Research Article

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Assessment of Fetal Wellbeing by Color Doppler Ultrasonography in Severe Pre-Eclampsia Patients

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ABSTRACT: *Background:* By seeing and analyzing blood flow in both maternal and fetal veins, color Doppler ultrasound is a useful technique for evaluating fetal health, especially in high-risk pregnancies. *Objective:* Color Doppler ultrasound is used to evaluate the fetal health in patients with severe pre-eclampsia. *Methodology:* 50 randomly chosen individuals between the ages of 16 and 35 who had Doppler sonography of their umbilical, middle cerebral, and uterine arteries performed between weeks 29 and 40 of pregnancy participated in this prospective study. Prior to then, each patient's informed permission was obtained. After that, a thorough history and clinical examination are performed on each patient. This six-month study was carried out in the Department of Obstetrics and Gynecology at the Dhaka Medical College Hospital (DMCH), Dhaka, from December 22, 2023, to June 21, 2024. After data collection is complete, statistical analysis will be performed. *Result:* Accordingly, 70%, 68%, and 62% of the patients in my study had aberrant color Doppler blood flow indices for 70% of deliveries at 34±3.7 weeks gestation, while 30% of deliveries occurred at 38±1.6 weeks gestation, with normal color Doppler indices. Of the 50 patients who participated in my study, 5 (10%) experienced spontaneous NVD, 15 (30%) experienced NVD during induction, and 30 (60%) underwent caesarian section. Of the 34 patients (68%) with aberrant umbilical artery blood flow indices, 33 patients (66%) had babies that were undersized for gestational age. *Conclusion:* Evaluation of color Doppler maternal uterine artery, fetal middle cerebral and umbilical artery is useful tool for diagnosis of IUGR and prediction of adverse fetal wellbeing.

Keywords: Fetal Wellbeing, Color Doppler, Pre-Eclampsia.

INTRODUCTION

Prenatal screening tests are primarily used to detect high-risk pregnancies, which are the leading cause of fetal growth retardation. The nonstress test, fetal cardiac monitoring, and fetal biophysical profile are examples of old procedures for prenatal surveillance that are no longer adequate due to their incapacity to identify fetal distress at an early stage.[1] It has long been known that pre-eclampsia and intrauterine growth retardation (IUGR) are linked to compromised fetoplacental perfusion. One In patients who were previously normotensive with no proteinuria, pre-eclampsia, a multisystem disorder with an unclear cause, presents as hypertension that reaches 140/90 mm Hg or greater and proteinuria after the 20th week of pregnancy.[2] Growth at the 10th or lower percentile for the weight of all fetuses at that gestational age is known as

intrauterine growth retardation. Increased rates of meconium aspiration, hypoglycemia, respiratory distress syndrome, intrapartum developmental delay, stillbirth, and poor neurodevelopment are among the worst fetal morbidities linked to IUGR.[3] A newborn with IUGR has a higher chance of developing diabetes, heart disease, and hypertension in the future. The Doppler study is a non-invasive method for evaluating pathological hemodynamic changes in uteroplacental circulation and the resulting altered fetal and fetoplacental circulation.Since doppler ultrasound can detect fetal vascular resistance, doppler-measured impedance indices have been considered as an early screening tool for high-risk pregnancies, which are the most prevalent cause of growth retardation and the second greatest cause of perinatal mortality.[4] Of the noninvasive tests of fetal health, the color dopplcr provides the most exacting assessment. Fetal hemodynamics can be evaluated noninvasively with Dopplcr ultrasonography. Early detection of placental insufficiency is crucial for minimizing its risks.[5] Doppler readings are obtained from the umbilical, fetal, and maternal uterine arteries. The pulsatility index (PI), resistance index (RI), and systolic/diastolic ratio (S/D) are calculated.

