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Co-Relation between Doppler and NST as a Predictor of Neonatal Outcome: A Prospective Study

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Abstract: ***Background: The Doppler and Non Stress Test (NST) are very crucial tools for monitoring antenatal cases in the hospital. They play a very crucial role in timely intervention, also with the increasing number of medico-legal cases, they act as evidences to rationalize the actions of the obstetrician. While, NST is a fairly simpler tool, Doppler requires expertise and is not readily available in all setups, at all the times. The aim of the present study was to compare the efficacy of Doppler and NST in prediction of adverse neonatal outcome. Method: The present study was conducted at MLN Medical College, Prayagraj over a period of 1 year from October 2019 to September 2020. A total of 200 ANC cases attending the IPD of Department of Obstetrics were studied and divided into 4 Groups based on their Doppler and NST findings, Group I had both tests normal, Group II had abnormal Doppler but normal NST, Group III had normal Doppler but abnormal NST, and Group IV had both the tests abnormal. They were then followed up for neonatal outcome. The results were compiled and analyzed using appropriate statistical tools. Result: 28% patients had abnormal Doppler, while 35% had a non reactive NST. The number of patients in each of the Groups was: 115 (Group I), 15 (Group II), 29 (Group III), 41 (Group IV). NICU admission rate was least (0.9%) in Group I, while it was maximum in Group IV (95%). All the neonatal deaths(a total of 6 deaths) were seen among patients who belonged to Group IV. Conclusion: From this study, we concluded that the combination of Doppler and NST for antenatal fetal monitoring can provide us with wealth of information and is ideally suited for fetal well-being assessment. Taking into consideration the limitation of manpower, expertise and machinery in various health care centers around the country, it is not practically applicable to perform both the tests in all the cases. While Doppler was seen to identify abnormalities earlier and provide us with a lead time, the NST also proved to be an efficacious tool and can be reliably applied at places where we do not have expertise or machinery to perform Doppler.***

Keywords: Doppler, Non stress test, fetal wellbeing, neonatal outcome.

1. Introduction

Delivery of a healthy neonate provides a feeling of contentment to the treating obstetrician as well as to the mother and her family. The timely detection of morbid changes in the fetal status followed by adequate interventions to avoid death or disability is one of the most important objectives of pre-natal care. This involves regular assessment of fetal well-being and timely interventions, as per the findings of the investigations performed.

The role of Non-Stress Test (NST) has been established to predict the fetal well being, while Doppler is a fairly newer method being applied in antenatal fetal surveillance. Prenatal non-stress test, popularly known as NST, is an easy, non invasive test used for the surveillance of high-risk pregnancies when the fetus is at risk for hypoxemia or increased risk of death[1].

Doppler flow velocimetry is useful in assessing the flow variations and hemodynamic events that occur subsequent to placental insufficiency [2,3]. Flow indices of the waveforms in the umbilical artery is measured during systole (S) and diastole (D) and the mean peak frequency shift over the cardiac cycle (A). With the help of these, the Resistance Index (RI), Pulsatility Index (PI) and S/D ratio are calculated. The umbilical artery Doppler is considered abnormal if systolic- diastolic (S/D) ratio is > 95th percentile for gestational age or if diastolic flow is reduced, absent or reversed. Reversed end diastolic flow is associated with poor perinatal outcomes and is an ominous finding.

Fetal middle cerebral arterial (MCA) Doppler assessment is an important part of assessing fetal cardiovascular distress, fetal anemia or fetal hypoxia. The various parameters studied are - Fetal MCA pulsatility index (PI), Fetal MCA peak systolic velocity (PSV): the highest velocity should be recorded, Fetal MCA systolic/diastolic (S/D) ratio: a normal fetal MCA S/D ratio should always be higher than the umbilical arterial S/D ratio, Cerebro-placental ratio (CPR): ratio of pulsatility index of MCA and umbilical artery. Middle Cerebral Artery Doppler has the advantage of being highly reproducible. Unlike the uterine and the umbilical arteries whose vascular beds show continuous changes with advancing gestational age, the MCA vascular bed resistance is constant throughout the pregnancy.

