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''To evaluate the cerebroplacental ratio and it's diagnostic value in the prediction of adverse perinatal outcome''.

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Abstract-,

Introduction- A high-risk pregnancy carries a greater risk to the mother or her fetus than an uncomplicated pregnancy. Pregnancy places additional physical and emotional stress on a woman's body. Health problems that occur before a woman becomes pregnant or during pregnancy may also increase the likelihood for a high-risk pregnancy.

Doppler is a noninvasive method for evaluation of fetoplacental circulation without any disturbance to human pregnancy. It gives 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. Doppler ultrasound technology evaluates umbilical artery (and other fetal arteries) waveforms to assess fetal well-being in the third trimester of pregnancy.

Aims and objectives- ***''To evaluate the cerebroplacental ratio and it's diagnostic value in the prediction of adverse perinatal outcome''*** in patients with abnormal cerebroplacental ratio and timely intervention in these fetus to prevent adverse perinatal outcome.

Material and methods- This study, Prospective observational study, was conducted in the Department of Obstetrics & Gynecology at tertiary care center at central India population periods of 1 Year and 6 Months, from January 2018 to June

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2019. Patients those were attended OPD & got admitted as IPD, at 30-36 weeks of gestation comprised the study population. Only those women who fulfilled the inclusion criteria and were willing to participate in the study voluntarily were included in the study after taking an informed consent.

Results and conclusion - In our study**,** 58% and 42% patients in control group were primigravida and multigravida respectively which was comparable to patients in Case group 56% and 44% respectively. Doppler flow velocity analysis can be valuable in antenatal assessment of SGA, FGR and even in AGA for prediction of late onset growth restriction and perinatal adverse outcome. By noninvasive hemodynamic monitoring of umbilical arteries (Feto-placental circulation) and middle cerebral arteries (fetal-circulation) has been a great help to improve perinatal outcome in pregnancy with comorbidities.

For the prediction of adverse perinatal outcome in women with high-risk pregnancies, the best doppler index according to our study was cerebroplacental ratio (MCA/UA PI ratio). In cases with abnormal doppler, timely interventions lead to improved perinatal outcome. Hence, repeated doppler study in these pregnancies can help to reduce perinatal morbidity and mortality in high-risk cases. This study also suggested that CP ratio has the value for identifying those fetuses at risk for adverse perinatal outcome even their weights was greater than the 10th centile but are at risk for adverse outcome or late onset FGR because of an abnormal or lower CP ratio than 50th percentile value for age specific cutoff value.

INTRODUCTION

Every newborn has the right to be born undamaged mentally and physically. The fulfillment of this goal plays a pivotal role in maternal-fetal medicine, whose sole objective is that every pregnancy should culminate into a healthy baby and a healthy mother.

A pregnancy is considered high risk when there are potential complicating factors that could affect the mother, baby or both. High risk pregnancies require management by a specialist to help ensure the best outcome for the mother and the baby. The risk factors for high risk pregnancy are extremes of maternal age, maternal medical conditions that exist before pregnancy and medical conditions that occur during pregnancy.

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A high-risk pregnancy carries a greater risk to the mother or her fetus than an uncomplicated pregnancy. Pregnancy places additional physical and emotional stress on a woman's body. Health problems that occur before a woman becomes pregnant or during pregnancy may also increase the likelihood for a high-risk pregnancy.

Doppler is a noninvasive method for evaluation of fetoplacental circulation without any disturbance to human pregnancy. It gives 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 [2]. With the introduction of doppler ultrasound examination it became possible to assess the uteroplacental blood flow, feto placental blood flow and to assess the fetal blood circulation. The uteroplacental and fetoplacental circulation give information on the placental resistance whereas evaluating the fetal circulation using doppler ultrasound could non-invasively assess the fetal response to hypoxia. This is become possible to identify those fetuses that were at increased risk of perinatal morbidity and mortality due to impaired uteroplacental and fetoplacental circulations. The use of doppler can be credited leading to a significant decrease in perinatal mortality and morbidity.

The findings on uterine Doppler evaluation predict most occurrences of early onset preeclampsia and intrauterine growth restriction, and its use in these pregnancies improves a number of perinatal outcomes.

Doppler ultrasound technology evaluates umbilical artery (and other fetal arteries) waveforms to assess fetal well-being in the third trimester of pregnancy. It is widely used in high-risk pregnancies to identify fetal compromise and thus reduce perinatal mortality [4, 5]. Therefore, it might also be useful when performed as an antenatal intervention to detect fetal compromise and predict complications, particularly IUGR and pre-eclampsia, in apparently healthy pregnancies. Doppler ultrasound is useful for distinguishing between fetuses that are growth-restricted (FGR) and those that are constitutionally small (SGA)[6]. It can be performed as part of a fetal ultrasound examination or separately. The examination quantifies blood flow through the umbilical artery as either a pulsatility index or a resistive index [7]. A high resistance to blood flow often indicates an increased risk of jeopardy and pre-eclampsia and indicates the need for further investigation.

