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COLOUR DOPPLER CHANGES IN IUGR WITH RESPECT TO PULSATILITY INDEX OF UA AND MCA AND CEREBROPLACENTAL RATIO

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ABSTRACT

BACKGROUND : Doppler indices form an integral component of noninvasive evaluation of fetal well-being. There is paucity of information about normal obstetric Doppler indices, particularly from the Indian subcontinent. The aim of the study was to find the values of pulsatility index (PI), resistive index (RI) of umbilical artery (UA), and fetal middle cerebral artery (MCA) and calculate cerebro-placental ratio (CP ratio) for 31–41 weeks of normal gestation.

METHODS : 250 patients were enrolled in the study for color Doppler study of UA and MCA and were serially followed up at 4–6 weeks interval for Doppler indices. Angle-independent Doppler indices like PI and RI for MCA and UA were obtained during each examination. CP ratio was calculated in each case. All the cases were followed up till delivery and the perinatal outcome was recorded.

RESULTS & CONCLUSION : Abnormal cerebroplacental ratio is strongly correlated with IUGR and worse fetal prognosis. Fetuses with abnormal doppler velocimetry have a significantly higher incidence of preterm birth, low birth weight and admission to NICU. Associated risk factors were anemia, PIH, DM, previous history of IUGR, TORCH infection, thyroid disorder. Anemia was found to be common risk factor followed by PIH. In conclusion with the help of non-invasive color Doppler parameters we can identify those pregnancies which are at risk and intervene before the fetus actually become growth restricted and act accordingly for better perinatal outcome.

KEYWORDS : Doppler Indices, Middle Cerebral Artery, Umbilical Artery, Cerebroplacental Ratio

INTRODUCTION

Intra uterine growth retardation (IUGR) is defined as the failure to achieve specific fetal biometric measures or estimated weight (<10th percentile) by a specific gestational age due to some pathologic process that inhibits expression of the normal intrinsic growth potential. IUGR is associated with increased fetal and neonatal morbidity and mortality.

Doppler investigation is an efficient method of surveillance in IUGR monitoring[1]. Hemodynamic changes involve maternal uterine, fetal umbilical (UA), middle cerebral (MCA), umbilical vein (UV) and ductus venosus (DV)[2,3].

The circulation in Umbilical artery (UA) is normally a low-impedance circulation, with an increase in the amount of end-diastolic flow with advancing gestation[4,5].

Umbilical arterial Doppler waveforms reflect the status of the placental circulation, and the increase in end-diastolic flow that is seen with advancing gestation is a direct result of an increase in the number of tertiary stem villi that takes place with placental maturation[6,7].

In 2013, the International Society for Ultrasound in Obstetrics and gynecology (ISUOG) recommended taking Doppler measurements from a free loop cord for the sake of simplicity and consistency[8].

Middle cerebral artery (MCA) is the vessel of choice to assess the fetal cerebral circulation because it is easy to identify, is highly reproducible and it carries more than 80% of cerebral blood flow[9]. In the presence of fetal hypoxemia, central redistribution of blood flow occurs, resulting in increased blood flow to the brain, heart, and adrenals and a reduction in flow to the peripheral and placental circulations. This blood flow redistribution is known as the brain-sparing effect and plays a major role in fetal adaptation to oxygen depri I

vation[10,11].

Here, the purpose of the study is to find out the role of color Doppler ultrasonography in association with IUGR.

MATERIAL AND METHODS

The observational prospective study was conducted in Department of Obstetrics and Gynaecology, MLB Medical College Jhansi from March 2018 to August 2019.

The study was conducted among 250 cases of pregnant women in 31-41weeks of gestation with clinically suspected IUGR. All pregnant women underwent Doppler Velocimetry of umbilical and middle cerebral arteries in coordination with the department of Radio Diagnosis and Imaging.

Full term pregnant women with following criteria were included in the study:
1. Well known last menstrual period.
2. Singleton pregnancy
3. Clinically suspected of IUGR (based on findings such as insufficient weight gain, decrease or no increase in abdominal girth and decrease or no increase in fundal height.)
4. Known cases of pregnancy induced hypertension, gestational hypertension, preeclampsia, eclampsia
5. Known cases of diabetes mellitus, history of TORCH infection.
6. Previous history of IUGR.
7. Based on obstetric grey scale ultrasound FL/AC, HC/AC ratio.

