

ORIGINAL ARTICLE

ROLE OF DOPPLER INDICES IN THE PREDICTION OF ADVERSE PERINATAL OUTCOME IN PREECLAMPSIA

Monika Singh¹, Archana Sharma², Parul Singh³

Author's Affiliation: ¹Assistant Professor, Department of Obstetrics & Gynaecology, V.C.S.G. Government Medical Sciences & Research Institute, Srinagar, Pauri Garhwal, Uttarakhand, India; ²Assistant Professor, Department of Obstetrics & Gynaecology, GMERS Medical College, Dharpur, Patan, Gujarat, India; ³Senior Resident, Department of Obstetrics and Gynaecology, PGIMS, Rohtak, India

Correspondence: Dr. Monika Singh, Email: dr.monika.ms@gmail.com

ABSTRACT

Objectives: To determine the role of doppler indices in the prediction of perinatal outcome in pre eclampsia.

Materials & Methods: A prospective study was conducted at Patna Medical College and Hospital between March 2008-March 2009 on 50 pregnant patients with preeclampsia at ≥ 32 weeks gestation. All these patients were subjected to a detailed history, clinical examination and laboratory investigations. Study of fetal vessels was performed serially using a pulsed Doppler ultrasound. Resistance index (RI), pulsatility index (PI) and systolic / diastolic ratio (S/D) were measured in middle cerebral artery (MCA) and umbilical artery (UA). FL/AC (femur length/abdominal circumference) ratio was also measured.

Results: 30 patients had IUGR (intrauterine growth restriction). The patients with abnormal indices had higher incidence of caesarean delivery (44%), low apgar score (32%), need for admission to NICU (26%) and neonatal complications (24%) as compared to those with normal indices.

Conclusion: Doppler indices were more accurate than FL/AC ratio in the early detection of IUGR. MCA/UA ratios were more accurate than the individual components of MCA and UA. Abnormal Doppler ratios were significant predictors of IUGR and adverse perinatal outcome.

Keywords: Preeclampsia, IUGR, Doppler, UA, MCA

Abbreviations:

ACOG- American College of Obstetricians & Gynecologists,
BP- Blood pressure,
MCA/UA- Middle cerebral artery/Umbilical artery,
FL/AC ratio- Femur length/Abdominal Circumference Ratio,
IUGR- Intrauterine Growth Restriction
MCA- Middle Cerebral Artery,
MCA/UA- middle cerebral artery/umbilical artery,
NICU- Neonatal intensive care unit,
NHBPEP- National High Blood Pressure Education Program,
PI- Pulsatility Index
RI - Resistance Index,
S/D Ratio - Systolic/Diastolic Ratio,
SGA- small for gestational age,
UA- Umbilical Artery,
USG- Ultrasonography.

INTRODUCTION

Hypertensive disorders complicate 7-10% of all pregnancies [1]. They can be classified into five types according to the Working Group of National High Blood Pressure Education Programme [NHBPEP] and American College of Obstetricians and Gynecologists (ACOG) [2]. Preeclampsia is one of the common conditions limiting the availability of substrates necessary for growth of the fetus resulting in IUGR manifesting

as birth weight less than 2.5 kg [3]. In preeclampsia there is failure of normal trophoblastic invasion which results in decreased uteroplacental flow. In the initial stages there is sparing of brain growth at the expense of compromise in fetal length [4]. But if the insult continues, brain growth is also compromised. Initially UA S/D ratio increases and MCA S/D decreases indicating placental resistance. Then MCA S/D ratio becomes lower than UA S/D ratio indicating centralization of flow. Next the UA Doppler shows absent and reversal of flow which is associated with adverse perinatal outcome [5]. IUGR can be detected by clinical and ultrasound examination which detects IUGR at a very late stage when the fetus is already compromised, but Doppler can detect it at an early stage and help salvage a compromised fetus.

OBJECTIVES

Objective of the study was to determine the role of doppler indices in the prediction of perinatal outcome in pre eclampsia.

