Cerebro-placental Index in Perinatal Outcome of Pregnancy with Intra- Uterine Growth Restriction

Tomar Basar[1], Jyoti Kamda[2], Noyomi Saring[3]

ABSTRACT

Introduction: Intrauterine growth restriction (IUGR) indicates a situation when the fetus has not achieved its genetically pre-determined size and the birth weight is below 10thpercentile for their gestational age. We intend to find out the role of cerebroplacental index (CPI) using Doppler velocimetry procedure to determine the IUGR and its perinatal outcome.
Study was done to determine the poor perinatal fetal outcome as morbidity or mortality in IUGR using Doppler cerebroplacental index.

Material and methods: This study was conducted on 50 antenatal patients who have sub-optimal fundal growth delayed by 4 weeks and or IUGR diagnosed by ultrasound in tertiary care center of Arunachal Pradesh. They were divided into two groups according to CPI as; group (A) CPI >1 or normal and group (B) CPI ≤ 1 or abnormal CPI and it is correlated with perinatal outcome in relation to the normal and abnormal Doppler velocimetry. The diagnosis of IUGR was confirmed after delivery of fetus whether normal vaginal delivery or caesarean section delivery. Patients who do not remember last menstrual period (LMP), no ultrasound (USG) in first trimester, gross C/D or multiple gestations were excluded from the study. Statistical analyses used were X^2test and student t-test. Sensitivity, specificity, positive predictive, negative predictive value and diagnostic accuracy in assessment of poor perinatal outcome was analyzed and discussed.

Results: We found that the group A with CPI >1 has higher gestation age at delivery (38.182 week) than the group B CPI ≤1 (35.795 week). The difference is found to be highly significant ($p < 0.01$). Also there was higher birth weight of baby in average (2.464 ± 383 Kg) in group a with CPI >1 than the group CPI ≤ 1 with whose average baby weight is (1.756 ± 0.470 Kg) in CPI ≤ 1, Although this finding were statistically not significant ($p > 0.05$).

Conclusion: We conclude that CPI is a useful method to determine fetal outcome in IUGR.

Keywords: Cerebroplacental Index, Intra-uterine Growth Restriction, Doppler Waveform.

INTRODUCTION

Many maternal or fetal clinical conditions may associate with increased perinatal morbidity and mortality, one among them is intrauterine growth retardation (IUGR). IUGR indicates a situation when the fetus has not achieved its genetically pre-determined size and the birth weight is below l0th percentile for their gestational age. Both Small for Gestational age (SGA) and IUGR fall under this are consider to be baby weight less than 2500gms at birth. SGA babies include those who are constitutionally small and systemic causes which effect fetal growth. Most fetal medicine unit classify IUGR to be fetus in which growth potential is reduced due to placental insufficentcy.[1] Its incidence is about 2-5% of all new born babies. There are various Bio-physical methods used for diagnosing and monitoring of fetal well being using in IUGR fetus. Doppler velocimetry is a non-invasive technology using high frequency sound wave for investigation of blood flow in various vessels. The feasibility of its fetal application was first reported by Fitzgerald DE and Drum JE in 1977.[2] The accumulated data reveal that there is a strong association between abnormal Doppler studies and fetal distress especially in IUGR babies. The Uteroplacental flow increase with increased in gestational age as a consequences of decrease in placental resistance, but in case of cerebral hypoxia this does not happen due to decrease in vascular resistance (Rajen Et al[3]). So detection of fetal jeopardy in utero will be preceded in the Doppler Velocimetry by weeks earlier than that detected by B-mode scanning, Physical finding and electronic fetal monitoring. Doppler waveform provides the clinician with various indices such as Systolic/ Diastolic (S/D) ratio, resistance index (RI), Pulsatile index (PI) and cerebro-placental index (CPI) index. According to study of Gramellini et al[4], to predicting adverse perinatal outcome, the predictive accuracy for CPI ratio was 90%, as compared to 78.8% in MCA and 83.3% for UA. Thus, CPI is thought to be better predictor of IUGR than single vessel index of Umbilical artery (UA) or Middle Cerebral artery (MCA). There by, Doppler cerebroplacental index (CPI) proved to posses the predictive capacity in diagnosing and management of IUGR fetus. It is a feasible, affordable and can be repeated as frequently as required.
Study aimed to determine the poor perinatal fetal outcome as morbidity or mortality in IUGR using Doppler cerebroplacental index