Umbilical arterial (UA) doppler velocimetry is the most rigorously evaluated tests of fetal well-being[8]. Doppler ultrasound studies of the human fetal circulation have

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shown that in fetuses with circulatory compromise there is a significant reduction of middle cerebral arterial (MCA) pulsatility index when compared with those in normal fetuses[9].By cordocentesis, a significant correlation has been observed between hypoxemia in fetuses with intrauterine jeopardy and an abnormal MCA pulsatility index[10]. UA velocimetry correlates with hemodynamic changes in the fetoplacental circulation. With an increase in the number of tertiary stem villi and arterial channels, as the fetoplacental compartment develops, the impedance in the UA decreases. A diastolic component in the UA flow velocity waveform (FVW) appears during the early second trimester, i.e. at 15 weeks gestation and progressively increases with an increase in the gestational age. A mature UA FVW is usually achieved by 28- 30 weeks. The normal UA waveform pattern shows low impedance and high diastolic flow with a low PI.

Past studies calculated cerebroplacental ratio (C/P RATIO) which is ratio of MCA PI & UA PI and they found that it remained constant in the last 10 weeks of pregnancy. Therefore use a single cut-off value of 1.08 for all cases of 30–41 weeks of gestation. Above this value, doppler velocimetry is considered normal and below it abnormal. Doppler studies of the fetal circulation in intrauterine fetal compromise have demonstrated as increased resistance to flow in the umbilical arteries and redistribution in the fetal circulation with reduced resistance and increased velocity in the internal carotid and middle cerebral artery and the opposite in the descending thoracic aorta [11,12,13]. Doppler investigation of middle cerebral artery in combination with umbilical artery seems to improve prediction of adverse outcome in near-term pregnancies[14]. cerebroplacental ratio, which is the ratio of umbilical artery pulsatility index (PI) & middle cerebral artery pusatility index (PI) can depicts the alteration in compensation to hypoxia in the fetus. The application of cerebroplacental ratio has been well established regarding intrauterine growth restriction, fetal hypoxia, hypertension, fetal anemia and cardiac malformations[15, 16].

The hypothesis that cerebroplacental ratio is effective in reducing mortality and major morbidity in high-risk pregnancy was tested in many trial[17].

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Hence the present study was done at our tertiary care center to evaluate the usefulness of the pulsatility index (PI) of the umbilical artery (UA), fetal middle cerebral artery (MCA) and the cerebroplacental ratio which is the ratio of pulsatility index of middle cerebral and umbilical arteries and it's diagnostic value in the prediction of adverse perinatal outcome.

AIMS AND OBJECTIVES

AIM

- To evaluate the cerebroplacental ratio and it's diagnostic value in the prediction of adverse perinatal outcome.

To emphasize on the importance of altered cerebroplacental ratio in predicting the adverse perinatal outcome in patients with abnormal cerebroplacental ratio and timely intervention in these fetus to prevent adverse perinatal outcome.

Materials and methods-

This study, Prospective observational study, was conducted in the Department of Obstetrics & Gynecology at Tata Main Hospital, Jamshedpur, Jharkhand, periods of 1 Year and 6 Months, from January 2018 to June 2019. Patients those were attended OPD & got admitted as IPD to Tata Main Hospital at 30-36 weeks of gestation comprised the study population. Only those women who fulfilled the inclusion criteria and were willing to participate in the study voluntarily were included in the study after taking an informed consent.

Inclusion criteria:

1. Singleton pregnancy.

2. The gestational age of patient should be between 30 to 36 weeks

3. At least one of the following risk factors was present in the study group of patients.

gestational hypertension, essential hypertension, prior neonatal death, diabetes mellitus, malnutrition, anemia

Exclusion criteria-

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1.multiple pregnancy

2.congenital anomalies in the fetus.

Outcome was calculated as:

- Perinatal outcome - in terms of apgar score ,admission in nicu, and days of stay in nicu, still birth/perinatal death
- Obstetrical outcome: in terms of mode of delivery
- Abnormal cerebroplacental ratio, adverse perinatal outcome, abnormal doppler pulsatility index was assessed in terms of maternal age & gravidity.

2. Methodology

Women who visited ANC OPD and who got admitted in the ward and who fulfilled the inclusion criteria and women who has no comorbidity as control were enrolled in the study between 30 to 36 weeks of gestation, after taking the written informed consent in their local language.

A detailed history was taken with regard to period of amenorrhea. The menstrual history with reference to LMP was taken and period of gestation calculated. The women was asked for any significant past and family history. A detailed general examination was done. Per abdomen examination was done to determine the fundal height, the lie, position and presentation of the fetus. Fetal heart rate(FHR) was auscultated.

Ultrasound with doppler study was done and cerebro-placenta ration was calculated with middle cerebral artery and umbilical artery pulsatility index. The Doppler determinations done by same consultant for all study. Waveforms of good quality were collected and analyzed in the absence of fetal breathing movements; on average,3 separate readings were performed. During the examination, the women were in a semi-recumbent position with the head and chest slightly elevated. The recording was performed during periods of fetal apnea, because of a potential effect of fetal breathing movements on waveform variability.

Perinatal outcomes were measured.

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OBSERVATION & RESULTS

Table no. :- 01 Comparison of demographic parameters between two groups.

Parameters		Case (n=50)		Control (n=50)		P value	Results
		No.	Percentage	No.	Percentage		
Age (Mean ± S.D)		26.80 ± 4.31		26.28 ± 4.61		0.5615	Not Significant
Gravidity	G_1	28	56%	29	58%	0.8898	Not significant*
	G_2	17	34%	15	30%		
	$\geq G_3$	5	10%	6	12%		
Gestational age (μ ± δ) at doppler usg		34w+2d ± 1w+2d		34w+4d ± 1w+1d		0.1521	Not significant**

-There were statistically no significant difference between two groups according to their

mean age, gravidity and mean gestational age, with p – value { $p > 0.05$ } .