MATERIALS AND METHODS

The present study was conducted on 50 singleton pregnant patients with preeclampsia at ≥ 32 weeks

gestation admitted in department of obstetrics & Gynaecology at Patna Medical College and Hospital between 1st April 2008 - 31st March 2009 on 50 pregnant patients with preeclampsia at ≥32 weeks gestation. The criteria of inclusion were- patients coming to labor room and obstetrics Outpatient Department with more than 32 weeks gestation having BP more than or equal to 140/90 mmHg with proteinuria. The exclusion criteria were twin pregnancy, congenital malformations and the patients who lost in follow up. All these patients were subjected to a detailed history and physical examination with special emphasis on present and past obstetric and family history, along with signs and symptoms suggestive of hypertension. Preeclampsia was defined as BP ≥ 140/90 mmHg or proteinuria ≥ 0.3g in a 24 hr sample ≥ +1 on dipstick in a random sample. Study of fetal vessels was performed serially using a pulsed Doppler ultrasound with a 2.5-5MHz probe with a high pass filter. Femur length / abdominal circumference (FL/AC ratio) was estimated by Ultrasonography (USG) examination. FL/AC ratio >23.5 is considered as IUGR. During the Doppler study, the patients were in a semi recumbent position with the head and chest slightly elevated. The pulsed Doppler samples were placed in the lumen of the umbilical artery, away from the placental and fetal cord insertion. For MCA, an axial view of fetal head was obtained at the level of cerebral peduncles, than the color Doppler was used to visualize the circle of Willis, and the Doppler samples were placed within 1 cm of the origin of MCA^[6]. Doppler indices measured for both arteries were PI, RI and S/D ratio and the ratio of PI

and RI were calculated with respect to MCA/UA as shown in figure 1. The abnormal cut off values indicating IUGR of UA was PI > 0.85, RI > 0.6, S/D > 3, for MCA PI < 1.5, RI < 1, S/D < 4 and for MCA/UA ratio is PI < 1.5 and RI < 1^[7]. These indices were then compared with routine ultrasonic measurement of FL/AC and were also correlated with subsequent perinatal outcome. The outcome variables were number of newborns with IUGR, the incidence of preterm delivery, the incidence of neonatal morbidity as reflected by the number of days that the newborn remained in the neonatal intensive care unit (NICU), the incidence of cesarean sections and Apgar score at birth. Comparison of Doppler parameters in the prediction of perinatal outcome was done by Chi Square test.

OBSERVATIONS

Preeclampsia is a disease of primigravida i.e. 41 patents were in the age range of 20-30 years. Gestational age of all patients was variable ranging from 32 – 38 weeks. Maximum number of patients i.e. 26 were in the gestational age range of 34-36 weeks. The commonest presenting symptom in patients was swelling of feet (68%); other symptoms were decreased fetal movements (24%), headache (16%), nausea (4%), vomiting (4%) blurring of vision (2%) and epigastric pain (2%). All the patients were examined clinically and underwent USG and Doppler analysis for the detection of IUGR. Accuracy of these methods were calculated for the detection of IUGR as shown in Table 1.

Table 1: Accuracy of various methods for the detection of IUGR in Preeclampsia

	Clinical	FL/ AC	MCA			UA			MCA/UA		IUGR
			PI	RI	S/D	PI	RI	S/D	PI	RI	
Patients with IUGR	37	22	28	25	29	28	26	27	31	29	30
Percentage	74	44	56	50	58	56	52	54	62	58	60

Acronyms used: FL/AC -Femur length/Abdominal Circumference ratio, IUGR-Intrauterine Growth Restriction, MCA-Middle Cerebral Artery, MCA/UA - Middle cerebral artery/Umbilical artery ratio, PI- Pulsatility Index, RI - Resistance Index, S/D Ratio - Systolic/Diastolic Ratio, UA-Umbilical Artery.

