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EVALUATION OF PLACENTAL ANEMIA USING THE MIDDLE CEREBRAL ARTERY AND UMBILICAL ARTERY INDEX THROUGH THE CEREBRAL PLACENTAL RATIO

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ABSTRACT

This study is to investigate fetal hemodynamics in pregnant women suffering from severe anemia, a condition prevalent in Pakistan where a hypoxic environment is common. Severe maternal anemia during pregnancy poses significant risks to both the mother and the fetus. Using advanced diagnostic techniques such as Doppler ultrasound, we will measure various parameters of fetal blood flow and vascular resistance. This will provide a detailed understanding of how the fetus compensates for the lack of oxygen.

The objective of the study is to evaluate the placental anemia using umbilical artery and middle cerebral artery index through the cerebral placental ratio. Maternal anemia is a hypoxic condition that could be responsible for the redistribution of fetal blood flow.

This study includes 155 pregnant women from Kishwar Sultana Hospital. Ultrasound was performed on all patients. Statistical analysis was performed using SPSS v 25.0

Out of 155 patients,38 women (24.5%) age is 19 to 23 years, 55 women (35.5%) age is 24 to 28 years, 58 women (37.4%) age is 29 to 33 years, and 4 women (2.6%) age is more than 34 years. Out of 155 pregnant women,29 women (18.7%) with history of hypertention,37 women (23.9%) with history of diabetes, 32 women (20.6%) with history of hypertension and diabetes and 57 women (36.8%) with no history. Out of 155 pregnant women,17 women (11%) with gestational age 21-25, 61 women (39.4%) with gestational age 26-30, 66 women (42.6%) with gestational age 31-35 and 11 women (7.1%) with gestational age more than 36. Out of 155 pregnant women, 91 women (58.7%) with parity 0-1 and 64 women (41.3%) with parity 2-3. Cerebroplacental ratio is highly sensitive in diagnosing hemodynamically compromised fetuses and very useful for the prediction of adverse perinatal outcome in these fetuses.

Keywords: *Cerebro placental ratio, Middle Cerebral Artery, Umbilical artery*

INTRODUCTION

Doppler ultrasonography (DU) velocimetry of fetal and uterine vessels is a well-established method for antenatal monitoring. Certain Doppler waveforms indicating circulatory changes can be used to predict adverse perinatal outcomes[1]. Doppler was successfully introduced in obstetric imaging and fetal monitoring way back in 1977 [2].

Fitzgerald et al. (2017) were the first to report noninvasive demonstration of the umbilical cord (UC) blood flow pattern and suggested that the umbilical artery (UA) waveforms could be abnormal in fetuses with intrauterine growth-restriction (IUGR) [3]. This breakthrough concept of studying waveforms also resulted in several important clinical applications. Doppler assessment of the UA has now become the standard of care

in antenatal surveillance [4]. Doppler assessment of the fetal middle cerebral artery (MCA) had also been widely used for the diagnosis of fetal anaemia [5].

DU waveforms not only reflect blood velocity but also provide information on various aspects of blood flow like presence and direction of flow, velocity profile, flow volume, and impedance. Angle-independent Doppler indices were developed for flow velocimetry to avoid inter- and intraobserver variation, and these are widely in use today.[6]

Among all vessels studied in DU, the UA and MCA are relatively easier to access and evaluate and are reported to be more reproducible. MCA of fetuses had been extensively studied for evaluation of placental compromise and fetal anaemia [7]. Combining the Doppler indices of the MCA with that of the UA by the ratio of their pulsatility indices, also known as cerebro-placental ratio (CP ratio), is a useful tool for monitoring fetal health. A low CP ratio indicates relative redistribution of the blood flow to the cerebral circulation and is found to increase accuracy in envisaging complications and adverse outcomes as compared to MCA or UA Doppler indices alone [8]. This ratio has now been increasingly used in the surveillance of the fetus at risk by repeating the Doppler studies at regular intervals.