2. Material and Method

The present study was conducted at MLN Medical College, Prayagraj over a period of 1 year from October 2019 to September 2020. A total of 200 ANC cases attending the IPD of Department of Obstetrics were studied and divided into 4 Groups based on their Doppler and NST findings, Group I had both tests normal, Group II had abnormal Doppler but normal NST, Group III had normal Doppler but

abnormal NST, and Group IV had both the tests abnormal. The management of pregnancy and mode of delivery were based on maternal and fetal parameters. Placenta was sent for histopathological examination and neonatal outcome was assessed. Doppler was done by USG machine with 3.5 MHz curvilinear transducer. Doppler readings were taken from Umbilical artery and Middle Cerebral artery. The fetal vessels were located in the standard plane and Doppler study was considered abnormal, when any of the following parameters was abnormal- i. Umbilical artery S/D ratio > 3. ii. Absence or reversal of end diastolic flow in Umbilical Artery. iii. Cerebro- placental ratio< 1.

NST was done for a period of 20 minutes and included following components-
a) Baseline fetal heart rate.
b) Beat to beat variability of fetal heart rate.
c) Accelerations.
d) Decelerations.

Data was analyzed using SPSS version24. Descriptive analysis for non parametric variables were expressed in proportion and parametric variables in mean and standard deviation .The treatment difference was assessed using t test for independent samples for parametric and by chi square for non parametric variables . A P value was calculated comparing each of the four groups with Group I (normal Doppler study and reactive NST) and a P value of <0.05 was considered significant and P value=0.0001 as highly significant.

Sensitivity, Specificity, Positive predictive value, Negative predictive value of Doppler velocimetry and NST were calculated for Apgar score, NICU admission and neonatal death.

3. Results

Table 1: Group-Wise Distribution of Patient Population

Patient group	Total (N)	Percentage
Group I: Patients with both tests normal.	115	57.5%
Group II: Patients with Abnormal Doppler study.	15	7.5%
Group III: Patients with Non- reactive NST.	29	14.5%
Group IV: Patients with both tests abnormal.	41	20.5%
Total	200	100%

Table 2: Comparison of Doppler and NST Group with Birth Weight and APGAR Score

	Birth weight			P -Value	APGAR score at 5 minute		P -Value
	>2.5 kg (n=87)	2-2.5 kg (n=68)	<2.0 kg (n=45)		>7/10 (n= 147)	<7/10 (n=53)	
Group I (n=115)	57 (49.8%)	40(34.7%)	18(15.6%)		114 (99.1%)	1 (0.9%)	
Group II(n=15)	5 (33.3%)	5 (33.3%)	5 (33.3%)	0.2137	11 (73.3%)	4 (26.7%)	0.0001
Group III(n=29)	10 (34.5%)	10 (34.5%)	09 (31%)	0.1316	20 (69.0%)	9 (31.0%)	0.0001
Group IV(n=41)	15 (36.6%)	13 (31.7%)	13(31.7%)	0.077	2 (4.9%)	39 (95.1%)	0.0001

Among neonates with birth weight >2.5kg maximum were in Group I i.e. 57 out of 87 (49.8 %). There was no significant co- relation found between study groups and birth weight of the neonates (P -value >0.05). On studying the Group wise distribution of APGAR score at 5 minute, it was seen that in Group I, 114 out of 115(99%) neonates had APGAR score >7/10, while in Group IV, 39 out of 41 (95%) neonates had an APGAR score of <7/10. On comparing all the Groups, there was a significant co-relation found between the incidence of low APGAR score and abnormal investigation. (P – Value <0.05).

Table 3: Adverse Neonatal Outcomes and their Co-Relation with Patient Groups

	NICU Admission (N= 57)	Duration of NICU stay		Need for Mechanical Ventilation (N=12)	Death (N=6)
		>7days (N=11)	<7 days (N=46)		
Group I (n =115)	01 (1.7%)	00	01 (2%)	00	00
Group II (n =15)	08 (14%)	00	08 (17.3%)	00	00
Group III (n=29)	09 (15.7%)	03 (27.2%)	06 (13%)	03 (25%)	00
Group IV (n=41)	39 (68.4%)	08 (72.2%)	31 (67.7%)	09 (75%)	06 (100%)

In Group I, only 1(0.9%) out of 115 neonates needed NICU admission while in group IV, 39 (95%) out of 41 required NICU admission. From the above Table, it is evident that, NICU admission was significantly higher in group II, III & IV when compared to Group I. The group IV neonates also had longer stay in NICU i.e. 67.7%, as compared to other groups. Need for mechanical ventilation was also higher in group IV, with 75% of those needing ventilation belonged to Group IV and 25 % to Group III, while none of those belonging to Group I & II required ventilation. In terms of neonatal deaths, amongst the total study group, there were 6 deaths, all belonging to group IV.Statistically significant correlation was found between abnormal test and adverse neonatal outcome (P – Value <0.05).

