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COLOUR DOPPLER VERSES NST IN PREDICTING PERINATAL OUTCOME IN SEVERE PREECLAMPSIA AND FETAL GROWTH RESTRICTION

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ABSTRACT: AIM: The aim of our study was to evaluate and compare the usefulness of colour Doppler velocimetry of UA, MCA and NST in predicting the perinatal outcome in severe preeclampsia and fetal growth restriction. **METHODS:** The study population comprised of 90 singleton pregnancies beyond 30 weeks of gestation complicated by severe preeclampsia, fetal growth restriction or both were prospectively examined with serial colour Doppler of UA, MCA and NST. The results of last Doppler and NST within one week of delivery were correlated with perinatal outcome. The data were analyzed using Chi square test after Yate's correction. **RESULTS:** colour Doppler is useful in recognizing fetal compromise earlier than NST, giving a lead time which is important in the management of preterm high risk pregnancies such as severe preeclampsia and fetal growth restriction.

KEYWORDS: Severe preeclampsia, fetal growth restriction, UA, MCA, NST, Colour doppler.

INTRODUCTION: Preeclampsia and Fetal growth restriction are associated with failure of normal development of maternal placental arteries into low resistance vessels, resulting in reduced oxygen and nutrient supply to the intervillous space. These fetuses are more at risk of intra uterine hypoxia and acidosis, leading to increased perinatal mortality and morbidity. Identification of suspected fetal compromise is essential to initiate appropriate timely care before it leads to fetal demise.

Antepartum fetal surveillance tests to evaluate fetal health have been the focus of interest for many decades. There are many tests available today, each with its advantages and disadvantages. NST is the most widely used test and it reflects oxygenation of fetal brain. Doppler can detect hemodynamic rearrangements that occur in response to fetal hypoxemia.¹ It is now proved that significant Doppler changes occur due to hypoxia, when other fetal wellbeing tests are still normal.^{2&3} Therefore we decided to find out the comparative usefulness of Doppler and NST in the management of severe preeclampsia and fetal growth restriction.

METHODS: A total of 90 pregnancies complicated by severe preeclampsia and fetal growth restriction beyond 30 weeks of gestation were included in our prospective study.

Severe preeclampsia (BP>160/110, proteinuria>5g/24 hours, platelet count<1lakh/cu. mm, epigastric pain, visual disturbances and oliguria) and fetal growth restriction (Fetal weight and abdominal circumference <10th percentile for gestational age) were defined according to standard criteria. Multiple pregnancy, pregnant female with diabetes, USG estimated fetal weight <1000grams and USG diagnosed congenital anomaly in the fetus were excluded from our study. Our patients were followed up by colour Doppler and NST. The results of the last Doppler and NST within one week of delivery were considered for correlation with perinatal outcome. The time interval between the first abnormal Doppler and the development of abnormal NST was used to calculate the lead time.

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NST was interpreted according to ACOG criteria for term and preterm babies.¹ Doppler study was performed using a pulsed Doppler machine (Medison 770 with high pass filter) Doppler readings were taken from UA and MCA. Doppler study was considered abnormal when any of the parameters mentioned below was abnormal:

1. PI of UA >2SD for Gestational age.
2. Absence or reversal of end diastolic flow in UA.
3. PI of MCA <5th percentile for gestational age.
4. Abnormal CPR (PI MCA/UA) <1.08.⁴

Based on the Doppler and NST results, the study population was divided into four Groups.

Group 1 (n=38): Normal NST and normal Doppler.

Group 2 (n=25): Normal NST and abnormal Doppler.

Group 3 (n=7): Abnormal NST and normal Doppler.

Group 4 (n=20): Abnormal NST and abnormal Doppler.

The management of pregnancy and route of delivery were based on maternal and fetal parameters.

The perinatal outcome parameters studied were gestational age delivery, mode of delivery, birth weight, perinatal mortality, 5 minutes APGAR score <7, NICU stay and complications that developed.

The comparison of adverse perinatal outcome among the four study groups was done by chi square test after Yate's correction. A p value < 0.05 was considered significant.

RESULTS: Maternal characteristics of study population were shown in table 1. Out of 90 pregnant females included in our study 58(64.45%) were multi gravida, 30% of multi gravida had history of preeclampsia in previous pregnancy. 45.5% of our study population had both severe preeclampsia and fetal growth restriction.

There were 38 women in group1 who had normal NST and Doppler, 25 women in group2 had normal NST and abnormal Doppler, 7 women in group 3 had abnormal NST and normal Doppler and 20 women in group4 had both NST and Doppler were abnormal.

There were 27 women with abnormal NST and 45 women with abnormal Doppler findings. Brain sparing effect was seen in 40 women.

The pregnancy complications, mode of delivery and perinatal outcome in different groups were shown in Table 2. Group 4, which had maximum number of cases of combined preeclampsia and fetal growth restriction (15/20:75%) had both tests abnormal and had the worst perinatal outcome associated with prematurity and low birth weight.

