



Comparative Study Of Umbilical Artery Color Doppler Versus Non Stress Test As A Predictor Of Perinatal Outcome In High Risk Pregnancy

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Abstract

Aim and Objective: To evaluate the accuracy of NST and Umbilical Artery Doppler measurements as an antenatal screening test of fetal well-being in high risk pregnancies.

Material and methods: A Prospective cohort study conducted on 200 patients attending the antenatal OPD over a period of 18 months.

Results :

Conclusion: The Non Stress Test and Doppler Velocimetry both examine two different aspects of fetal circulation and should be considered complimentary to one another in monitoring High risk Pregnancies

Keywords: NIL

Introduction

The desire of every women contemplating motherhood is to culminate her pregnancy with a healthy offspring who has the potential to achieve the highest possible physical and mental growth. The aim of the antepartum monitoring is to detect fetal hypoxia at the earliest in order to prevent subsequent acidemia and brain damage. Antepartum fetal asphyxia is an important cause of still birth and neonatal death (1).

A high-risk pregnancy is one that threatens the health or life of the mother or her fetus. Antepartum fetal surveillance is of immense importance for detection of fetal compromise in utero in high risk pregnancies like gestational hypertension, diabetes mellitus, fetal growth restriction, post-dated pregnancy(2,3,4). Preeclampsia is a major cause of maternal and perinatal mortality and morbidity worldwide and responsible for 24% of all maternal deaths in India. (5, 6)

Non stress test (NST) is most commonly used for antepartum evaluation of fetal status. It is easy, non-invasive, easily performed and interpreted method by

which one can identify nearly twice as many fetuses with an abnormal fetal heart rate pattern than intermittent auscultation of fetal heart rate (2). At present NST is the most widely used and accepted method of antenatal fetal surveillance. It is based on hypothesis of intact neurologic coupling between fetal CNS and fetal heart (3). NST utilizes the observation that the occurrence of accelerations of the fetal heart rate in response to fetal movements is a reliable indicator of immediate fetal wellbeing. However an abnormal NST is nonspecific and warrants further tests. (7)

The use of Doppler ultrasonography for the evaluation of the fetal circulation is based on physical principal i.e. the frequency of sound wave change when reflected from a moving object and proportional to the velocity of moving object (Doppler Effect)(4).

It aims to evaluate blood flow in the vessels supplying the placenta and the fetus. The blood vessels most often used for evaluation in pregnancy are umbilical and middle cerebral arteries in the fetus. Significant Doppler changes occur with reduction in

fetal growth at a time when other fetal wellbeing tests are still normal. (8)

A decrease in the umbilical artery end diastolic velocity and increase in the Resistance Index or Pulsatility Index can be witnessed once 30% or more of the placental vasculature is abnormal.(9) Once 60-70% of the vasculature is affected, absent or reversed end diastolic flow results.(10) Reversed end diastolic flow is an ominous finding and is associated with a high mortality rate within 1-7 days if fetus is left in utero.(11) Doppler findings improve perinatal outcome in high risk pregnancies, reduces antenatal admissions, induction of labor and cesarean sections for fetal distress.(12,13)

This study aims to study two different aspects of fetal monitoring the NST and Doppler Velocimetry for monitoring high risk pregnancies with probable placental cause of pathology and to assess the perinatal outcome. Thus, find out the comparative usefulness of Doppler and NST in the management of FGR and severe preeclampsia and subsequent correlation with perinatal outcome.

The utility of each test will be assessed individually especially considering the fact that majority of obstetric decisions in a majority of institutions including ours at night are made solely of the basis of NST due to the non-availability of USG machines at all hours.

Aims & Objectives:

To compare and evaluate the rates of the accuracy of NST and Umbilical Artery Doppler measurements as an antenatal screening test of fetal well-being in high risk pregnancies. Comprison includes Abnormal test results, Successful induction of labor, Cesarean section rates for fetal distress, Fetal outcome and Perinatal outcome.

Materials & Methods:

1. Study design: Prospective cohort study
2. Study setting: Patients attending the antenatal OPD.
3. Study duration: 18 months
4. Sample size: 200

Inclusion Criteria:

All Singleton High Risk Pregnancies with placental cause of pregnancy complication like IUGR, preeclampsia, Gestational hypertension.

Exclusion Criteria:

1. Twins
2. IUD
3. Gestation age < 34 weeks

This study was started after the approval from institutional ethical committee was obtained. 200 high risk pregnant women detected to have the above mentioned high risk factors were enrolled in the study. The nature of this study was first explained to all the participants and then a written informed consent was obtained.

NST was be performed by using the Bistos BT350 test in a semi sitting position over a 20 minute period. Results are classified into normal or pathological according NICE Guidelines 2007 criteria updated in 2017.

In case of a suspicious NST it was repeated for 40 minutes.

For the purpose of statistical analysis normal was taken as reactive and suspicious and pathological as non-reactive.

