerebroplacental ratio

GA	PERCENTILE								
Weeks	2.5th	5th	10th	25th	50th	75th	90th	95th	97.5th
21	0.82	0.9	1	1.18	1.41	1.67	1.94	2.11	2.27
22	0.9	0.98	1.09	1.28	1.52	1.79	2.07	2.25	2.42
23	0.98	1.07	1.18	1.38	1.63	1.92	2.2	2.39	2.56
24	1.06	1.16	1.27	1.48	1.74	2.04	2.33	2.52	2.7
25	1.14	1.24	1.36	1.58	1.85	2.15	2.46	2.65	2.83
26	1.22	1.32	1.45	1.67	1.95	2.26	2.58	2.78	2.96
27	1.3	1.4	1.53	1.76	2.05	2.37	2.69	2.9	3.08
28	1.37	1.47	1.6	1.84	2.14	2.46	2.79	3	3.19
29	1.42	1.53	1.67	1.91	2.21	2.55	2.88	3.09	3.29
30	1.47	1.58	1.72	1.97	2.28	2.62	2.95	3.17	3.37
31	1.51	1.62	1.76	2.01	2.32	2.67	3.01	3.23	3.43
32	1.53	1.64	1.78	2.04	2.35	2.7	3.05	3.27	3.47
33	1.53	1.65	1.79	2.05	2.36	2.72	3.07	3.29	3.49
34	1.52	1.63	1.78	2.04	2.35	2.71	3.06	3.29	3.49
35	1.49	1.6	1.74	2	2.32	2.68	3.03	3.26	3.46
36	1.44	1.55	1.69	1.95	2.27	2.62	2.97	3.2	3.41
37	1.37	1.48	1.62	1.88	2.19	2.54	2.89	3.12	3.33
38	1.29	1.4	1.53	1.78	2.09	2.44	2.79	3.01	3.22
39	1.19	1.29	1.43	1.67	1.97	2.31	2.66	2.88	3.09

DISCUSSION

Cerebro-placental ratio is emerging as an essential obstetric ultrasound marker to predict adverse pregnancy outcomes in clinically diagnosed IUGR babies. An abnormal CPR is a result of redistribution of cardiac output to cerebral circulation and relates to intrapartum fetal distress resulting in increased emergency cesarean sections, low APGAR scores, NICU admissions and perinatal mortality. It is calculated by dividing the Doppler middle cerebral artery pulsatility index by the umbilical artery (UA) pulsatility index ($CPR = MCA-PI / UA-PI$).^[13]

Total 84 cases had CPR below 5th centile. The mean CPR was 1.23 at <5th centile which is similar to that of Nandita et al study and also corresponds with the study of Ebbinget al.^[14]

The present study noted that in fetuses associated with abnormal CPR, 70 were caesarean deliveries and 14 were vaginal deliveries. This finding was comparable to the statistically significant relation noted by Shriya Ganju et al with 80% caesarean deliveries and adverse perinatal outcome in 75%; also comparable associated with Singh et al with 61.5% caesarean deliveries. In our study, abnormal CPR is significantly associated with caesarean

delivery.

Abnormal CPR was associated with LBW in 75% cases, APGAR <7 at 5 min in 100% cases, NICU admission in (80%) cases; Meconium Aspiration in 70% cases and respiratory distress in 75% cases. In a study of Shriya Ganju et al^[13] data presents 90% LBW, APGAR <7 at 5min 67% cases, NICU admission 86% cases. Bano et al^[15] also present a comparable data where 100% of the neonates with abnormal CPR had LBW, 75% were admitted in NICU and was statistically significant.^[16] Allam et al. Observed that an abnormal CPR is significantly associated with LBW, NICU admission and adverse perinatal outcomes.^[17]

Khalil et al. in a study on 7,944 pregnancies found that even after excluding the SGA fetuses, low CPR measure in multiples of median (MOM) was a predictor of adverse outcomes even in fetuses whose size is considered appropriate using conventional biometry.^[18]

Limitations of our study are small sample size and less cases of medical disorders complicating pregnancy cases and also they used immediate intervention before 37 weeks and hence cannot be included in the study. Hence relationship between medical disorders and CP ratio cannot be assessed.

CONCLUSION

It may be concluded that in our study fetal MCA and UA Doppler ratio of <5th centile at 38-40 weeks was statistically significant in predicting fetal distress. There has been significant association between CPR <5th centile caesarean delivery and low birth weight at 38-40 weeks. It can also be concluded that CPR <5th centile has higher chances of adverse perinatal outcomes. However large sample size study is required to develop relationship between CPR and each medical disorder complicating pregnancy

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

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