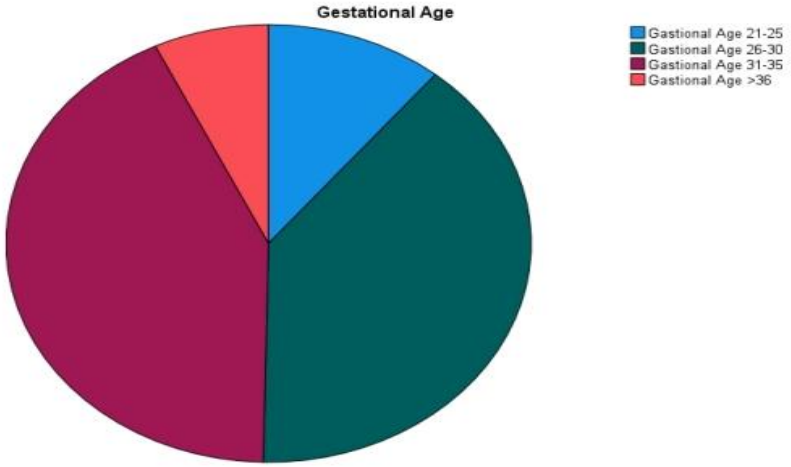
Maternal anemia is frequently associated with premature delivery, reduced neonatal weight, infant iron deficiency neonatal death, and low Apgar scores at 1 min [9-12]. It is also suspected to reduce the oxygen supply to the growing fetus, leading to the redistribution of fetal blood flow [13]. In the presence of fetal hypoxemia, fetal blood flow becomes centrally distributed to preserve cerebral oxygenation, known as the brain-sparing reflex; this plays a major role in fetal adaptations to oxygen deprivation. Maternal anemia is a hypoxic condition that could be responsible for the redistribution of fetal blood flow; however, no evidence of placental insufficiency has been documented currently [13]. The combination of increased placental resistance and decreased cerebral resistance, measured using Doppler ultrasonography, is quantified by calculating the cerebral-to-umbilical artery resistance ratio [14]. This Doppler parameter is not influenced by the duration of a pregnancy and is always greater than 1.1 during normal pregnancy [15,]

Method:

This Prospective cohort study was conducted at the Radiology Department of Kishwar Sultana Hospital of Lahore for 4 months.The study received approval from the institutional ethical review board.The study include 155 pregnant women (age 19-37).Patients with twin pregnancy and other congenital abnormalities were excluded.ultrasound was performed using a transducer between 3-5 MHz. Measure the Systolic/Diastolic (S/D) ratio, Pulsatility Index (PI), and Resistance Index (RI) of MCA and Umbilical artery. Calculate the CPR by dividing the MCA PI by the UA PI.Data were analyzed using SPSS version 25.0. Senstivity ,specificity and accuracy were calculated using standard formulas.Chi-square tests were used to evaluate categorical variables, and p-value <0.05 were considered statistically significant.

Results:

This study include 155 pregnant women with mean maternal age 1.18,median 1.00 and standard deviation 0.833.Out of 155 patients,38 women (24.5%) age is 19 to 23 years, 55 women (35.5%) age is 24 to 28 years, 58 women (37.4%)age is 29 to 33 years and 4 women (2.6%) age is more than 34 years.Out of 155 pregnant women,29 women (18.7%) with history of hypertention,37 women (23.9%) with history of diabetes, 32 women (20.6%) with history of hypertention and diabetes and 57 women (36.8%) with no history.Out of 155 preganant women,17 women (11%) with gestational age 21-25, 61 women (39.4%) with gestational age 26-30, 66 women (42.6%) with gestational age 31-35 and 11 women (7.1%) with gestational age more than 36.Out of 155 pregnant women, 91 women (58.7%) with parity 0-1 and 64 women (41.3%) with parity 2-3.