The statistical significance for perinatal outcome in group 1 vs 4 and group 2 vs 4 were shown in table 3. Presence of preeclampsia with fetal growth restriction, significantly increased perinatal mortality (p<0.001), prematurity (p<0.001) and NICU admissions (p<0.001) in group4 when compared to those in group 1. However there was no statistically significant difference between group 1 and 4 regarding route of delivery (p>0.1) and low APGAR at 5 minutes (p>0.5). The number in group 3 was too small for statistical comparison. Fetuses in group 2 (Normal NST and abnormal Doppler) were more advanced in gestation and had better neonatal outcome in group 4.

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Hence cesarean section was higher in group 2 in comparison to group 4, where cesarean section was deferred when neonatal survival prospects were poor. Perinatal deaths, prematurity and neonatal complications were significantly more in group 4 compared to group 2. There were five intra uterine deaths and twelve neonatal deaths in the study population. There were two neonatal deaths in group 1. One death was due to pulmonary hemorrhage in fetal growth restriction fetus on 4th day and the other was due to septicemia. There were four intrauterine deaths and eight neonatal deaths in group 4. Major causes of neonatal death in group 4 were pulmonary hemorrhage, septicemia and respiratory distress syndrome.

Highest perinatal mortality was seen in group 4 (12/20, 60%) where both tests were abnormal. Majority of women showed Doppler abnormality prior to changes in NST. We observed that lead time was shorter in cases of severe preeclampsia, longer in cases with only IUGR without other maternal diseases. The lead time was seen only in group 4, whereas in group 2 babies were delivered before NST had become abnormal and therefore no lead time.

DISCUSSION: Our study showed when both NST and colour Doppler were abnormal, baby weight and gestational age at birth were low. But the perinatal mortality and neonatal morbidity were high. Though both tests are effective in predicting perinatal outcome, significant advantage of Doppler over NST was observed in our study in group 4, the Doppler changes occur earlier than NST giving a significant lead time up to 9 days with an average of 3.45 days. This lead time is very important as babies can be delivered or can be followed up during this period to gain a pulmonary maturity, which may be crucial for a preterm fetus, steroid prophylaxis may be administered during this period to accelerate the lung maturity. In growth restricted fetuses, when both NST and colour Doppler were abnormal (group 4) indicates that those fetuses suffer from severe placental insufficiency. Though abnormal Doppler was found in group 2 and 4, the perinatal outcome was better in group 2, because those fetuses were less compromised and relatively more advanced in gestation, hence early intervention was possible before the development of abnormal NST. When neonatal survival prospects are good it is better to deliver the compromised fetus than to monitor till the development of abnormal NST, as it is evident in group 2.

The Growth Restriction Intervention Trial,⁵ (GRIT) which was designed to time the delivery in compromised preterm fetuses showed that delaying delivery to increase maturity in severe hypoxemia, resulted in increased stillbirths to fivefold, death before discharge was about one third but earlier delivery resulted in almost equal number of perinatal deaths and neonatal complications such as intraventricular hemorrhage, necrotising enterocolitis, respiratory distress syndrome and septicemia.

Radika and Raj lavanya⁶ conducted a prospective study to evaluate the usefulness of colour Doppler and NST in 55 pregnancies complicated by severe pre eclampsia and IUGR. In their study also Doppler showed changes earlier than NST giving significant lead time of upto 9 days with an average of 4.14 days. The hemodynamic changes picked up by Doppler occur in compensatory phase in high risk pregnancies. Fetal heart rate abnormalities occur much later in decompensatory phase, which is a late sign of fetal compromise.

Arduini Rizzo et al,⁷ in their study of 37 fetuses had a lead time ranging from 1-26 days. They observed that the lead time is shorter in the presence of pre terminal Doppler changes like pulsatile umbilical vein and in preeclampsia. Longer time interval between abnormal Doppler and NST was seen in idiopathic IUGR detected early in gestation. This is because smaller fetuses have low

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nutritional and oxygen requirement allowing them to develop longer metabolic adaptations reflected by abnormal Doppler. Another interesting observation they made was the gestational age influenced this interval which we did not observe. The time sequence of deterioration depends on gestational age and concomitant maternal disease. The quick deterioration of placental function in the presence of preeclampsia resulting in shorter lead time.

Ott et al,⁸ studied the single parameter MCA/UA PI in comparison with NST in a larger group of 447 cases to predict the neonatal compromise and concluded that combination of NST and MCA/UA PI was excellent predictor of perinatal outcome. Colour Doppler depicts chronic hypoxic changes while NST detects acute events in the presence or absence of chronic hypoxia. NST is useful to detect acute fetal distress due to abruption, cord compression and fetomaternal hemorrhage which are not rare in high risk pregnancies.