There is a correlation between the indices and fetal health. According to the usual reference value, Doppler indices are deemed abnormal when the S/D, PI, and RI of each artery are greater than 2SD for the gestational age.[6] All three indices gradually decrease as gestational age increases in a typical pregnancy. However, spiral artery resistance is elevated in pre-eclampsia. Because the umbilical artery resistance decreases with age, the mean of all indices in a typical pregnancy shows a steady reduction. However, in IUGR, the umbilical artery's diastolic flow is first reduced because of an increase in resistance in the tertiary villi's tiny arteries and arterioles. As a result, the umbilical artery's S/D ratio, Pl, and RI increase. The diastolic flow falls, eventually disappears, and then reverses as placental insufficiency develops. Unfavorable prenatal outcomes are strongly and significantly predicted by the absence of umbilical artery wave shape. [7] In hypertensive pregnancies, Doppler velocimetry has been shown to accurately predict any unfavorable fetal outcome and assist in determining the best time for delivery. It assists us in planning treatments, acting promptly, and advising patients about future pregnancies. One of the primary goals of prenatal treatment is to accurately identify the impaired 1UGR fetus so that prompt intervention can take place.

MATERIALS AND METHODS

This prospective study involved 50 randomly chosen patients aged 16–35 whose umbilical artery, middle cerebral artery, and uterine artery Doppler sonography were performed between 29 and 40 weeks of pregnancy. Prior to that, each patient gave their informed consent. After that, each patient is assessed by a thorough history and clinical examination. This study was carried out during a six-month period, from December 22, 2023, to June 21, 2024, in the Department of Obstetrics and Gynecology at the Dhaka Medical College Hospital (DMCH), Dhaka. In all, fifty subjects were used in this investigation. The research protocol was approved by the relevant authority before to the start of this investigation. For this study, appropriate approval was obtained from the relevant department. Every patient who was a part of this study was made aware of the risks and advantages of it. The included patients were given an explanation of these in a language that was simple to understand. The patients gave their appropriate written consent for the trial. They received assurances that all of the data and documents would be kept private. Convenient sample was used in this study to include DMCH patients who were clinically diagnosed with severe pre-eclampsia in the third trimester (29 to 40 weeks) and sent to the Radiology and Imaging department of Dhaka Medical College. This study excluded individuals who refused the treatment, had numerous pregnancies, or were extremely ill with conditions other than preeclampsia.

Doppler velocimetry indices include
>Pulsatility index (PI)
>resistance index (RI)
>Sytolic/dystolic velocity ratio (S/D ratio)

In this study we are going to use
Uterine artery Doppler to study uteroplacental circulation
Umbilical artery Doppler to study fetoplacental circulation
Middle cerebral artery Doppler to study fetal circulation

Doppler indices were considered abnormal when S/D ratio, Pl and Rl of each artery > 2SD for the gestational age according to the standard reference values.

Appropriate data were collected using a preformed data sheet. All the findings were analyzed by appropriate standard statistical method. To ascertain whether color Doppler sonography of the fetoplacental circulation can be used to predict the outcome of early pregnancies. In the majority the diagnostic utility of umbilical artery velocity waveforms, which are a significant predictor of unfavorable perinatal outcomes such the early diagnosis of pregnancy-induced hypertension and intrauterine growth retardation, was investigated in this study. to ascertain the study's sensitivity, specificity, accuracy, positive predictive value, and negative predictive value.

RESULTS

Table 1: Distribution of Respondents According to Normal and Abnormal Blood Flow Indices (S/D, PI, RI) of Uterine Artery, Umbilical Artery, Middle Cerebral Artery in Doppler Sonography. (n=50)

Blood flow indices (S/D ratio,PI,RI)	Normal flow	Abnormal flow	Total
Uterine artery	15(30%)	35(70%)	50(100%)
Umbilical artery	16(32%)	34(68%)	50(100%)
Middle cerebral artery	19(38%)	31(62%)	50(100%)