Table no. :- 02 Distribution of patients according to age

Age (in year)	Case (n=50)		Control (n=50)	
	No.	%	No.	%
< 25 years	17	34%	19	38%
25 – 35 years	31	62%	31	62%
>35 years	2	4%	1	2%

-There were statistically not significant difference between two groups , according

to their , with p – value = 0.3480 { $p > 0.05$ } .

-There were statistically no significant difference between two groups , according to their gravidity , with p – value = 0.9998**{ p> 0.05}.**

Table no. :- 03 Distribution of case and control with gestational age of doppler ultrasound.

Gestational age (in weeks)	Case (n=50)		Control (n=50)		Total	P value
	No.	%	No.	%		
30 – 32^{+6} weeks	10	20%	6	12%	16	**0.4533**

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33 – 34^{+6} weeks	12	24%	16	32%	28	**0.5708**
35 – 36 weeks	28	56%	28	56%	56	**0.8937**
Gestational age (μ ± δ)at doppler usg	34w+2d ± 1w+2d		34w+4d ± 1w+1d		0.1521	**Not significant****

-There were statistically no significant difference between two groups according to their

gestational age , with p – value { p >0.05 }.

-There were statistically significant difference between two groups , according to their gestational age at delivery , with p – value {p <0.0001} showed that in case group there were need of termination of pregnancy before term to reduce the perinatal morbidity.

-There were statistically significant difference between two groups, according mode of delivery, with p – value { p < 0.05 } showed that there were need of LSCS more in case group and vaginal delivery were more in control group .

Table no. :- 04 Comparison of mode of delivery with CP ratio value.

Mode of delivery	**Case (n=50)**				**Control (n=50)**				**P value**	**Results**
	<1 (n=11)		**>1 (39)**		**<1(n=0)**		**>1(n=50)**			
	N	**%**	**N**	**%**	**N**	**%**	**n**	**%**		
LSCS	10	90.90	34	87.17	0	0	30	60.0	0.0138	Significant
NVD+VD	1	9.10	5	12.83	0	0	20	40.0	0.5146	Not significant

-There were statistically significant difference between two groups , according to their mode of delivery as LSCS in case group with abnormal CP ratio (p – value < 0.05) but not significant in NVD+VD,as Thus cerebroplacental ratio < 1 has more significant probability for the need of emergency LSCS as mode of delivery interms to reduce adverse perinatal outcome.

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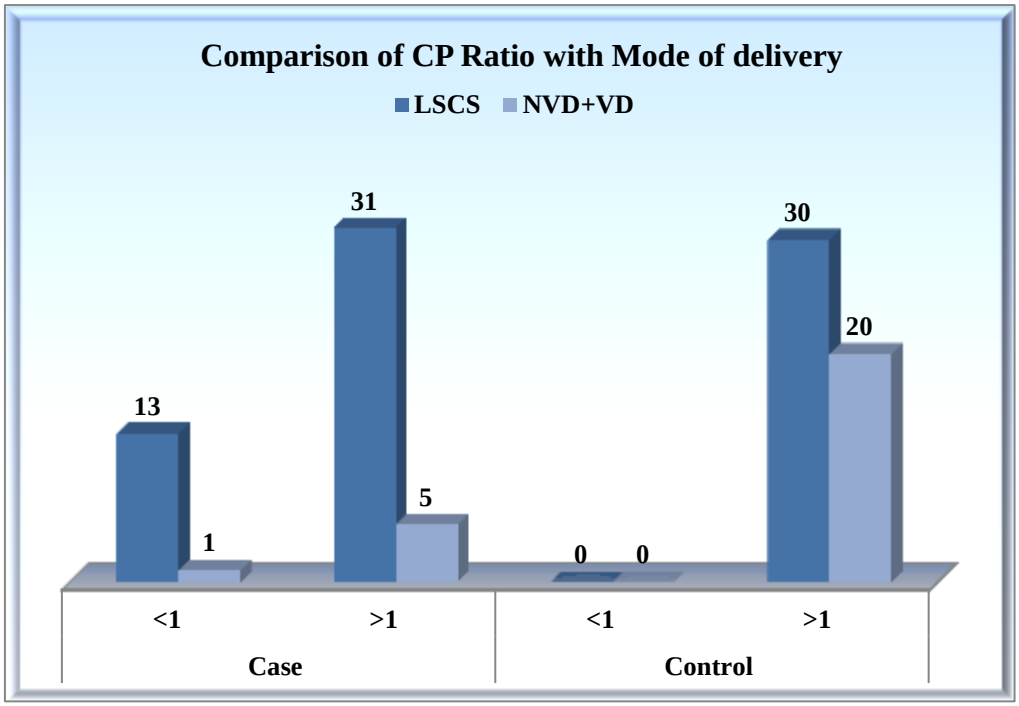

Table no. :- 05 Distribution of patients according to high risk in case group

High risk	Case (n=50)	
	No.	Percentage
ANEMIA	23	46%
CHRONIC HTN	4	8%
DM	7	14%
GDM	21	42%
PE	41	82%
GEST HTN	2	4%

- Majority of the patient had preeclampsia as a high risk factor.