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MATERIAL AND METHODS

This study was conducted on 50 antenatal patients who have sub-optimal fundal growth delayed by 4 weeks and or IUGR diagnosed by ultrasound in Tomo Riba Institute of Health and Medical Sciences, Naharlagun, Arunachal Pradesh. They were divided into two groups according to CPI as; group (A) CPI >1 or normal and group (B) CPI ≤ 1 or abnormal CPI and it is correlated with perinatal outcome in relation to the normal and abnormal Doppler velocimetry. The diagnosis of IUGR was confirmed after delivery of fetus whether normally vaginally or caesarean section. Patients who do not remember last menstrual period (LMP), no USG in first trimester, gross C/D or multiple gestations were excluded from the study.

The Doppler waveform velocimetry were obtained after placing woman in the supine position from Umbilical artery (UA). When a minimum of at least five consecutive pulsatile arterial waveform are obtained, the image is frozen then the S/D, RI and PI is calculated during the absence of fetal breathing movement and body movement. Doppler examination of middle cerebral artery was performed by making the transducer angled in horizontal section of the brain including the plain of thalami and cavum septum pellucidum. Then the transducer was moved to locate BPD in close proximity to the greater wing of the sphenoid. The middle cerebral arteries were seen as two pulsating structure in sylvian fissure, then the transducer position was manipulated to obtained maximum velocity, where the image was frozen and S/D, RI and Pl were calculated. A total of 162 examination were done in 50 IUGR patient varies from 2-5 per patient (3 average) from admission till deliveries, Last Doppler reading before delivery was taken for calculation. Percentage of normal and abnormal Doppler velocimetry of umbilical artery and middle cerebral artery was observed and its relation with perinatal outcome (poor perinatal outcome and or perinatal mortality) was analyzed and discussed. Poor perinatal outcome was defined by the presence of any of the following: Apgar score≤7 in 5min, meconium stain liquor below voccal cord, neonatal intensive care unit (NlCU) admission, operative delivery for fetal distress, oligohydromnios and intrauterine fetal death (IUFD).

Statistical analyses used were X^2test and student t-test. Sensitivity, specificity, positive predictive, negative predictive value and diagnostic accuracy in assessment of poor perinatal outcome was analyzed and discussed. P-Value > 0.05 is considered not significant (NS), P - value ≤ 0.05 is significant (S), P-value ≤ 0.001 is considered very highly significant (VHS) statistically.

RESULTS

The study results were obtained by comparing the patients divided into two groups based on perinatal outcome in relation with normal and abnormal cerebro-placental index. Group A was normal which is CPI >1 and Group B with subnormal CPI (CPI ≤1). For this purpose well known statistical formulae like student's t-test and chi- square (x2) test were advocated whenever found necessary and suitable interpretation were made accordingly as shown in table-1.

It is found that the group A (CPI > I) have higher gestation age at delivery (38.182 week) than the gestational age at delivery (35.795 week) for group B (CPI ≤ 1). The difference is found to be highly significant ($p < 0.01$). The average birth weight is (2.464 ± 383 Kg) in CPI >1(group a) which is higher in compare to the average birth weight (1.756 ± 0.470 Kg) in CPI ≤ 1, although statistically not significant ($p > 0.05$). Data were highly significant for cases of caesarean Section (CS) delivery for acute fetal distress in CPI ≤ 1 (76.9%) than the CPI >1 (9.1%0. Similarly high significant percentage of NICU admission and NICU > 7 days are observed in the CPI ≤1 (group B) in comparison with the corresponding figures in the normal CPI.

The differences in the perinatal outcome are outlined in the following bar diagram as follows in Figure 1. There was visible difference in Apgar score (A/S) < 7 in first 5 minutes of delivery which was not significant statistically. We also observed higher finding of meconium staining of liquor in CPI ≤ 1 cases which is in compliance with the finding of lower apgar score count in the same group as compare to normal CPI (insignificant statistically, $p > 0.05$) (figure-1).