Color Doppler was used to assess the blood flow indices (S/D PI, Rl) of the uterine, umbilical, and middle cerebral arteries in 50 patients with severe pre-eclampsia who were brought to DMCH. The majority of these patients had aberrant blood flow, as shown by 70%, 68%, and 62% of the patients in my study (Table 1).
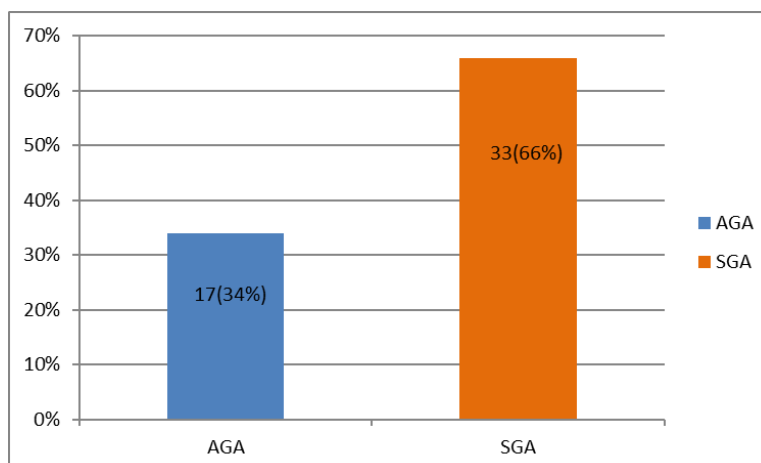
Figure 1: Bar chart shows prenatal outcome among the respondents (n=50)

AGA= Average Gestational Age of baby.
SGA= Small for Gestational Age baby.

Among 50 Patients 33 (66%) had small for gestational age (SGA) baby and 17 (34%) had average gestational age (AGA) of baby (Figure 1).

Table 2: Distribution of patients according to gestational age at delivery in weeks

Color Doppler indices Findings	Number of patients	Gestational age at delivery in weeks (Mean ± SD)
Abnormal	35(70%)	34±3.7
Normal	15(30%)	38±1.6
Total	50(100%)	

Out of the 50 patients, 30% had normal color doppler indices at 38±1.6 weeks gestational age, and 70% had aberrant color doppler indices at 34±3.7 weeks (Table 2).

Table 3: Distribution of Mode of Delivery Among the Study Population

Mode of delivery		Number of Patient	Percentage of patient
Normal vaginal	Spontaneous	5	10%
Delivery	Induced	15	30%
Cesarean Section		30	60%
Total		50	100%

Of the 50 patients who participated in my study, 5 (10%) experienced spontaneous NVD, 15 (30%) experienced NVD during induction, and 30 (60%) underwent caesarian section (Table 3).

Table 4: Correlation of Umbilical Artery Blood Flow with Fetal Wellbeing

Umbilical Artery Blood Flow Indices	Small for gestational age (SGA)		Total	Inferences
	Present	**Absent**		
Abnormal 34	34 (True Positive)	0 (False positive)	34	χ^2 = 45.43
Normal 16	1 (False Negative)	15 (True Negative)	16	
Total	35	15	50	df =2, p< 0.05

Fifty patients who were admitted to DMCH had their umbilical arteries evaluated using color Doppler. Sensitivity, specificity, positive and negative predictive value, and accuracy were calculated using a standard formula, and reports and perinatal follow-up of those patients were gathered in order to establish the validity of the tests (Table 4). A statistical investigation of this relationship showed a positive connection between poor fetal health and aberrant color doppler readings of umbilical artery blood flow parameters.

DISCUSSION

Pre-eclampsia and IUGR are two important factors that contribute to maternal and newborn morbidity and mortality. Blood flow investigations employing color doppler technology are utilized to evaluate fetal health in pre-eclampsia patients because conventional methods are insufficient to evaluate uteroplacental and fetoplacental circulation. A failure of normal placental invasion and development is linked to common pregnancy complications such as pre-eclampsia and intrauterine growth retardation (1UGR). The consequences of this placental dysfunction can include altered resistance to blood flow in the uterine circulation and carry a significantly increased risk of morbidity and mortality for both the mother and the fetus. Finding potentially harmful levels of fetal hypoxia and starting a timely intervention are the objectives of ultrasonography surveillance of the viable fetus. The ultrasound tools used for fetal well-being assessment include evaluation of fetal growth, amniotic fluid, fetal biophysical profile score, and cardiovascular/placental function. In order to identify fetuses at risk of hypoxia and acidemia, which worsen the IUGR of fetuses in women with severe preeclampsia, the current study was conducted to determine the utility of color Doppler sonography of the maternal uterine artery and the fetal umbilical and middle cerebral arteries in evaluating fetal wellbeing. The resistive index (RI), pulsatility index (PI), and systolic diastolic ratio (S/D) were calculated. There was a correlation between the indices and fetal health.