Siemens-Acuson x150 color Doppler machine having a biconvex abdominal probe of 3.5 MHz frequency was used to perform umbilical artery Doppler. Following Indices were calculated in all 100 patients:

1. Pulsatility index
2. Resistance index
3. Systolic to diastolic ratio

Abnormal levels were considered if $RI > 0.70$, $PI > 0.99$ or S/D ratio value >3 .

Every case had an individualized approach & Timing of delivery was decided as per obstetrical guidelines relevant to case.

Statistical Methods:

The data in this study was analyzed using MS Excel for classification, graphs and statistical software Minitab (Ver 18).

The probability of significance, P value < 0.05 was taken as a limit of statistical significance.

Two proportions were compared with Two Proportion Test.

Observations & Results

Of the 200 study subjects, mean age in the NST group was 24.14 years and mean age in the Colour Doppler group was 24.39 years with a p value of 0.91. Both NST and Colour Doppler group had no significant statistical difference with regards to being Primigravida or Multigravida. Among the NST group , 34% patients had Gestational Hypertension and IUGR each while 32% patients had Preeclampsia ; in the Colour Doppler group 32% patients had Gestational Hypertension, 33% had preeclampsia and 35% had IUGR.. In the NST group, 55% patients had non reactive NST and in Umblical Artery PI group, 46% patients had abnormal umblical Artery PI. In the NST group , 16% patients had Gestational Hypertension, 17% patients had pre eclampsia and 22% patients had IUGR respectively. Similarly while evaluating Umblical Artery PI group, 9% patients had Gestational Hypertension, 15% patients had

Preeclampsia and 22 % patients had IUGR respectively.

Since the P value is more than 0.05, there is not enough evidence to conclude that there are differences among the NST group and Color Doppler Group percentage at the 0.05 level of significance for Onset of Labor, except Successful induction (P value is less than 0.05). Successful inductions proportions are coming from different population. The success of induction of labor might be dependent on some factor which might not be part of this study.

There is no statistical significance among the NST group and Color Doppler Group for each Mode of Delivery. 41% patients in NST group and 28% patients in Colour Doppler group had undergone Caesarean Section for foetal distress with a p value of 0.051 which is not statistically significant.

TABLE 1: Age Distribution on cases

Age group	NST Group	Colour Doppler Group	P value
≤ 20	17	15	0.700
21 – 25	55	49	0.395
26- 30	21	28	0.248
31 – 35	6	7	0.774
> 35	1	1	1
Total	100	100	
Mean Age	24.14	24.39	0.910

TABLE 2: Distribution of Gravidity

Gravidity	NST Group	Colour Doppler Group	P value
Primi	49	55	0.395
Gravida2	31	22	0.147
Gravida3	15	16	0.845

Gravida4	5	5	1.00
Gravida5	0	2	0.153

TABLE 3: Distribution of High risk cases

	NST Group		Color Doppler Group		P Value
Gestational Hypertension	34	34%	32	32%	0.764
Preeclampsia	32	32%	33	33%	0.880
IUGR	34	34%	35	35%	0.882

TABLE 4: Results of NST and UMBLICAL ARTERY PI

NST	PATIENTS(100)	UMBILICAL ARTERY PI	PATIENTS (100)
Reactive	45 (45%)	Normal	54 (54%)
Non reactive	55 (55%)	Abnormal	46 (46%)
Non-Reactive NST	Patients	Abnormal Umbilical Artery PI	Patients
Gest HTN	16	Gest HTN	9
Preeclampsia	17	Preeclampsia	15
IUGR	22	IUGR	22

TABLE 5: Onset of Labor

Onset Labour	Of	NST Group	Colour Doppler Group	P value
Spontaneous		44	35	0.191
Induced		54	57	0.669
Successful induction		16	36	0.001
Elective LSCS		2	8	0.101

TABLE 5: Mode of Delivery

	NST Group	Color Doppler Group	P value

Mode Of Delivery	N=100	%	N=100	%	
Vaginal	35	35%	42	42%	0.308
Instrumental	13	13%	12	12%	0.831
Caesarean Section	52	52%	46	46%	0.395

TABLE 6: Rate of Cesarean section for Fetal Distress

Cesarean Section For Fetal Distress	NST Group	Colour Doppler	P Value
No. Of Patients	41	28	0.051

TABLE 7: Prediction Using NST and Umbilical Artery PI :

NST	Poor Perinatal Outcome	Good Perinatal Outcome	
Non-Reactive	44	11	55
Reactive	19	26	45
Total	63	37	100
Umbilical artery PI			
Abnormal	35	11	46
Normal	16	38	54
Total	51	49	100