We have also compared the mode of delivery (MOD) of two groups as shown in Table ii below. It is observed that the normal vaginal delivery (NVD) was higher and Caesarean section (CS) was lower in group with CPI > 1 which is in contrast to CPI ≤1. This difference was significant statistically (table-2).

In our study we evaluated the birth weight of the baby at delivery and compare them in normal with abnormal CPI ratio. It was seen that no baby was ≤ 1500gm in CPI > 1, but 9 cases have very low weight in IUGR with abnormal CPI. The birth weight in the babies of normal CPI was significantly higher than that of the abnormal CPI and this was statistically highly significant (P value <0.01) as shown in Table 3.

From the study, we found that the Doppler cerebroplacental index have sensitivity of 36/40 (90%,), Specificity of 7/10 (70%), positive and negative predictive value of 92.3% and 63.6% respectively. The diagnostic accuracy of the CPI is found to be 86%. Thus cerebroplacental index to be accurate

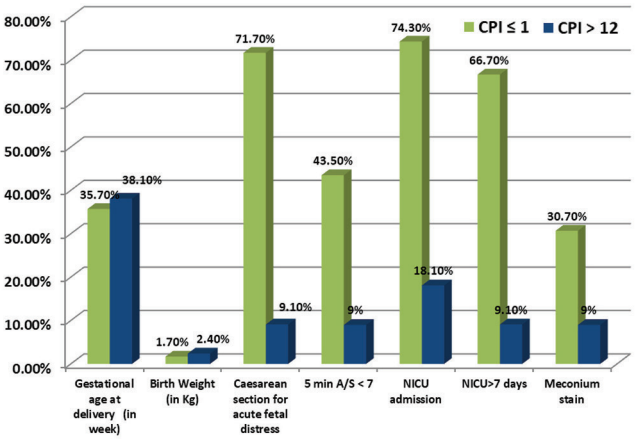

Figure-1: Bar Graph comparing Neonatal outcome Group A & B.

Indicators	Cerebro-placental ratio		Test value	P Value	Remark
	CPI >1(n = 11)	CPI ≤ 1(n = 39)			
Gestational Age (wks) at delivery	38.182 ± 1.25	35.795 ± 2.319	t = 3.261	<0.01	HS
Birth Weight (Kg)	2.464 ± 383	1.756 ± 0.470	t = 1.863	>0.05	NS
CS for Acute fetal distress	1 (9.1)	28 (71.7)	$x^2 = 11.394$	<0.001	VHS
5 minutes A/S <7	1 (9)	17 (43.5)	$X^2 = 3.061$	>0.05	NS
NICU Admission	2 (18.1)	29 (74.3)	$X^2 = 9.232$	<0.01	HS
NICU >7days	1 (9.1)	26 (66.7)	$X^2 = 9.250$	<0.01	HS
Meconium stain	1 (9)	12 (30.7)	$x^2 = 1.120$	>0.05	NS

Table-1: Showing the neonatal outcome according to cerebro-placental index of two groups

MOD	Cerebroplacental Index		Test Value	P – Value	Remarks
	CPI >1 (N = 11)	CPI ≤ 1 (N = 39)			
NVD	7 (63%)	9 (24%)	$X^2 = 6.487$	P < 0.05	S
CS	3 (27%)	30 (76%)	$X^2 = 9.246$	P < 0.01	HS
Ventouse	1 (10%)	0	-	-	-
Breech / Forceps	0%	0%	-	-	-

Table-2: showing mode of delivery in two groups

Birth weight (gram)	CPI ≤1 (n=39)	CPI > 1 (n=11)	Test value	P – Value	Remarks
< 1500	09 (23%)	0%	-	-	-
1500 - 2500	26 (66.6%)	5 (45.4%)	$X^2 = 01.639$	P > 0.05	NS
2500	04 (10.2%)`	6 (54.5%)	$X^2 = 10.519$	P < 0.01	HS

Table-3: Comparing birth weight (Kg)

predictive test fetal compromise in IUGR.