Maternal Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Age Group 19-23	38	24.5	24.5	24.5
	Age Group 24-28	55	35.5	35.5	60.0
	Age Group 29-33	58	37.4	37.4	97.4
	>34	4	2.6	2.6	100.0
	Total	155	100.0	100.0	

History

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hypertension	29	18.7	18.7	18.7
	Diabetic	37	23.9	23.9	42.6
	Hypertension & Diabetic	32	20.6	20.6	63.2
	Normal	57	36.8	36.8	100.0
	Total	155	100.0	100.0	

Gestational Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Gastional Age 21-25	17	11.0	11.0	11.0
	Gastional Age 26-30	61	39.4	39.4	50.3
	Gastional Age 31-35	66	42.6	42.6	92.9
	Gastional Age >36	11	7.1	7.1	100.0
	Total	155	100.0	100.0	

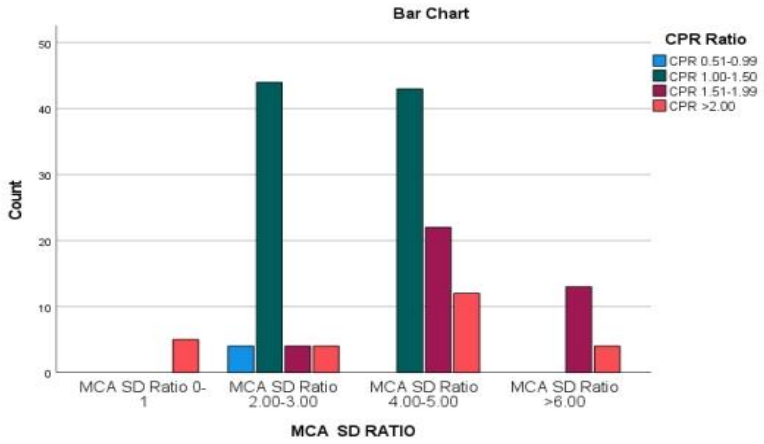
MCA PI * CPR Ratio

Crosstab

Count

		CPR Ratio			
		CPR 0.51-0.99	CPR 1.00-1.50	CPR 1.51-1.99	CPR >2.00
MCA PI	MCA PI Range 0-0.5	0	0	0	4
	MCA PI Range 0.51-	4	14	0	0

	0.99				
	MCA PI Range 1.00-1.50	0	61	8	9
	MCA PI Range 1.51-2.00	0	12	31	7
	MCA PI Range >2.00	0	0	0	5
Total		4	87	39	25



Discussion:

Maternal iron deficiency anemia being a worldwide medical complication, very few studies have been performed to evaluate the efficacy of iron supplementations for treating and preventing adverse pregnancy sequelae. This study attempts to show the impact of maternal iron deficiency anemia on the mother and the fetus and whether treatment can reverse the physiological and pathological effects of anemia on the mother as well as the fetus.

Ji chen e*t* al, in his study conducted that Cesarean section was more common in the observation group (42 cases, 70.0%) than in the control group (7 cases, 11.7%), while the rates of preterm delivery was also higher in the observation group (24 cases, 40.0%) than in the control group (6 cases, 10.0%); the incidence of fetal distress (12 cases, 20.0%), neonatal growth restriction (24 cases, 40.0%), and neonatal asphyxia (4 cases, 6.7%) was higher in the observation group than in the control group [(2 cases, 3.3%) (all $P < 0.05$) (4 cases, 6.7%) (all $P < 0.05$)] [16].

Qiuping *et* al, in his study conducted that the good pregnancy outcome group had lower S/D, PI, and RI values of the UA, compared to the adverse pregnancy outcome group. The good pregnancy outcome group had higher S/D, PI, and RI values of the MCA, compared to the adverse pregnancy outcome group[17].

CONCLUSIONS

Cerebroplacental ratio is highly sensitive in diagnosing hemodynamically compromised fetuses and very useful for the prediction of adverse perinatal outcome in these fetuses.

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