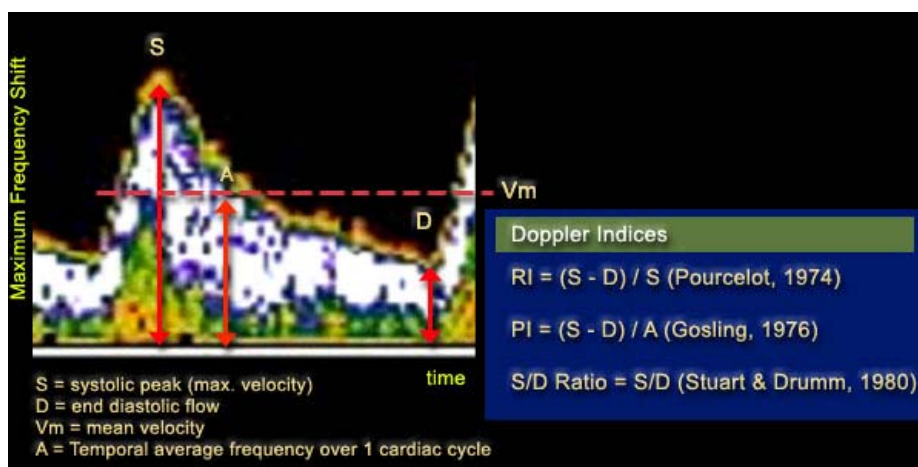


Figure 1: Showing various indices (Acronyms used: PI- Pulsatility Index, RI - Resistance Index, S/D Ratio - Systolic/Diastolic Ratio)

The symphysis fundal height was not corresponding to the period of gestation in 37(74%) patients and they were suspected to be cases of IUGR. The number of IUGR cases were 30. FL/AC ratio could detect only 22(44%) cases with IUGR which is much less than that by Doppler. The mode of delivery in patients of preeclampsia i.e. need for cesarean section and instrumental delivery is 30 and 2 respectively. Eighteen patients delivered vaginally. The perinatal outcomes were shown in Table 2.

The number of newborns with 5 min Apgar score <7 was 20, admission to NICU was 16 and perinatal complications was found in 14 patients. The significance of MCA/UA PI and RI in detection of adverse perinatal outcomes was calculated and shown in Table 3. Out of 31 patients with abnormal MCA/UA PI, 22 had cesarean delivery, while in patients with normal MCA/UA PI (n=19) eight patients required cesarean delivery, and the p value was < 0.01.

Table 2: Perinatal outcome in preeclampsia patients

Outcome	Newborns (%)
Baby weight < 2.5 kg	30 (60%)
5 minute apgar score < 7/10	20 (40%)
Admission to NICU	16 (32%)
No. of days in NICU (Mean ± SD)	5.43 ± 6.14
Perinatal Complications	14 (28%)

Acronyms used: NICU- Neonatal intensive care unit, SD- Standard deviation

Out of 29 patients with abnormal MCA/UA RI, 21 patients were delivered by cesarean section while in patients with normal MCA/UA RI (n=19) nine patients had cesarean section and the p value was < 0.01. 5 minutes apgar score in newborns of patients with abnormal PI (n=31) and RI (n=29) was < 7 in 16 newborns while in patients with normal Doppler it was < 7 in 4 newborns which was statistically significant.

Table 3: Correlation of color Doppler indices with the perinatal outcome

Outcomes	MCA / UA PI			MCA / UA RI		
	<1.5 (n=31)	> 1.5 (n=19)	p value	<1 (n=29)	>1 (n=21)	p value
Patient with Cesarean sections	22	8	< 0.01	21	9	< 0.01
Newborn with 5 minute apgar score < 7/10	16	4	< 0.01	16	4	< 0.01
Newborn admitted in NICU	13	3	< 0.05	13	3	< 0.05
Stay in NICU (Mean ± SD)	5.69 ± 7.01	4.33 ± 2.08	< 0.01	5.69 ± 7.01	4.33 ± 2.08	< 0.01
Newborn with Neonatal complications	12	2	< 0.01	12	2	< 0.01

Acronyms used: MCA-Middle Cerebral Artery, MCA/UA - Middle cerebral artery/Umbilical artery ratio, n-number, PI- Pulsatility Index, RI - Resistance Index, SD-Standard Deviation, UA-Umbilical Artery.

Table 4: Comparison of various USG parameters in the detection of IUGR

Parameter	FL/AC	MCA			UA			MCA/UA	
		PI	RI	S/D	PI	RI	S/D	PI	RI
Sensitivity (%)	63.3	86.6	80	86.6	83.3	80	80	96.6	96.6
Specificity (%)	85	90	95	85	85	90	85	90	95
Positive predictive value (%)	86.3	92.8	96	89.6	89.2	92.3	88.8	93.5	96.6
Negative predictive Value (%)	60.7	81.8	76	80.9	77.2	75	73.9	94.7	90.4
Accuracy (%)	72	88	86	86	84	84	82	94	94

Acronyms used: FL/AC -Femur length/Abdominal Circumference ratio, IUGR-Intrauterine Growth Restriction, MCA-Middle Cerebral Artery, MCA/UA - Middle cerebral artery/Umbilical artery ratio, n-number, No.- number, PI- Pulsatility Index, RI - Resistance Index, S/D Ratio - Systolic/Diastolic Ratio, UA-Umbilical Artery.