The cases with following criteria were excluded from the study:
i. Wrong dates/LMP not sure
ii. Fetus with congenital anomaly
iii. Not willing to participate
iv. Twin pregnancy

Abnormal Perinatal Outcome was noted as IUGR – birth weight < 10 percentile for the gestational age. And any of the following –
Thick MSL
NICU admission within 72 hrs
Apgar score < 7 at 5 min
Perinatal death

STATISTICAL ANALYSIS

All information collected from the patients were entered in the computer using Microsoft excel. All quantitative data were presented in form of mean and standard deviation. Sensitivity and specificity of the test was calculated. Chi square test applied to calculate statistical association between two qualitative variables. p value <0.05 was considered as statistical significance at 95% confidence interval.

RESULTS

This study was conducted among 250 high risk mothers to study Doppler flow in umbilical artery and middle cerebral arteries. Women in reproductive age group 21-25 yrs present with maximum 45.6% of clinically suspected cases of IUGR followed by age group of 26-30 yrs (31.2%). Most of the women 60.4% belong to rural cases as compared to 39.6% of urban areas.

57.6% of clinically suspected cases of IUGR are primigravida whereas 41.4% are multigravida. Majority of patients of clinically suspected cases of IUGR belong to gestational age 35-37 wks accounting to 32.8%, followed by gestational age 33.1-35 wks accounting to 28.0%.

Table 1: Normal and Abnormal Doppler variables for UA

Doppler variables	UA			
	Normal	%	Abnormal	%
S/D ratio	184	73.6	66	26.4
Pulsatility Index	170	68.0	70	28.0
Resistance Index	168	67.2	82	32.8

Above table shows various abnormal and normal Doppler variables of Umbilical Artery. For Umbilical Artery abnormal S/D ratio was found in 66 cases (26.4%), abnormal Pulsatility Index was found in 70 (28.0%) and abnormal Resistance Index was found in 82 (32.8%).

Table 2: Normal and Abnormal Doppler variables for MCA

Doppler variables	MCA			
	Normal	%	Abnormal	%
S/D ratio	170	68.0	80	32.0
PI	198	79.2	52	20.8
RI	182	72.8	68	27.2

Above table shows various abnormal and normal Doppler variables of MCA. Abnormal S/D ratio was found in 80 (32.0%) cases, abnormal pulsatility index was found in 52 (20.8%) cases and abnormal resistance index was found in 68 (27.2%) cases.

Table 3: Normal and Abnormal Doppler variables for CPR

Doppler variables	CPR			
	Normal	%	Abnormal	%
Pulsatility Index	180	72.0	70	28.0

Above table shows various abnormal and normal Doppler variables of CPR. Abnormal Pulsatility Index was found in 70 (28.05%).

Table 4: UA and MCA and PI and CPR as predictors of IUGR

Artery doppler		Cases with IUGR	Cases without IUGR	Sensitivity	Specificity	P value
UA PI	Normal	88	104	37%	77.6%	p<0.05
	Abnormal	40	30			
MCA PI	Normal	74	124	22.9%	80.5%	
	Abnormal	22	30			
CPR	Normal	34	146	61.7%	90.68%	P<0.05
	Abnormal	55	15			

Table 5 : UA and MCA and PI and CPR as predictors of IUGR

Artery doppler		Thick MSL	Apgar score at <7 min	NICU admission	Perinatal death	
UA	S/D ratio	42	54	64	1	
	PI	55	58	50	2	
	RI	22	28	30	0	
MCA	S/D ratio	35	20	42	1	
	PI	42	18	38	1	
	RI	24	22	25	0	
CPR	PI	54	62	72	5	

Adverse perinatal outcome in terms of fluid MSL low APGAR score, NICU admission, perinatal death were more with abnormal CPR.

Table 6: Distribution according to causes

Causes	No. of cases	Percentage
Hypertension	120	48.0
Anaemia	154	61.60
Diabetes mellitus	7	2.8
TORCH infection	2	0.8
Previous history of IUGR	3	1.2
Hypothyroidism	2	0.8
Others	10	4.0
Total	250	100%

Anaemia is the most common cause found in 61.60% of cases followed by hypertension which accounts in 48.0% of cases.

