



A STUDY OF CEREBROPLACENTAL DOPPLER RATIO and PERINATAL OUTCOMES IN INTRAUTERINE GROWTH RESTRICTION AT A TERTIARY CARE CENTRE.

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KEYWORDS :

INTRODUCTION

INTRAUTERINE GROWTH RESTRICTION:

Fetal growth restriction (FGR) is said to be present in those babies whose birth weight is below the 10th percentile of the average for gestational age¹. Growth restriction can occur in preterm, term or post term babies.

Incidence: FGR comprises about one-third of low birth weight babies in developed countries, its overall incidence is about 2-8%. The incidence among the term babies is about 5% and among the post term babies is about 15%.

Intrauterine growth restriction (IUGR) is associated with adverse perinatal outcomes. The use of Doppler velocimetry has been shown to reliably predict these adverse Outcomes².

Recent studies suggest that the Cerebroplacental Doppler Ratio (CPR), which is a ratio of the pulsatility indices of the middle cerebral artery (MCA) to the Doppler indices of the umbilical artery, is a better index for predicting adverse outcomes in IUGR when compared with using either the umbilical artery Doppler values or the MCA values alone^{3,4}.

However, the validity of the CPR appears to vary with gestational age⁷. In an attempt to correct this limitation, Baschat and Gembruch⁷ developed a gestational age-based nomogram for the CPR. To our knowledge, the chart has not been validated by any study. CPR remains constant during last 10 weeks of gestation and so it is having a better diagnostic accuracy.

The aim of this study was to determine the effect of using gestational age-specific reference levels of the CPR on the prediction of adverse perinatal outcomes in cases of IUGR and to evaluate the role of Doppler study in normal and high risk pregnancy in relation to perinatal outcome.

Doppler velocimetry is a rapid non-invasive test that provides valuable information about hemodynamic situation of the fetus and is an efficient diagnostic test of fetal jeopardy that helps in management of high risk pregnancy. The development of Doppler ultrasound evaluation of uteroplacental and fetoplacental circulation is the most important achievements of modern obstetrics. It can be credited to cause a significant decrease in perinatal mortality and morbidity⁸.

Abnormal Doppler findings are associated with fetal growth restriction and have been used as a screening test for fetal stress. Absent or reversed diastolic flow is particularly ominous finding indicating extreme downstream resistance, placental dysfunction and fetal compromise.

Doppler evaluation of blood flow through cerebral vessels might be used to detect altered cerebral circulation before there is hypoxemia significant enough to alter the fetal heart rate pattern.

The present study was conducted to evaluate the diagnostic value Cerebroplacental Doppler Ratio (CPR) in predicting perinatal outcome in high risk pregnancies.

Need of the study

Most common methods for evaluating health in high risk pregnancy are Biophysical profile and Non Stress Test. Unfortunately neither of these are particularly sensitive for predicting poor outcome in high risk pregnancies.

AIMS AND OBJECTIVES

- To analyse the cerebroplacental blood flow ratio using Doppler ultrasound in all pregnant women, especially those who are at high risk to develop IUGR
- To assess the value of cerebroplacental blood flow ratio as an early prediction of fetal growth restriction and analysing the perinatal outcome in IUGR.
- To evaluate the role of Doppler ultrasound in the management of patients with IUGR and to improve perinatal mortality, maternal mortality and morbidity.

MATERIALS AND METHODS

It is a prospective cohort study, Fifty women with high risk pregnancy meeting the inclusion criteria who were admitted in the department of obstetrics and gynaecology, Kurnool medical college, Kurnool from November 2016 to July 2018. This study was approved by ethical committee.

Inclusion Criteria:

Singleton pregnancy with gestational age between 31-40 weeks of gestation with associated risk factors

- Hypertensive disorders of pregnancy.
- IUGR
- Anaemia
- Rh Negative pregnancy
- Bad obstetric history.