Preterm birth is substantially correlated with being tiny for gestational age, albeit the strength of this correlation varies somewhat depending on the style of delivery and gestational age. premature births before 34 weeks of gestation have the largest correlation between growth restriction and premature delivery.[8] In fact, patients with an aberrant waveform had significantly greater odds of preterm delivery, fetal distress caesarean sections, intensive care unit admissions, major newborn morbidity, and perinatal deaths. The resistive index (RI),

pulsatility index (PI), and systolic/diastolic ratio (SD) all decreased with gestation length in the low-risk group, whereas these values increased in the high-risk group in the uterine and umbilical arteries. While PI decreased as the gestational stage increased, the middle cerebral artery's (MCA) peak systolic velocity (MCA-PSV) increased. These results imply that abnormal blood vessel Doppler indices in pregnant women at high risk might result in a fetal state that is not favorable.[9] The blood flow indices (S/D PI, Rl) of the uterine, umbilical, and middle cerebral arteries were assessed by color doppler in 50 patients who were admitted to DMCH with severe pre-eclampsia. The majority of these patients had abnormal blood flow, as evidenced by 70%, 68%, and 62% of the patients in my study, of whom 70% gave birth at 34±3.7 weeks gestation with abnormal color doppler indices and 30% at 38±1.6 weeks gestation with normal color doppler indices. Of the 50 patients who participated in my study, 5 (10%) experienced spontaneous NVD, 15 (30%) experienced NVD during induction, and 30 (60%) underwent caesarian section. Numerous other research have shown a high correlation between fetal health and the umbilical artery doppler indices.

Hypoxemia at steady state is linked to elevated umbilical artery doppler indices when positive end diastolic flow is present. Significant worsening of hypoxemia and the possibility of acidemia are linked to absent end diastolic flow in the umbilical artery. In 1994, Yoon and Lee *et al*., showed in the American Journal of Obstetrics and Gynecology that women with aberrant umbilical artery waveforms had a higher risk of poor perinatal outcomes than those with normal waveforms.[10] According to Ducey *et al*., an irregular umbilical artery waveform was found in 65% of preeclampsia patients. They proposed that patients with aberrant Doppler velocirnetry have worse outcomes and that the degree of placental ischemia in preeclamptic patients is correlated with the severity of the condition.[11] Pregnancy-induced hypertension (PIH) and preeclampsia were found to be the most common high-risk characteristics in another investigation. The study found that 58.33% of individuals with pre-eclampsia had aberrant umbilical artery (UA) flow patterns. Abnormal UA and middle cerebral artery (MCA) Doppler indices were significantly linked to negative outcomes.[12] A placental function test called UA (umbilical artery) Doppler offers crucial diagnostic and prognostic data in cases with preterm IUGR. Regardless of the UA waveform, Color Doppler successfully detects preterm IUGR pregnancies that are at high risk for a negative outcome, including stillbirth, at least one week prior to delivery.[13] In my study result also have same findings that 34 (68%) patients had abnormal blood flow indices of umbilical artery, of which 33 (66%) patients had small for gestational age baby.

CONCLUSION

It can be concluded that color Doppler evaluation of the maternal uterine artery, fetal middle cerebral, and umbilical artery is a useful modality in diagnosing IUGR and predicting adverse fetal wellbeing because the validity test and the color Doppler findings of these arteries are nearly identical to those of prenatal findings as reported by other researchers. Significant flow resistance persists until 24-26 weeks of gestation, which is why Doppler is used to assess placental circulation and predict the onset of preeclampsia and fetal growth limitation. [2] In our nation, more research with a larger sample size can be conducted to develop the screening test standard for IUGR identification, which is closely linked to perinatal death and morbidity. Doppler USG has emerged as one of the most crucial clinical methods for feto-maternal surveillance in high-risk pregnancies because it makes it possible to better comprehend the hemodynamic alterations. Perinatal mortality and morbidity have significantly decreased as a result of it.

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