Table no. : 06- Comparison of UA PI between groups with gestational age specific cutoff value

UA PI	Case (n=50)		Control (n=50)		$\|z\|_{cal}$	p-value
	No.	%	No.	%		
≤ 1.4	38	76%	49	98%	0.0184	significant
>1.4	12	24%	1	2%		

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-There were statistically significant difference between two groups , according to their UA PI value , with p – value { p <0.05 } ,showed that in high risk pregnancies more proportion of the patient had umbilical artery resistance more than gestational age specific cutoff value -----in comparison with normal pregnancies**.**

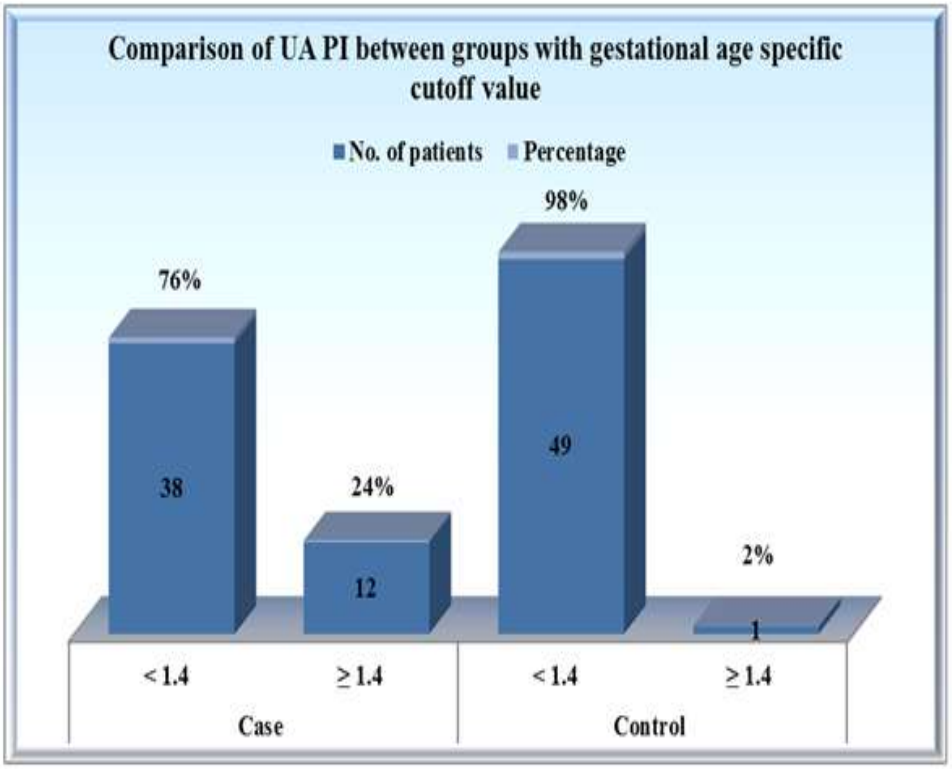

Table no. :7 -Comparison of MCA PI gestational age specific cutoff in case and control

MCA PI	Case (n=50)		Control (n=50)		$\|z\|_{cal}$	p-value
	No.	%	No.	%		
< 1.5	31	62%	13	26%	**0.0004**	**Significant**
≥ 1.5	19	38%	37	74%		

-There were statistically significant difference between two groups , according to their MCA PI value, with p – value {p < 0.05}, showed that in high risk pregnancies

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more proportion of the patient had umbilical artery resistance more than gestational age specific cutoff value in comparison with normal pregnancies**.**

Table no. :8 - Comparison of CP Ratio in case and control groups

CP Ratio	Case (n=50)		Control (n=50)		$\|z\|_{cal}$	p-value	Results
	No.	%	No.	%			
< 1	14	28%	0	0%	10.215	0.0002	Significant
≥ 1	36	72%	50	98%			

-There were statistically significant difference between two groups , according to their CP ratio , with p – value {p <0.05},which predicted the adverse perinatal outcome in high risk group with abnormal CP ratio

Table no. :9- Prediction of adverse perinatal outcome according to doppler indices : performance characteristics

Criteria	Sensitivity	Specificity	PPV	NPV	Prevalence	AUC
UA PI >1.4	24%	98%	92.31%	56.32%	50%	0.61
MCA PI <1.5	62%	74%	70.45%	66.07%	50%	0.68
MCA/UA PI <1	**28%**	**100%**	**100%**	**58.14%**	**50%**	**0.64**

PPV: Positive Predictive value , NPV : Negative Predictive value, AUC: Area under curve

-Showed among all the doppler indices evaluated, MCA/UA PI <1.0 showed the highest specificity (100.0%), the highest positive predictive value (100.0%) and higher negative predictive value (58.14%) with low sensitivity(28%) in the prediction of overall perinatal outcome. This showed that an abnormal CP ratio was always recognized fetal jeopardy with cerebroplacental insufficiency.

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Table no-:10 Comparison of patients according to adverse perinatal outcome.

Adverse Perinatal outcome	Case (n=50)		Control (n=50)		P value	Results
	No.	Percentage	No.	Percentage		
Need of ventilator	5	10%	0	0%	0.0665	Not Significant
NICU admission >2 days	14	28%	0	0%	0.0002	Significant
Premature birth	42	84%	3	6%	<0.0001	Significant
RDS	15	30%	0	0%	<0.0001	Significant
NEC	1	2%	0	0%	1	Not Significant
LSCS for fetal distress	21	42%	8	16%	0.0082	Significant
5 min Apgar <8	6	12%	1	2%	0.1162	Significant
IUD	1	2%	0	0%	1	Not Significant
NND	0	0%	0	0%	Not applied	
Still Birth	0	0%	0	0%	Not applied	

For test of significance, here we use "Chi – square proportion Test {χ2 – Test}"

-Among cases there were statistically significant adverse perinatal outcomes in terms of NICU admission >2 days ,premature birth, RDS, LSCS for fetal distress,5 min Apgar <8 .