Exclusion criteria:

- Morphologically abnormal fetus
- Multiple pregnancy
- Intrauterine death.

Doppler examination was done after recording the destined clinical history of the patients, clinical examination and ultrasound.

Waveforms were obtained for umbilical, uterine and middle cerebral artery and various indices were calculated viz., Pulsatility index (PI), difference between peak systolic and diastolic flow over the mean flow velocities, Resistance index (RI), difference between peak systolic and diastolic flow over systolic flow and S/D ratio – the ratio of peak systolic and diastolic flow.

All data thus calculated was charted, tabulated and analyzed statistically. The different parameters were determined as normal or abnormal for gestational age by using previous studies as reference values. The mode of delivery was tabulated whether vaginal or caesarean. Perinatal outcome of these pregnancies was also studied, in the form of perinatal death, mean Apgar at 1 and 5 minutes, birth weight and admission to neonatal ICU (intensive care unit).

RESULTS

In the present study out of fifty cases of study groups, 45 showed abnormal Doppler indices in any or combinations of the three vessels studied. The remaining 5 cases showed normal Doppler indices in all the three vessels studied. The following were the results of the study.

Table-1: AGE DISTRIBUTION OF CASES.

Age (years)	Study group
< 20	02
20-24	35
25-29	10
>30	03

70% (35 patients) were between 20-24 age group in study group.

Table-2: Gestational age distribution in study group.

Gestational age(Wk)	Study group
31-32	7
33-34	5
35-36	11
37-38	20
39-40	7

Table-3 : Distribution characteristics of placental maturity

Placental grading	Study group
2	15
3	35
Total	50

Table-4: Gravida distribution

Gravidity	Gravida 1	Gravida 2	Gravida 3	Gravida 4	Total
Study group	34	12	2	2	50

Majority 68% in study group were in primigravida

Table- 5 : Amniotic fluid distribution in the study group

Amniotic fluid	Doppler normal	Doppler abnormal	Total
Oligohydramnios	3	17	20
Normal	16	14	30
Total	19	31	50

40%(n=20) had oligohydramnios and 60%(n=30) had normal amniotic fluid

Table 6: Maternal complications of study group

Maternal complications	Number of cases	Percentage
IUGR	20	40
IUGR + Preeclampsia	12	24
IUGR + Chronic hypertension	02	4
IUGR + HELLP SYNDROME	02	4
IUGR + Anaemia	03	6
IUGR + Rh Negative pregnancy	06	12
IUGR + BOH	01	2
IUGR + Antepartum eclampsia	04	8

Table 7: Mode of delivery

Mode of delivery	Normal doppler	Abnormal doppler
EmLSCS	3	19
Vaginal delivery	2	26
Total	5	45

Table-8: Duration between Doppler and delivery

Duration	Normal doppler	Abnormal Doppler
<24 hours	5	16
1-2 days	1	28

Table-9: Adverse outcome Parameters in study and control groups

Pregnancy outcome	No. of cases	Percentage
	Study Group	Study Group
EmLSCS	22	44
Low Apgar Score	11	22
NICU Admission	29	58
Neonatal death	8	16
Low birth weight	42	84
Preterm delivery	23	46

84% of neonates(n=42) had birth weight of less than 2.5 kg. Of the 50 neonates, 29 neonates were admitted to NICU,11 neonates had 5 min Apgar score of less than 7 and 10 babies were born by emergency caesarean section for fetal distress.

Table-10: Normal and Abnormal Doppler Wise Distribution of Cases

Doppler	Number	Percentage
Normal	5	10
Abnormal	45	90
Total	50	100

Table-11: Doppler velocimetry of Umbilical artery and perinatal outcome

	Complications or death		Live or healthy		Total	
Abnormal	23	82.14	5	17.8	28	100
Normal	14	63.3	8	36.6	22	100
Total	37	74	13	26	50	100

Table-12: Doppler velocimetry of middle cerebral artery and perinatal outcome.

