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Non-Stress Test (NST) As a Test to Assess the Outcome of High-Risk Pregnancy

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Abstract
Background: *The antepartum assessment of fetal well being has now become an integral part of management of all pregnancies. To achieve this evaluation,various biochemical and biophysical techniques have been devised. Non-stress Test is one of the most widely used primarily testing methods for assessment of fetal well being.*
Objectives:*To evaluate the efficacy and diagnostic value of NST for antenatal surveillance To compare the mode of delivery with the test results*
Methods:*Study was carried out in the Department of Obstetrics and Gynaecology, J.J.M. Medical College, Davangere, for a period of 1 year. Patient population consisted of 200 singleton term pregnancies in first stage of labour. Non-stress test was performed for a period of 20 minutes. Test is reassuring if, there are two or more accelerations that peak at 15 bpm or more, each lasting for 15 seconds or more, within 20 minutes of beginning the test. If a reassuring test failed to occur within this 20 minutes, tracing continued for another 20 minutes to exclude the possibility of foetal sleep.*
Results:*The incidence of Reassuring Non-stress tests performed in patients at term pregnancy was 76 percent & Non- Reassuring tests was 24 percent. The incidence of LSCS and parameters of poor foetal outcome, like, incidence of foetal distress, incidence of Apgar Score<7 at 5 minutes and perinatal mortality was found to be more in NonReassuring groups of NST.*
Conclusion*:The specificity of NST is high that is, it can almost correctly identify those fetuses who are not at risk for foetal distress but ability to detect correctly those who are truly in distress that is, sensitivity of the test is low. So, Antepartum FHR testing, especially Non-Stress test is of accepted value in antepartum foetal surveillance of all pregnancies.*
Keywords: *Biophysical profile,Non Stress Test . Reactive / Reassuring ,Non Reactive / Non Reassuring/APGAR score.*

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I. Introduction

The antepartum assessment of fetal well being has now become an integral part of management of all pregnancies. To achieve this evaluation; various biochemical and biophysical techniques have been devised. The primary purpose of various antepartum surveillance techniques is to detect fetal distress, so as to prevent fetal death. Hence, these techniques aim to identify those babies that are at risk and separate them from the normal fetus in utero, who are not likely to be adversely affected.The early identification of fetus at risk of preventable morbidity or mortality; from utero placental insufficiency; due to maternal risk factors, placental disorders or fetal disease has become a major goal of perinatal medicine[1]

Routine electronic monitoring of fetal heart rate in labour is becoming an established obstetric practice in western world, but with few monitors available, there is a need to find a method without compromising fetal outcome. Even in low risk mothers, fetal acidosis can occur with equal frequency as in high risk group[2].Routine electronic monitoring is accepted in high risk women, but low risk women too require some reliable objective assessment to optimize the outcome. Non stress test may serve to address this problem. If is not only simple and inexpensive, it is also non-invasive, easily performed and interpreted. NST is a graphical recording of fetal heart activity and uterine contractions simultaneously. The non-stress test is primarily a test of fetal condition and it differs from CST which is test of uteroplacental function. It is one of the most widely used primarily testing methods for assessment of fetal well being and has also been incorporated into biological profile (BPP) system[3].

II. Objectives

• To evaluate the efficacy and diagnostic value of NST for antenatal surveillance and to compare the mode of delivery with the test results.
• To correlate the test results with different parameters of adverse fetal Outcome.

• Different parameters of fetal outcome such as intrapartum fetal distress, meconium stained amniotic fluid, decreased liquor quantity, cord factor, low Apgar score, perinatal death.

III. Methods

The study was carried out in the Department of Obstetrics and Gynaecology, Chigateri General Hospital, Bapuji Hospital, Women & Children Hospital, attached to J.J.M. Medical College, Davangere. 100 women with high risk pregnancies(study group)and 100 women with low risk pregnancies(control group) were randomly enrolled into study and followed up with NST (non-stress test) from 32 weeks of gestation and repeated at appropriate intervals.Informed consent was obtained from all the patients. Ethical clearance was obtained from the Institutional Ethics Committee.