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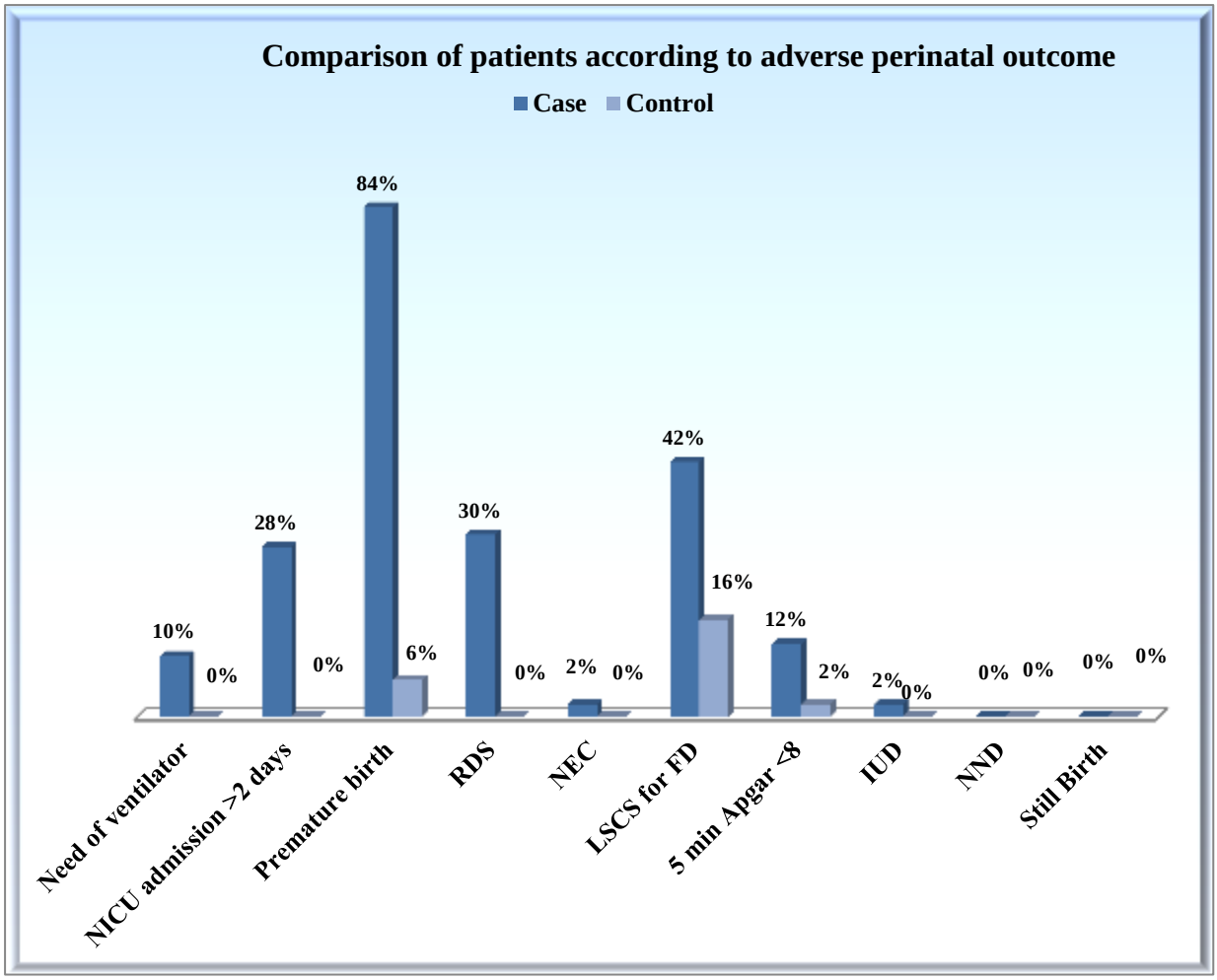

-No significant association between CP ratio and maternal gravidity.

-CP ratio and maternal age both were independent to each other, no significant association was found.

Table no:11 probability of adverse Perinatal outcome by cerebroplacental ratio

Adverse Perinatal outcome	CP Ratio <1				CP Ratio >1				P value	Result
	Case n=11	%	Control n=0	%	Case n=39	%	Control n=50	%		
Need of ventilator	4	36	0	0	1	9	0	0	0.0027	S
NICU admission >2 days	9	82	0	0	5	45	0	0	0.0002	S

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Premature birth	11	100	0	0	31	79	3	6	<0.0001	S
RDS	8	73	0	0	7	18	0	0	0.0001	S
NEC	0	0	0	0	1	3	0	0	0	NS
LSCS for FD	10	91	0	0	11	28	8	16	0.0082	S
5 min Apgar <8	4	36	0	0	2	5.1	1	2	0.0360	S
IUD	1	9.1	0	0	0	0	0	0	0	NS
NND	0	0	0	0	0	0	0	0	0	0
Still Birth	0	0	0	0	0	0	0	0	0	0

-Abnormal CP ratio in high risk pregnancies had significantly probability of adverse perinatal outcome as need of ventilator, NICU admission >2 days, premature birth, RDS, LSCS for fetal distress, 5 min Apgar <8 but not significant correlation with NEC,IUD.