Table 4: Comparison of Neonatal Outcomes in Patients with Normal Doppler and Abnormal Doppler Study

Doppler (N=200)	APGAR Score		Need for NICU admission		Duration of NICU stay		Need for Mechanical ventilation		Death	
	<7/10	>7/10	Yes	No	<7 Days	>7 Days	Yes	No	Yes	No
Normal (n=144)	10 (6.9%)	134 (93.1%)	10 (6.9%)	134 (93.1%)	07 (70%)	03 (30%)	03 (02%)	141 (98%)	00	144 (100%)
Abnormal (n=56)	43 (76.7%)	13 (23.3%)	47 (84%)	09 (16%)	39 (83%)	08 (17%)	09 (16%)	47 (84%)	06 (11%)	50 (89%)
P-Value	0.0001		0.0002		0.344		0.0003		0.00001	

Out of the 200 patients in the study, 144 had normal Doppler findings, while 56 had abnormal Doppler. On comparing Apgar score between the 2 groups, it was found that the incidence of low Apgar score was significantly higher (P <0.05) in neonates of patients with abnormal Doppler study. In terms of NICU admission, again the need for NICU was significantly higher in neonates of cases with abnormal Doppler (P <0.05). Similarly, the need for mechanical ventilation and neonatal death were also significantly higher in neonates of the patients with abnormal Doppler.

Table 5: Comparison of Neonatal Outcomes in Patients with Reactive NST and Non Reactive NST

NST (N=200)	APGAR Score At 5 minutes		Need for NICU Admission		Duration of NICU stay		Need for mechanical ventilation		Death	
	<7/10	>7/10	Yes	No	<7 Days	>7 Days	Yes	No	Yes	No
Reactive (n=130)	05 (3.8%)	125 (96.2%)	09 (7%)	121 (93%)	09 (100%)	00	00	130 (100%)	00	130 (100%)
Non Reactive (n=70)	48 (68.5%)	22 (31.5%)	48 (68.5%)	22 (31.5%)	37 (77%)	11 (23%)	12 (17%)	58 (83%)	06 (8.5%)	64 (91.5%)
P-value	0.0001		0.0003		0.00001		0.0180		0.012	

Out of the total study group, 70 patients had non reactive NST. Amongst these, 48 (68.5%) had an APGAR score <7/10 & required NICU admission. Out of these, 11 (23%) had a NICU stay of >7 days, 12 (17%) required mechanical ventilation and 6 (8.5%) had neonatal deaths .The association between non reactive NST and poor neonatal outcomes was statistically significant (P <0.05).

Table 6: Comparison of Colour Doppler and NST Efficacy in Predicting Adverse Neonatal Outcomes

	APGAR Score <7/10		Need for NICU admission		Neonatal death	
	DOPPLER	NST	DOPPLER	NST	DOPPLER	NST
Sensitivity	81.1%%	90.5%	82.4%	84.2%	100 %	100%
Specificity	91.1%	85%	93.7%	84.6%%	74.2%	67%
Positive Predictive Value (PPV)	76.7%	68.57 %	82.4%	68.57%	10.7%	8.5%
Negative Predictive Value (NPV)	93%	96%	93%	93%	100%	100%

From the above table, we conclude that while NST was more sensitive than Doppler for prediction of adverse neonatal outcomes, Doppler was more specific. The Positive predictive value for Doppler was better than that of NST and Negative predictive value of NST was higher than that of Doppler.

4. Discussion

Antenatal fetal monitoring is an important aspect of management of pregnant females in order to ensure fetal safety and timely interventions to ensure good neonatal outcome. Doppler and NST are the main tools useful in this work.