Discussion

This prospective study compares two tests of antenatal fetal well-being, Non Stress Test and Color Doppler for assessment of adverse perinatal outcome post-delivery. It was conducted in a tertiary care on 200 patients attending the ANC OPD were recruited for the study according to the inclusion criteria. These patients were randomly allocated into two groups by using computer software. 100 patients were subjected to Non Stress Test while the other 100 to Umbilical artery color Doppler. Those with abnormal results were induced and ones with normal results were followed up till spontaneous onset of labor or requirement of induction / cesarean section due to obstetric indications. Majority of the patients in this study 55% in NST group and 49% in Doppler group were in the age group of 21 to 25 years. This is

similar to the study conducted by N Choudhary et al in January 2017 in Sikkim Manipal University, Gangtok. ⁽¹⁴⁾. The mean age of the patients in the NST group was 24.14 years while in the Doppler group was 24.39 years which is not statistically significant. Majority of the patients were Primigravida 49% in the NST group and 55% in the Doppler group. The difference was not statistically significant.. NST was non-reactive in 55% of the cases and Umbilical Artery PI was abnormal in 46% of the cases. Onset of labor was spontaneous in 44% in NST group and 39% in Color Doppler group. 54% of the patients in the NST group were induced of which 16 patients delivered vaginally. In the Color Doppler group 57% of the cases were induced of which 36 patients delivered vaginally. In the current study the rate of successful induction of labor was significantly higher in UAD group (63.15% vs. 29.6% p<0.01) (table 13).

This result is in accordance with *Williams et al (2003)* who found that more patients in the Doppler group required an induction of labor than in NST group (4.8% versus 1.9% for UAD and NST respectively $p < 0.05$)⁽¹⁵⁾. Finding of our study could be attributed to the fact that Doppler assessment identified a higher proportion of patients with early placental compromise than NST which lead to successful induction of labor before the occurrence of placental decompensation. EI –Edessy et al showed 57.9% patient in Umbilical Artery group required inductions as compared to 18.2% in NST group. In our study 35% of the patients in the NST group and 42% of the patients in the Color Doppler group had vaginal delivery. Incidence of forceps delivery was 8% in NST group and 7% in Color Doppler group

and that of Ventouse delivery is 5% in each in NST and Doppler group. The NST group was associated with higher cesarean section rate for fetal distress than Color Doppler group (41 patients in NST group and 28 in Color Doppler group). This is accordance with *Williams et al, (2003)* who found the rate of CS for fetal distress to be (27% vs. 16% for NST and UAD respectively $p < 0.01$) and El Edessy et al 46.2% vs. 29.7% respectively $p = 0.02$. Overall poor perinatal outcome that including either meconium staining of liquor , low APGAR score or NICU admissions was seen in 44% of patient with nonreactive NST, 19% with reactive NST, 35% with Abnormal umbilical artery PI and 16% of patients with normal umbilical PI.

Comparison of Predictability of NST and Umbilical Artery Color Doppler:

TABLE 15: Comparison of Predictability of NST and Umbilical Artery Color Doppler

	NST Group	Umbilical Artery Color Doppler
Sensitivity	69.8%	68.62%
Specificity	70.27%	77.55%
Positive Predictive Value	80%	76%
Negative Predictive Value	57%	70%
Accuracy	70%	73%

Table 16: Efficacy of NST in predicting adverse perinatal outcome

	Fleischer et al	Tongsong et al	Eden et al	Phelan et al	Ramrekersingh et al	J Gonzalez et al	Current study
Sensitivity	57%	33%	17%	26%	33%	33%	69.8%
Specificity	85%	80%	88%	88%	93%	89%	70.27%
PPV	40%	40%	10%	16%	31%	50%	80%
NPV	98%	98%	93%	93%	93%	81%	57%

In our analysis, the sensitivity of NST was greater than that of previously reported studies, specificity was similar to the study conducted by Tongsong et al.

Table 17: Efficacy of PI of Umbilical Artery in predicting adverse perinatal outcome

	D.Gramellini et al	KW Fong et al	N Mahale et al	BN Lakhkar et al	Dandologarm et al	J Gonzalez et al	Current study
Sensitivity	64%	58.3%	55%	58%	64%	28%	68.62%
Specificity	90.7%	81.8%	86.6%	56.5%	90.7%	88%	77.55%
PPV	72.7%	22.2%	73.3%	35%	72.7%	42%	76%
NPV	86.7%	95.7%	74.2%	86.8%	86.7%	79%	70%

In our analysis the sensitivity of Umbilical artery PI is similar to study carried out by D Gramellini et al and Dandologarm et al, the specificity is similar to the study carried out by K W Fong et al.

Limitations Of Study:

Limited number of patients and Doppler assessment done only on the basis of umbilical artery Doppler other parameters like uterine artery Doppler, middle cerebral artery Doppler and cerebroplacental index were not taken into consideration. The significance of results of this study need to be reproduced, validated & supported by more similar studies on different population size & composition. Further analysis of the results on different risk parameters & long term neonatal follow-up, outcome considerations can be value addition to the conclusions.

Conclusion

The Non Stress Test and Doppler Velocimetry both examine two different aspects of fetal circulation and should be considered complimentary to one another in monitoring High risk Pregnancies like IUGR and Preeclampsia. Doppler depicts chronic hypoxic changes while NST can detect acute events in presence or absence of chronic hypoxia. Doppler Velocimetry gives an indication of imminent hypoxia /asphyxia earlier than NST.

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