In the study by Weiner et al,⁹ in 13 fetuses, 6 fetuses showed loss of brain sparing effect followed by development of abnormal fetal heart rate pattern. They compared fetal Doppler with computerized fetal heart rate monitoring. They opined that a loss of autonomic reactivity occurs first in brain followed by similar response in the heart manifested by abnormalities in fetal heart patterns. We observed loss of brain sparing effect followed by development of abnormal NST in eight cases resulting in five perinatal deaths. This loss of Brain sparing effect is due to development of cerebral edema in terminally hypoxic fetus.

Harrington et al,² observed the Doppler changes in fetal circulation in pregnancies complicated by preeclampsia and small for gestational age fetuses and concluded that fetal Doppler has the power to discriminate the sick and healthy fetuses and serial measurements it is possible to monitor any deterioration in the fetus. In chronic hypoxia Doppler changes occur first while abnormal heart rate pattern represent late sign of fetal deterioration.

Smitha et al,¹⁰ in their Doppler study in 100 pregnant women with PIH concluded that absent diastolic flow and reversed end diastolic flow in UA is a ominous sign with high perinatal mortality. CPR is a better predictor of adverse perinatal outcome with highest diagnostic accuracy, sensitivity and positive predictive value. They opined that the Doppler study is a simple non-invasive and found accurate among the other tests for antepartum fetal surveillance.

The advantages of NST are low cost, minimal time requirement, ease of use and interpretation. The disadvantage of the Doppler is the requirement of sophisticated equipment and degree of operator skill and expertise. Combined fetal testing modalities such as colour Doppler, NST and Biophysical profile provide information regarding fetal health. Integrated fetal testing would be ideal for individualized care of preterm compromised fetus for timed intervention.¹¹

CONCLUSION: An abnormal NST following an abnormal Doppler is associated with worst perinatal outcome in patients with severe preeclampsia and fetal growth restriction. In cases of abnormal Doppler if the prospects of neonatal survival are good it is better to deliver the fetus before NST becomes abnormal. It is to conclude that colour Doppler is useful in recognizing fetal compromise earlier than NST, giving a lead time which is important in the management of preterm high risk pregnancies such as severe preeclampsia and fetal growth restriction. Even though both tests are complimentary to each other in fetal surveillance of high risk pregnancies, the clinical condition dictates the appropriate test.

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Maternal Characteristics	Number	Percentage
Primiparity	32	35.55
Multiparity	58	64.45
Mean age	27.5 years (20-35)	
Mean period of gestation on admission	34.6 weeks (31-38.4)	
Preeclampsia	14	15.5
Fetal growth restriction	35	38.8
Preeclampsia with Fetal growth restriction	41	45.5

Table 1: Maternal characteristics

	Group 1(n=38) Normal NST & Normal Doppler.	Group 2(n=25) Normal NST & Abnormal Doppler.	Group 3(n=7) Abnormal NST & Normal Doppler.	Group 4(n=20) Abnormal NST & Abnormal Doppler.
1. Pregnancy complications.				
Preeclampsia.	6 (15.9%)	3 (12%)	1 (14.2%)	4 (20%)
Fetal growth restriction.	20(52.6%)	12(48%)	2 (28.5%)	1 (5%)
Preeclampsia with fetal growth restriction.	12 (31.5%)	10 (40%)	4(57.1%)	15 (75%)
2. Mode of delivery				
Normal delivery.	21 (55.2%)	5 (20%)	-	8(40%)
Cesarean section.	17 (44.7%)	20(80%)	7(100%)	12(60%)
3. Perinatal outcome.				
Survival.	36	22	7	8
IUD.	0	1	0	4
Neonatal death.	2	2	0	8
Perinatal death.	2 (5.2%)	3 (12%)	0	12 (60%)
4. Neonatal characteristics.				
Average birth weight.	2215 grams	1778 grams	1878 grams	1513 grams
APGAR <7 at 5 minutes.	2	2	0	7
Admissions to NICU.	15(39.47%)	18 (72%)	7 (100%)	15 (75%)
Neonatal complications.	6 (15.7%)	10 (40%)	4 (57.1%)	15 (75%)

Table 2: Mode of delivery, perinatal outcome and neonatal characteristics

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Perinatal factors	Group 1.	Group 4.	P value
Cesarean delivery	17	12	>0.10
Perinatal deaths	2(5.2%)	12(60%)	<0.001
Preterm	6(15%)	18(90%)	<0.001
APGAR <7 at 5 minutes	2	7	>0.50
NICU admissions	15(39.4%)	15(75%)	<0.001
Neonatal complications	6(15.7%)	15(75%)	<0.005

Table 3: Comparison of perinatal outcome between groups

Perinatal factors	Group 2.	Group 4.	P value
Cesarean delivery	20	12	>0.10
Perinatal deaths	3(12%)	12(60%)	<0.001
Preterm	15(60%)	18(90%)	>0.05
APGAR <7 at 5 minutes	2	7	>0.10
NICU admissions	18(72%)	15(75%)	>0.10
Neonatal complications	10(40%)	15(75%)	<0.001

Table 4

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