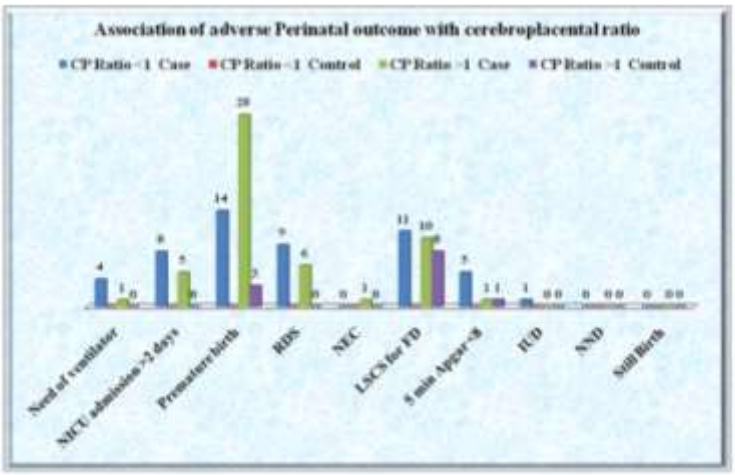

Table no.12: Diagnostic performance of cerebroplacental ratio for adverse perinatal outcome

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Adverse Perinatal outcome	Sensitivity	Specificity	PPV	NPV
Need of ventilator	36.36%	97.44%	80%	84.44%
NICU admission >2 days-ok	81.82%	87.18%	64.29%	94.44%
Premature birth	100%	20.51%	26.19%	100%
RDS	72.73%	82.05%	53.33%	91.43%
NEC	0%	100%	0%	78%
LSCS for FD	90.91%	71.79%	47.62%	96.55%
5 min Apgar <8	36.36%	94.87%	66.67%	84.09%
IUD	9.09%	100%	100%	79.59%
NND	0%	100%	0%	78%
Still Birth	0%	100%	0%	78%

Table no.13- Adverse Perinatal outcome with High risk Factors.

Adverse Perinatal outcome	High risk						
	ANEMIA +DM (n=27)	CHRONIC HTN (n=4)	DM+PE (n=44)	GDM+PE (n=44)	PE (n=44)	GEST HTN+GDM (n=21)	P value
Need of ventilator	2	1	4	4	4	1	0.5140
NICU admission >2 days	11	1	13	12	12	5	0.0224
Premature birth	23	3	38	36	36	18	<0.0001
RDS	9	1	14	14	14	8	0.0199
NEC	1	0	1	1	1	0	1
LSCS for FD	15	1	20	19	19	10	0.0016
5 min Apgar <8	5	1	5	5	5	1	0.3243
IUD	1	0	1	1	1	0	1
NND	0	0	0	0	0	0	0
Still Birth	0	0	0	0	0	0	0

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For test of significance, here we use "Multivariate analysis"

-Most significant predicted adverse neonatal outcome were NICU admission >2 days, Premature birth, RDS, LSCS for fetal distress in high risk pregnancies. Multivariate analysis showed that preeclampsia in combination with other comorbidities was the most important risk factor affecting outcome.

Table: 14-Comparison of mean UA PI , MCA PI and CP Ratio between case and control

Mean ± S.D	Case (n=50)	Control (n=50)	$\|t\|_{cal}$	p-value
UA PI	1.07 ± 0.34	0.92 ± 0.14	0.0039	Significant
MCA PI	1.39 ± 0.45	1.68 ± 0.31	0.0003	Significant
CP Ratio	1.47 ± 0.81	1.83 ± 0.39	0.0056	Significant

-Hence, there were Statistically significant difference between two groups, according to their UA PI , MCA PI and CP Ratio mean with p – value { $p < 0.05$ } .

In normal pregnancy the umbilical artery PI showed the lower mean because lower resistance of umbilical artery and middle cerebral artery PI showed a higher mean because MCA has higher resistance usually but in brain sparing effect this resistance decreases. Ratio of both artery's PI showed higher mean in normal pregnancy.

Here in comparison with normal group, the high risk group showed higher mean of the umbilical artery PI and middle cerebral artery PI showed lower mean and ratio of both PI mean was found lower.

-Out of 36 AGA fetuses with normal CP ratio at time of ultrasound doppler examination in high risk pregnancies ,8 were FGR at birth and we observed that out of which 7 (88%) had CP ratio value was below the 50^{th} centile of reference range at time of doppler examination in spite >1 ratio .This observation could might have been predicted the risk of developing cerebroplacental insufficiency and FGR later in these fetuses and ANC visits frequency for doppler ultrasound could be planned accordingly.

Discussion

Intrauterine morbidity as growth restriction does not imply a specific pathophysiology but merely a result of a series of events occurring along several possible pathways.

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Hence, accurate antenatal diagnosis must decide to minimize fetal and neonatal morbidity which can happens as a consequence of impaired placental perfusion.

The purpose of current study was for prediction of adverse perinatal outcome in women with high-risk pregnancies, the best doppler index according to our work is MCA/UA PI ratio.

The age distribution in our study showed that majority of the patients (62%) in cases were in the age group of 25-34 years followed by 34% in the age group of <25 years and 4% in the age group of >35 years. Majority of the patients (62%) in controls were in the age group of 25-34 years followed by 38% in the age group of <25 years and 2% in the age group of >35 years. There was no significant difference between the groups as per Student t-test ($p>0.05$).