In patients with abnormal Doppler velocity waveforms 13 newborns were admitted to NICU and the mean duration of stay was 5.69 ± 7.01 days, while in patients with normal Doppler 3 newborns needed NICU admission and the mean stay was 4.33 ± 2.08 days.

Neonatal complications such as jaundice, birth asphyxia etc. occurred in 12 newborns of mothers with abnormal Doppler waveforms.

Comparison of various USG parameters in detection of IUGR as shown in Table 4.The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Doppler indices in detection of IUGR were higher as compared to FL/AC ratio. But the ratio of

MCA/UA PI and RI were more accurate than the individual components.

DISCUSSION

Preeclampsia is a disease of young primigravida^[8].In the present study ,the maximum number of patients were in the age group were in the age group 20-30 yrs.76% patients had mild preeclampsia and 12% had severe preeclampsia. Fundal height in cms corresponds to the number of weeks in gestation after 20 weeks. Belizan et al (1978) identified 86% of SGA fetuses with fundal height^[9]. In the present study, symphysiofundal height

was not corresponding to period of gestation in 74% patients, which was similar to the above studies. The FL/AC ratio remains constant after 20 weeks of gestation and the normal value is 22 ± 2 ^[10]. Hadlock et al (1983) reported that an upper limit of 23.5 has a sensitivity of 63.3% and specificity of 90% for the diagnosis of IUGR^[11]. In our study the sensitivity, specificity, positive predictive value and negative predictive value of FL/AC in detecting IUGR were 63.3%, 85%, 86.3% and 60.7% respectively which are consistent with the above results. In the present study Doppler waveforms of MCA and UA were analyzed. The values of these are shown in Table 4 above. Ben Ami et al (1991) in their study of pregnancies complicated by hypertension found that umbilical S/D ratio had a sensitivity of 72%, specificity (83%), positive predictive value (82%) and negative predictive value of (75%) in predicting the IUGR and other adverse perinatal outcome^[12]. In the present study the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of UA S/D ratio in detection of IUGR were 80%, 85%, 88.8%, 73.9% and 82% respectively. Our findings are similar to the above study. Various workers have used MCA PI and RI in detection of IUGR with varying accuracies. Wijngaard et al (1989) reported a sensitivity of 85% in the identification of IUGR^[13]. Gramellini et al (1992) found the positive predictive value, negative predictive value and accuracy of MCA PI in detection of SGA neonates as 83%, 52.3% and 54.4% respectively^[7]. Our study had similar results.

As the MCA/UA Doppler ratio will reflect not only the circulatory insufficiency of the placenta manifested by alteration in the UA C/, but also the adaptive changes resulting in the modification of MCA .Preterm delivery is often associated in patients of preeclampsia due to the fact that the definitive treatment of preeclampsia mandates termination of pregnancy regardless of gestational age of fetus. Sibai have recommended performing cesarean delivery in mothers with an unfavorable cervix because of high incidence of intrapartum complications^[1]. Dildy et al have reported the rate of cesarean delivery in patients of hypertension in the range of 11% to 57% ^[14]. In our study, cesarean section was done in 60% of patients. This included emergency as well as elective cesarean sections.

Gramellini et al (1992) found neonatal complications in 33.3% newborns of the mothers with abnormal MCA/UA ratio as compared to 1.38% newborns with normal MCA/UA ratio. Kassanos et al also found similar results in 2004^[15]. As the MCA/UA ratios were more accurate than the individual Doppler indices in the detection of IUGR, the patients with abnormal MCA/UA ratio had higher incidence caesarean delivery (44%), low apgar score (32%), need for admission to NICU (26%) and neonatal complications (24%) as

compared to those with normal MCA/UA ratio which is statically significant.

CONCLUSIONS

Doppler indices are more accurate than FL/AC ratio in the early detection of IUGR and the MCA/UA ratios were more accurate than the individual components of MCA and UA in the prediction of adverse perinatal outcome in preeclampsia. Hence Doppler can be a useful tool in the management of patients with preeclampsia and can help in deciding the time of delivery so that fetuses can be saved.

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