In our study, we performed Doppler and NST for antenatal fetal well-being in 200 pregnant females beyond 34 weeks and followed them for perinatal outcome. Based on their investigation results, they were divided into following 4 groups-
Group I: Patients with both tests normal.
Group II: Patients with Abnormal Doppler study.
Group III: Patients with Non-reactive NST.
Group IV: Patients with both tests abnormal.

Sensitivity & specificity of Doppler & NST individually and in combination were assessed in predicting neonatal outcome was calculated and compared. Results were statistically analysed and compared with those of the similar studies conducted in past.

Table 1 shows Group-wise distribution of patients in the study, we observed that the majority of patients (57.5%) had both the tests normal followed by patients with both tests abnormal (20.5%). 14.5 % patients had a non reactive NST but normal Doppler and least were having abnormal Doppler with reactive NST (7.5%). This kind of distribution and majority patients belonging to normal tests group is because we included all antenatal Patients irrespective of their high risk status in our study. Even in the studies done on high risk patients by Choudhury et al[4] and Tambat et al[5] on 100 and 70 high risk pregnancies respectively, majority of patients had a normal Doppler & NST.This indicates high adaptability of feto-maternal physiology, which ensures fetal safety in majority of cases, irrespective of presence or absence of high risk factors.

Table 2 shows the group-wise Birth weight and APGAR score of the neonates. In Group I, 49.8%, 34.7%, & 15.6% neonates had birth weight >2.5 Kg, 2-2.5 Kg and <2 Kg respectively. No significant co-relation between birth weight and study Groups was found in our study.

In the study by Vijaya et al[8] it was found that in the Group with normal Doppler and reactive NST, majority (97.6%) had a birth weight >2.5 kg, in the group with abnormal Doppler and non reactive NST majority of neonates had a birth weight <2 kg. A significant co-relation was found in their study between birth weight <2 kg and abnormal investigation Groups.

In terms of APGAR score at 5 minutes, in our study, a total of 26.5% neonates were found to have an APGAR of <7/10. A significant co-relation between low APGAR score and abnormal investigations was seen.

In the study by Vijaya et al[6] amongst the 200 neonates studied by them, it was found that, while in Group with both investigations normal, none of the neonates had APGAR <7/10, in the Group with both investigations abnormal, 99% neonates were found to have a low APGAR score. In the Group with abnormal Doppler and reactive NST, they found 70% of the neonates to be having a low APGAR score,

while in the Group with normal Doppler and non-reactive NST, 65% neonates had a low APGAR score. They found a significant co-relation between low APGAR and abnormal antenatal studies.

Table 3 shows the comparison of adverse neonatal outcomes amongst different groups in the study, it was observed that a total of 28.5% neonates required NICU admission. Of these, the majority (68.4%) were from Group IV, 15.7 % belonged to Group III, followed by 14% patients from Group II. This relation between study Groups and need for NICU admission was statistically significant and was in accordance with the study by Vijaya et al[6], who found similar results, with majority of NICU admissions taking place from Group with both investigations abnormal.

When we took into consideration, the need for mechanical ventilation, we found that in our study, a total of 6 % neonates required mechanical ventilation, 3/4 of these were from Group IV. In the study by Vijaya et al[6] also, it was found that the need for mechanical ventilation was highest, when both Doppler and NST were abnormal. These observations suggest a greater extent of underlying damage to the fetus, when both the investigations are abnormal.

Amongst those with neonatal mortality, it was seen in our study that all the 6 cases of neonatal deaths belonged to Group IV. These results were in accordance with that of the study conducted by Hemvathy et al[8], where also 100 % mortality was seen in group with patients having both abnormal investigations.

Table 4 shows comparison of neonatal outcomes amongst patients with Normal and Abnormal Doppler studies, out of 56 patients who had abnormal Doppler study, 76.7% neonates had low APGAR score, 84% were admitted to NICU, 16% needed ventillatory support and 11% had neonatal death. In 144 patients with normal Doppler study only 6.9% were admitted to NICU, 2% needed ventillatory support and there was no neonatal death. In the study by Choudhury et al[4], 7 patients had abnormal Doppler findings and all of them were found to have adverse neonatal outcomes, while 93 neonates had normal Doppler and amongst these, 9 were found to have complications. In their study the co-relation between abnormal Doppler and adverse neonatal outcomes was found to be statistically significant and was in accordance with our study.