	Complications or death		Live or healthy		Total	
Abnormal	26	78.78%	7	21.21%	33	66%
Normal	11	64.7%	6	35.29%	17	34%
Total	27	46%	13	24%	50	100%

Table- 13 : Doppler velocimetry of uterine artery and perinatal outcome.

	Complications or death		Live or healthy		Total	
Abnormal	28	82.3%	6	17.6%	34	68%
Normal	9	56.25%	7	43.75%	16	32%
Total	37	74%	13	26%	50	100%

Table-14: Cerebro-placental ratio (MCA PI/UA PI) and perinatal outcome

Parameters	Complications or death		Live or healthy		Total	
CPR>1	33	82.5%	7	17.5%	40	80%
CPR<1	5	50%	5	50%	10	20%
Total	38	76%	12	24%	50	100%

Table-15: Spectral characteristics of umbilical artery and perinatal outcome.

	No.of cases	Mortality	Percentage
REDF	03	03	100
AEDF	01	01	100

All 3 cases with AEDF and 1 case with REDF had neonatal death.

Table-16: Performance characteristics of Doppler indices.

Parameters	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
Umbilical artery doppler	60%	61%	80%	36.36%	60.41%
Middle cerebral artery doppler	70.2%	46.15%	77.41%	35.29%	64%
Cerebroplacenta l ratio	86.8%	41.6%	82.5%	50%	76%

Cerebroplacental ratio (MCA/UA PI Ratio was most sensitive (sensitivity = 86.8%) than MCA Doppler (sensitivity = 70.2%) and Umbilical artery (Sensitivity =60%)

Umbilical artery doppler was the most specific (Specificity=61%), than Cerebroplacental ratio (Specificity=41.6%) and Middle cerebral artery Doppler (Specificity=46.15%). Cerebroplacental ratio had highest Positive predictive value followed by Umbilical artery Doppler (PPV=80%) and Middle cerebral artery (PPV=77.41%) . Cerebroplacental ratio had highest Negative predictive value (NPV=50%) followed by Umbilical artery Doppler (NPV=36.36%) and Middle cerebral artery (NPV=35.29%). Diagnostic accuracy of Cerebroplacental ratio (Accuracy = 76%) was better than Middle cerebral artery doppler(Accuracy=64%) and Umbilical artery Doppler (Accuracy=60.41%) in predicting adverse outcomes.

DISCUSSION

Intrauterine growth restriction is associated with increased risk of perinatal morbidity, mortality and impaired neurological development. It is a challenge to differentiate the fetus with pathologic growth restriction and hence at risk for perinatal complications from constitutionally small but healthy fetus. Doppler velocimetry is a noninvasive technique that evaluates abnormal fetal haemodynamics that takes place in response to changes in placental resistance. A Doppler index that reflects both of these areas can be useful for identifying foetuses with increased placental and decreased cerebral resistance.

Umbilical artery and middle cerebral artery Doppler ultrasound clearly depicts the information about placental resistance and the changes in the fetal haemodynamics in response to it. Umbilical arteries Doppler

reflects the maldevelopment of the placental tertiary stem villi which increases the placental resistance leading to growth retarded fetus. Middle cerebral artery Doppler has enabled the confirmation of brain sparing effect in IUGR. Hence we chose the UA PI, MCA PI and MCA PI/UA PI i.e., cerebroplacental ratio as the tool for predicting the perinatal outcome in IUGR.

The MCA PI and UA PI values for the corresponding gestational age were compared with reference values given by Harrington et al normograms. MCA PI was considered abnormal when it is less than 5th percentile for that gestational age and UA PI was considered abnormal when it is more than 95th percentile for the corresponding gestational age.

Arbeille et al also found the cerebral-placental ratio constant during the pregnancy and suggested 1 as the cut off value and all values below 1 were considered abnormal. We considered the study of Gramellini et al that cerebroplacental ratio less than 1.08 as abnormal.