DISCUSSION

In the present study out of 250 women with suspected IUGR, 99 women (39.61%) were form urban area and 151 women (60.4%) from rural area. Further shows maximum cases 114 (45.6%) in the age group 21-25 years followed by age group 26-30 years (31.2%).

Women below the age group 20 years and 30 years constituted only 13.6% and 9.6%. This is in concordance with the study of Mallik and Saxena (2013)[12]. They found increased risk of IUGR in 21-25 years of age group (47%). The mean age group was 25.5 years in the study by Sharma and Bhatnagar (2010)[13].

In the present study out of 250 mothers 144 (57.6%) mothers were primary gravid whereas 106 (42.4%) were multigravida. Sumangali et al, 2017 reported 52% multiparous and 48% primary and multiparous in their study. Our study commensurate with Wen et al, 1990[14] who found IUGR more common in primary gravid. Malik and Saxena, 2013[12] reported 49% primary gravid in 2013.

UMBILICAL ARTERY EVALUATION

In this study abnormal S/D ratio was present in 26.4% cases, abnormal pulsatility index in 28% cases and abnormal resistance index in 32.8%. The sensitivity of umbilical artery PI was 37% whereas specificity was 77.6%. A study conducted by Gramellini et al (1992)[15] reported 64% sensitivity for PI and a specificity of 70.02% which is concordance with present study.

It also correspond to Fong et al[16] where sensitivity was 44.7% and specificity was 86.6%. In a study by Sharma and Bhatnagar (2010)[13] S/D ratio pulsatility index and resistance index of the umbilical artery is significantly higher in the high risk pregnant women (P<0.001).

MIDDLE CEREBRAL ARTERY

In the present study abnormal S/D ratio was 32%, found in abnormal PI ratio in 20.8% and abnormal resistance index in 27.2%, patients sensitivity for MCA PI was 22.9% whereas specificity was 80.5%. The study is in concordance with the study by Gramellini et al (1992)[15] in which sensitivity was 24% and specificity was 100%. Similar findings with sensitivity 41.6% and specificity of 99.9% was also mentioned in Lakhar et al (2006)[17] whereas Fong I (1999)[16] reported sensitivity of 72.4% and specific 58.1% which do not correlate with our study.

CEREBROPLACENTAL RATIO

In the present study sensitivity of cerebroplacental ratio (CPR) is 61.7% and specificity 90.6%. This corresponds with the study of Gramelline et al (1992)[15] where sensitivity was 68% and specificity 98.4%. Lakhar et al (2006)[17] reported sensitivity of 47.2% and specificity of 86.3%. In another study by Fong et al (1999)[16] sensitivity was 51.3% and specificity 80.6%. All justify the present study. Gramelline et al (1992)[15] highlighted that CPR provide a better diagnostic accuracy than either vessel (RI) considered alone.

The study also evaluated the perinatal outcome in terms of birth weight, APGAR score and NICU admission and found correlation with SD ratio and RI and PI of UA and MCA. A study by Arduini and Rizzo, 1992[18] is an observational cross sectional study of 4 fetal vessel, there was combination of middle cerebral and umbilical artery Doppler velocimetry indices to produce ratio that gave the best method of predicting perinatal outcome. They finally concluded that these ratios of predicted hemodynamic changes in fetus are better than single vessel Doppler indices.

In this study among those women where the cause of IUGR was identified, 61.61% had anaemia, 48% has pregnancy induced hypertension complicating pregnancy. In a study by Devoe and Ramossantos, 1993[19], the association between PIH and IUGR was demonstrated and anemia was found to be most commonly associated.

CONCLUSION

Women in reproductive age group of 21-25 years and primi gravid comprises maximum no. of cases in our study. Abnormal cerebroplacental ratio is strongly correlated with IUGR and worse fetal prognosis. UA PI is more sensitive parameter as compared to MCA PI whereas both are almost equally specific. Fetuses with abnormal doppler velocimetry have a significantly higher incidence of low birth weight and admission to NICU and perinatal morbidity and mortality. Associated risk factors were anemia, PIH, DM, previous history of IUGR, TORCH infection, thyroid disorder, PIH was found to be the most common risk factor. Significant association of IUGR with oligohydramnios was present.

We conclude that with the help of non-invasive color Doppler parameters we can identify those pregnancies which are at risk and intervene before the fetus actually become growth restricted and act accordingly for better perinatal outcome.

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