In our study**,** 58% and 42% patients in control group were primigravida and multigravida respectively which was comparable to patients in Case group 56% and 44% respectively.

In our study table-4, mean gestational age at time of examination was 34w+2d ± 1w+2d weeks in cases and 34w+4d ± 1w+1d weeks in Control.

In our study-table-5, the mean gestational age at delivery in cases was 35week 2days ± 1week 2days and in control was 38weeks 2days ± 6 days and both the groups were compared according to mode of delivery, there were statistically significant difference between two groups showed that in case group there were need of LSCS as mode of delivery before term to reduce the perinatal morbidity.

In our study, control group, 1 patient (2%) had umbilical artery PI ≥1.40 (gestational age specific cut off value), while 49 ,(98%) had umbilical artery PI ≤1.40, and in the study group, 12 patients (24%) had umbilical artery PI above the gestational age specific cutoff value and 38 (76%) had umbilical artery PI below the gestational age specific cutoff value. The difference between two groups was statistically significant showed that in high risk pregnancies more proportion of the patient had umbilical artery resistance more than gestational age specific cutoff value in comparison with normal pregnancies**.**

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In our study, showed that in control group, 13 (26%) patients had MCA PI <1.50, 37 (74%) patients had PI ratio ≥1.50 while in the case group, only 31(62%) had PI ratio below the 2gestational age specific cutoff value and 19 (38%) had PI ratio above the gestational-age-specific cutoff value. The difference between two groups was statistically significant. MCA PI was significantly lower in fetus with jeopardy due to **Brain sparing effect.** The MCA doppler studies define the fetal response to abnormal placental function. There is cerebral vasodilation with redistribution of the blood flow from the fetal periphery to the brain known as "brain sparing effect", an adaptive phenomenon which occurs initially for some time[124]. The MCA PI and RI values change throughout normal pregnancy.

Table-11 showed MCA/UA PI ratio (CP ratio) in the study population using a single cutoff value of 1.00. No patient (0.00%) in the control group had MCA PI/UA PI ratio<1.00, i.e., all of the patients (100.0%) had the ratio value more than the cutoff value. However, 14 (28%) patients in the study group had MCA/UA PI ratio <1.00 and 36 (72%) had >1.00. Difference between two groups was statistically significant which predicted the adverse perinatal outcome in high risk group with abnormal CP ratio. **Rozeta S et al(2010)** in their study ,the study population was divided into 2 groups based on the MCA/UA ratio. Group A, MCA/UA ratio>1 (n=424); group B MCA/UA ratio <1 (n=314) and there was a statistical significant difference in gestational age at delivery between two groups, route of delivery and between two groups.

Shahina Bano et al(2010) had 20 of the 90 pregnancies showed an abnormal C/U ratio (<1.08). Of these, 20 (100%) fetuses were SGA and all had an adverse perinatal outcome and 70 pregnancies had normal CP ratio (>1.08).

D Gramellini,MC Folli et al13(1992)[21] studied 45 normal growth and 45 growth retarded fetuses between 30-41 weeks gestation. Velocity readings were obtained from middle cerebral artery and umbilical artery to calculate the ratio between the two pulsatility indexes. The cerebral umbilical Doppler ratio is usually constant during the last 10 weeks of gestation. Therefore a single cut off value of (1.08) was used, above which velocimetry was considered normal and below which it was considered abnormal.

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In our study recognized that in comparison with normal group, the case group had higher mean of the umbilical artery PI and middle cerebral artery PI showed lower mean and ratio of both PI mean was found lower. In normal pregnancy the umbilical artery PI showed the lower mean because lower resistance of umbilical artery and middle cerebral artery PI showed a higher mean because MCA has higher resistance usually but in brain sparing effect this resistance decreases. Ratio of both artery's PI showed higher mean in normal pregnancy

In our study showed that abnormal CP ratio in high risk pregnancies had significantly probability of adverse perinatal outcome as need of ventilator, NICU admission >2 days, premature birth, RDS, LSCS for fetal distress, 5 min Apgar <8 but not significant correlation with NEC, IUD. **Malik et al**[3]found that cases with abnormal CP ratio were 62 out of which 27 cases were delivered by LSCS for fetal distress.

Rozeta S et al. in their study there was a significant increase in perinatal deaths in cases with abnormal MCA/UA PI ratio, 97 cases (30.8%) versus1 case (0.23%) (P <0.0001). All the stillbirths were There was a significant increase in perinatal deaths in cases with abnormal MCA/UA PI ratio, 97 cases (30.8%) versus1 case (0.23%) (P <0.0001). Perinatal morbidity is increased significantly in the group with abnormal MCA/UA pulsatility index comparing to the group with normal MCA/UA pulsatility index ratio; 202 neonates (77.6%) versus 201 neonates (47.4%) were admitted to neonatal intensive care unit (NICU) (P<0,0001). There is a significant difference between the duration (in days) of treatment at neonatal intensive care unit (10.6 days versus 6.5 days) (P<0.0001). It was found to be more neonates with Apgar scores less than 7 at 5 minute in the group with abnormal MCA/UA PI ratio than in group with normal MCA/ UA PI ratio 161 (61.9%) versus 95 (22.4%) (P<0.0001). It was found a statistically difference between two groups for cesarean delivery for fetal distress and IUGR.