We have studied about 50 pregnancies with clinical suspicion of IUGR, Hypertensive disorders of pregnancy, case with anemia, Rh negative pregnancies, Bad obstetric history, Maternal diabetes mellitus. 84% of neonates (n=42) had birth weight of less than 2.5 kg. Of the 50 neonates, 29 neonates were admitted to NICU, 11 neonates had 5 min Apgar score of less than 7 and 22 babies were born by emergency caesarian section for fetal distress. There were 8 neonatal deaths. Of the 8 neonatal deaths, 3 cases had reversal of diastolic flow and 1 had absent diastolic flow.

In our study 10% of patients had normal doppler and 45 cases (90%) had abnormal doppler indices, as compared with other studies present study also had majority of cases with abnormal Doppler.

Cerebroplacental ratio: It had the highest sensitivity value of 86.8% more than Umbilical artery and Middle cerebral artery Doppler.

The highest sensitivity of cerebroplacental ratio indicates its usefulness of cerebroplacental ratio in ruling out the possibility of adverse perinatal outcome in IUGR when the ratio is normal for the gestational age. It showed the specificity of 41.6% which is less than compared to UA PI and better than the MCA PI. The values were comparable with Fong et al study.

The positive predictive values 82.5%. The value was comparable with Gramellini et al study.

The negative predictive value 50% is better than that of UA PI and MCA PI. The values were comparable with that of Fong K W et al and Gramellini et al studies. It indicates that the likelihood of prediction of favourable outcome is better when the cerebroplacental ratio is normal.

In our study when we compare the overall diagnostic accuracy in prediction of adverse outcome in IUGR. Cerebroplacental ratio has the diagnostic accuracy of 76% which is more than UA PI (60.41%) MCA PI (64%). The values obtained in our study are comparable with that of Gramellini et al.

In the present study, majority of the cases (50%) with abnormal Doppler indices had NICU stay.

100% mortality was seen in cases with reversed diastolic flow and absent diastolic flow.

The current study has shown that absent or reversed end-diastolic flow in the umbilical artery is strongly associated with major perinatal morbidity with mortality. This has been well recognized in the literature that there is strict correlation between the abnormal UA PI and poor perinatal outcome in IUGR. Studies have shown that absent and reversed diastolic flow in the umbilical artery is associated with increased perinatal mortality and morbidity.

The primary aim of antepartum fetal surveillance is timely recognition of fetal compromise to enable appropriate intervention and to prevent further serious complications. If the fetus would otherwise die in utero, delivery might save its life, but ill-advised preterm delivery may be followed by postnatal death. Hence Doppler of fetoplacental circulation plays a significant role in predicting the adverse perinatal outcome in IUGR fetus which helps in the management of such foetuses.

Our results in evaluating the usefulness of umbilical artery and middle cerebral artery Doppler, cerebroplacental blood flow ratio in predicting the adverse perinatal outcome in IUGR indicate that both abnormal umbilical Doppler indices and cerebral-umbilical ratio are strong predictors of adverse outcome in IUGR. The MCA PI alone is not a reliable indicator when used alone. The combination and fetal cerebral Doppler indices may increase the utility of Doppler ultrasound in clinically suspected IUGR.

CONCLUSION

In fetal growth restriction, CP ratio reflects both circulatory insufficiencies of placenta and also adaptive changes that occurs in middle cerebral artery, so it appears to be a valuable non-invasive modality for fetomaternal surveillance in IUGR. Abnormal CP ratio is a better predictor of adverse perinatal outcome in IUGR.

Doppler ultrasound plays a significant role in the management of growth restricted fetuses by early identification and thus helps in line of management, obstetrical surveillance.

Hence, Doppler ultrasound especially CP ratio (MCA/UI PI Ratio) should be an integral component of routine evaluation of a suspected IUGR pregnancies and thereby improving adverse perinatal outcome.

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