DISCUSSION

Continuous wave Doppler instruments are used routinely in most obstetricians' office to provide evidence of fetal wellbeing in high risk pregnancy. Out of various vessels, umbilical and middle cerebral arterial Doppler study provides fetal wellbeing status in IUGR fetus with a fair of degree of accuracy. Royal College of Obstetrician & Gynaecologist (RCOG) provide green code management for SGA.[5] According to RCOG, *SGA* and severe SGA defined as estimated Fetal Weight (EFW) or Abdominal Circumference (AC) of less than 10th and 3rd percentile respectively. 50 – 70% of SGA are constitutionally small but, growth restricted fetus may manifest evidence of fetal compromise by Doppler or reduced liquor. Similarly Frances Figueras and Eduard Gratacos[6] in their meta-analysis suggest stage base classification and management of fetal growth restriction. They conclude that CPR or CPI is best individual candidate to detect fetal growth restriction.

In this study, 50 IUGR fetuses diagnosed clinically and/or by ultrasound were evaluated by Doppler studies of umbilical artery and middle cerebral artery. Doppler velocimetry of cerebro-placental circulatory finding were correlated with period of gestation at delivery, birth weight, PIH, meconium stain, time interval between last Doppler study and delivery, Apgar score, mode of delivery, NICU admission and its duration in NICU care, operative delivery for Caesarean section for acute fetal distress (AFD), intrauterine fetal death (IUFD) and perinatal death.

The mean period of gestation (POG) in this study with normal and abnormal CPI was found to be 38.182 ± 1.250 weeks and 29.867 ± 8.867 weeks respectively which was found to be correlated with the findings of Erskine RLA and Ritchie JWK[8] and Rochelson et al[10] who found out the POG of abnormal doppler flow velocimetry to be less than 37 weeks of gestation. In a study Ch. Lalthantluanga et al (2015)[7] found that abnormal Doppler Velocimetry are associated with low birth weight, low Apgar score, meconium stain liquor and admission to the NICU post delivery which was same finding in our study. We found that abnormal CPI was associated with low birth weight babies (average of 1.756 ± 0.470gms) as compare to normal CPI (2.462 ± 0.383gms). This finding was found to be statistically significant. The 5mins A/S <7 was 9% and 43.5% for CPI >1 and CPI ≤ 1 respectively, which was found to be more than the finding of Gramellini et al (1992)[4] who found 5 min A/S <7 to be 16.6% in CPI ≤ and 2.7% in CPI> 1. Out of 47 IUGR neonates, 31 were admitted in NICU. 29 (74.3%) of them with CPI ≤ 1 and only 2 (18.1%) of CPI >1 were admitted to the NICU after delivery, out of 18.1% of normal CPI and 66.7% of abnormal CPI admitted more than 7days. The meconium staining of liquor was also significantly higher in abnormal CPI than the normal CPI (40.9% versus 14.3%). Thus indicated higher number of fetal distress, meconium stain and meconium aspiration.

In this study 4% IUFD have occurred who saw absent or reverse end diastolic velocimetry of umbilical artery. The perinatal death were 9% and 12.8% in normal and abnormal CPI group respectively. The percentage of patients undergoing caesarean section due to fetal distress was significantly higher in CPI ≤ 1 (71.4%) as compare to the

CPI >1 (26.6%). Sachin Dagade and Snehal Jadhav[11] in their study found abnormal CPI in IUGR cases with increased need for operative delivery for presumed fetal compromise and admission to the NICU. It was found to be consistent with the finding of Khalil A et al[9] who found increase interventional delivery due to higher perinatal compromises in CPI ≤ 1. Eliza B et al[12] in his study of Doppler assessment of intrauterine growth restriction recommended found that Doppler assessment significantly decreases labour induction, caesarean section and perinatal death in IUGR.

CONCLUSION

From our study, we conclude that cerebroplacental index can determine in diagnosis of intrauterine fetal growth restriction and thereby help in management of same. Thus, it will help in reduction of perinatal mortality and morbidity by early diagnosis and management.

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