The outcomes were, showed that in the control group, there were no stillbirth, no NICU admission >2 days, 3(6%) premature birth, 8(16%) delivered by LSCS due to fetal distress, 1(2%) had <8 apgar in 5 min. In the case group, there was no stillbirth,1 IUD, 5(10%) cases were in need of ventilator, 14(28%) had NICU admission >2 days, 42(84%) had premature birth, 15(30%) had respiratory distress syndrome, 1(2%) had

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necrotizing enterocolitis, 21(42%) had cesarean section due to fetal distress, and 6(12%) had Apgar score<8 in 5 min. Among cases there were statistically significant adverse perinatal outcomes in terms of NICU admission >2 days ,premature birth, RDS, LSCS for fetal distress,5 min Apgar <8 .

In our study recognized most significant predicted adverse neonatal outcome were NICU admission >2 days, Premature birth, RDS, LSCS for fetal distress in high risk pregnancies. Multiple logistics regression analysis showed that preeclampsia in combination with other comorbidities was the most important risk factor affecting outcome.

Among all the doppler indices evaluated, MCA/UA PI <1.0 showed the highest specificity (100.0%), the highest positive predictive value (100.0%) and higher negative predictive value (58.14%) with low sensitivity(28%) in the prediction of overall perinatal outcome. An abnormal CP Ratio was a better predictor for adverse perinatal outcome also need of an intervention as emergency cesarean delivery and This showed that an abnormal CP ratio was always recognized fetal jeopardy with cerebroplacental insufficiency than an abnormal UA or MCA.

In our study showed diagnostic performance of CP ratio for individual adverse perinatal outcome as for:

Need of ventilator	low sensitivity but **more specific ,high PPV, NPV**
NICU admission >2 days	Higher sensitivity ,specificity, NPV, high PPV
Premature birth	Highest sensitivity ,NPV
RDS	Higher sensitivity, specificity, NPV ,low PPV
NEC	Highest specificity ,higher NPV
LSCS for FD	Higher sensitivity, specificity, NPV ,low PPV
5 min Apgar <8	Low sensitivity but more specific ,high PPV, NPV
IUD	Low sensitivity ,highest specificity, PPV, higher NPV
NND	Highest specific, high NPV
Still Birth	Highest specific, high NPV

Prior et al. studied that no fetuses with a CP ratio greater than the 90th centile required cesarean delivery for fetal distress in labor. Therefore in high risk pregnancy, assessment of the CP ratio in AGA fetuses before active labor

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predicted intrapartum fetal compromise and the need for emergency cesarean delivery.

Cruz-Martinez et al evaluated the 210 fetuses at greater than 37 weeks of gestation suspected of having late-onset SGA and reported an abnormal CPR was associated with a significantly higher rate of emergency cesarean delivery for fetal distress in labor (37.8% vs 20.4%, p <0.001) and was a better predictor than an isolated MCA measurement.

-When an abnormal CP ratio was present, there was a significantly higher rate of fetal distress requiring emergent delivery. In addition, fetuses with an abnormal CP ratio also had higher rate of newborn intensive care unit (NICU) admissions. They found the best predictors for identifying fetuses at risk for emergency cesarean delivery in labor were the following: (1) an abnormally low CP ratio (2) an estimated fetal weight less than the third centile. CP ratio reflects the status of redistribution of the cardiac output to the cerebral circulation, which improves accuracy in predicating adverse outcome compared to MCA and
UA Doppler alone.

In our study CP ratio appears to identify late-onset FGR fetuses at increased risk for adverse intrapartum and neonatal complications. Because the majority of these fetuses have a normal doppler resistance but CP ratio value was below 50th centile for gestational age specific value and our observation was that out of 36 AGA fetuses with normal CP ratio at time of ultrasound doppler examination in high risk pregnancies ,8 were FGR at birth and we observed that out of which 7 (88%) had CP ratio value was below the 50^{th} centile of reference range at time of doppler examination in spite >1 ratio .This observation could might have been predicted the risk of developing cerebroplacental insufficiency and FGR later in these fetuses and ANC visits frequency for doppler ultrasound could be planned accordingly.

CONCLUSION

This study was conducted in department of obstetrics and gynecology, from January 2018 to June 2019 to evaluate the cerebroplacental ratio which is the ratio of pulsatility index of middle cerebral and umbilical arteries and it's diagnostic value in the prediction of adverse perinatal outcome and to emphasize on the importance of altered cerebroplacental ratio in predicting the adverse perinatal outcome in patients

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with abnormal cerebroplacental ratio and timely intervention in these fetus to prevent adverse perinatal outcome.

Doppler flow velocity analysis can be valuable in antenatal assessment of SGA, FGR and even in AGA for prediction of late onset growth restriction and perinatal adverse outcome. By noninvasive hemodynamic monitoring of umbilical arteries (Feto-placental circulation) and middle cerebral arteries (fetal-circulation) has been a great help to improve perinatal outcome in pregnancy with comorbidities.

For the prediction of adverse perinatal outcome in women with high-risk pregnancies, the best doppler index according to our study was cerebroplacental ratio(MCA/UA PI ratio). In cases with abnormal doppler, timely interventions lead to improved perinatal outcome. Hence, repeated doppler study in these pregnancies can help to reduce perinatal morbidity and mortality in high-risk cases .This study also suggested that CP ratio has the value for identifying those fetuses at risk for adverse perinatal outcome even their weights was greater than the 10th centile but are at risk for adverse outcome or late onset FGR because of an abnormal or lower CP ratio than 50^{th} percentile value for age specific cutoff value.

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