Table 5 shows comparison of neonatal outcome amongst patients with reactive and non-reactive NST, out of the 200 patients, 70 had abnormal NST findings. Out of these, 68.5 % neonates required NICU admission with 17% requiring mechanical ventilation and 8.5% neonatal deaths. In 130 patients with reactive NST there were only 7% NICU admission and no requirement of mechanical ventilation and no neonatal deaths .This is because NST indicates the integrity of autonomic nervous system (ANS) & any hypoxic injury to ANS is reflected upon by a non-reactive NST. Significant correlation was found between non reactive NST and adverse neonatal outcomes (P – value <0.05).

In the study conducted by Jamatia et al[7] on 100 cases of pre-eclampsia, it was found that NST was non-reactive in 32 cases (32%), out of these, 8 (25%) neonates had a low APGAR score, 19 (60%) required NICU admission and out of these, 2 (6.2%) neonatal deaths were observed. These results were statistically significant, suggestive of poor neonatal outcome, in presence of non-reactive NST.

In terms of sensitivity (Table 6), in our study, NST was better than Doppler study for prediction of APGAR score of neonates and is comparable for NICU admission and neonatal death. But Doppler had higher specificity than that of NST for low APGAR score, need for NICU admission and neonatal death. In terms of Negative predictive value, Doppler and NST were comparable, while Doppler had higher Positive predictive value than NST. In the study by Choudhury et al[4] Doppler was found to have a sensitivity of 43% and NST had a sensitivity of 12 %, while the specificity of Doppler was found to be 100% and for NST 94%.

5. Conclusion

From this study we conclude that abnormal Doppler study and non reactive NST were useful in predicting adverse neonatal outcomes in terms of low APGAR score, NICU admission, duration of NICU stay, requirement of ventilator support and neonatal deaths. However, no single test result should be considered for decision making because each test reflects different aspects of maternal and fetal pathophysiology. So it is advisable to repeat the test and combine with other modes of fetal surveillance before decision making to improve the perinatal outcome and for better prediction of adverse events.

References

[1] Gultekin- zootzmann B. the history of monitoring the human fetus. J. perinat. Med 1975;3:135-44.
[2] Ahmed M. Daver RG. Study of placental changes in pregnancy induced hypertension. Int J Reprod. Contracept. Obstetr. Gynecol.2016 Dec 13; 2(4):524-7.
[3] Goswami P, Lata H, Menon S, Khaskhalli LB. Excessive Placental Calcification observed in PIH patients and its relation to fetal outcome. JLUMHS 2012 Sep 1; 11(03):143-8.
[4] Choudhury N et al, assessment of Doppler velocimetry versus nonstress test in antepartum surveillance of high risk pregnancy Int J Reprod Contracept Obstet Gynecol 2017 Feb;6(2):663-670.
[5] Tambat, Anand & Chauhan, Ankita. (2016). Relationship of the Findings of Colour Doppler and Non-Stress Test with the Perinatal Outcome among the Cases of Intra-Uterine Growth Restriction. MVP Journal of Medical Sciences. 3. 115. 10.18311/mvpjms/2016/v3/i2/700.
[6] Subramanian V, Venkat J, Dhanapal M. Which is Superior, Doppler Velocimetry or Non-stress Test or Both in Predicting the Perinatal Outcome of High-Risk Pregnancies. *J Obstet Gynaecol India*. 2016;66(Suppl 1):149–156. doi:10.1007/s13224-015-0829-z.
[7] Jamatia et al, role of nonstress test in improvingthe perinatal outcome in pregnancies complicated by

preeclampsia. International journal of clinical obstetrics and gynaecology.3.30-35.

[8] K., Hymavathi; P., Prasuna; RANI, Davuluru Sandhya. Study of fetal doppler velocimetry versus non stress test as predictors of adverse perinatal outcome in high risk pregnancies. International Journal of Reproduction, Contraception, Obstetrics and Gynecology**,** [S.l.], v. 9, n. 2, p. 729-734, jan. 2020.