Inclusion criteria

- Singleton, non-anomalous pregnancies of 32 weeks or more weeks of gestation.
- Only NST performed within 3-7 days prior to delivery will be considered for the fetal outcome.
- Patients with clinically suspected or diagnosed cases of IUGR, Preeclampsia, chronic hypertension, diabetes mellitus, previous fetal demise, decreased fetal movements, severe anemia, third trimester bleeding, post dated pregnancy, Rh isoimmunization, PROM, advanced maternal age (>35 yrs) are included in the study.

Exclusion criteria

- Sedative usage in the mother 24 hours before testing.
- Malpresentations, patients with previous LSCS and cephalopelvic disproportion.
- Gestational age of < 32 wks
- Major congenital anomaly of the fetus detected by routine antenatal ultrasound scanning

This was a prospective, observational study carried out between December 2010 to December 2011.Hundred females with high-risk pregnancy and 100 with low risk pregnancy were included in the study. Data was collected on a prestructuredproforma. The included participants were subjected to NST. NST was done using a Cardiotocograph with ultrasound transducer placed on maternal abdomen for duration of 20 min.NST was recorded weekly, biweekly, on alternate days or even daily basis depending on high risk factors and were followed up.The patient's BP and pulse rate was recorded every 10 minutes during the procedure.

Non-stress test : This test was performed in patients, admitted to wards or labour room for a period of 20 minutes.If a reassuring test failed to occur within this 20 minutes, extended upto 40 minutes for non reactivetraces.The NSTs were classified into 3 groups based on the presence or absence of atleast 2 FHR – accelerations of 15 bpm lasting for 15 seconds in a 20 minutes reading into

- **Reactive or normal test or reassuring test**(Two or more accelerations that peak at 15 bpm or more, each lasting for 15 seconds or more, and all occurring within 20 minutes of beginning the test)
- **Non reactive or abnormal test or non reassuring test**(At the end of 40 minutes if there were no qualifying accelerations, baseline variability less than 5 bpm, late decelerations with spontaneous uterine contractions, and variable decelerations, repetitive and lasting for more than 30 seconds)
- **Suspicious or Equivocal test** – in these cases, NST was done with vibroacoustic stimulation and extended to 40 minutes and the results were further classified as reactive or normal and non reactive or abnormal test based on the reactivity criteria. (Vibroacoustic stimulus was given with an artificial larynx of approximately 80 Hz and 82 dB for 1-3 seconds)

The patients were then followed up for the mode of delivery and the different variables of the perinatal outcome. At the time of delivery following data variables were collected like perinatal mortality, fetal distress during labour, 5 min Apgar score of > 7, meconium stained amniotic fluid (MSAF), decreased liquor and the cord factor.Chi square test and student t test were used to assess variables and to determine if there was a significant difference between the means of two groups.If the resulting P-value is < 0.05 we conclude that the groups are heterogenous and if p-value is > 0.05, the conclusion is that the groups do not differ significantly ie., they are homogenous.

Age (Years)	LR Group No. (%)	HR Group No. (%)
18-20	39 (39)	42 (42)
21-25	33 (33)	23 (23)
26-30	27 (27)	31 (31)
31 – 35	1 (1)	3 (3)
≥ 35 years	0	1 (1)
Total	100 (100)	100 (100)

TABLE NO.1 AGE DISTRIBUTION OF LOW RISK(HR) AND HIGH RISK(LR)PREGNANCY.

IV. Results:

A total of 100 females with high risk pregnancy and 100 with low risk pregnancy were included in the study. Table 1 show the age-wise distribution of the subjects. Maximum.The mean age for high risk and low risk were 23.26yrs and 22.69yrs respectively.There was no statistical difference in the mean age between the two groups as p>0.303.Primigravida were observed more frequently in the composition of low risk group(62%).However,multigravida were found more commonly in high risk group(67%).Among the 100 patients with high risk factors 30cases were of preeclampsia,20 cases of severe anemia, 15 cases of IUGR, 6 cases each of decreased fetal movements,5 cases of gestational diabetes mellitus,8 cases of prolonged pregnancy, 4 cases of placenta praevia,6 cases of PROM, 5 cases of previous IUD/still birth and 1 cases of advanced maternal age.

The patients in the HR and LR groups were classified based on the NST results into normal/reactive and abnormal/NR test result categories. The incidence of abnormal test result was 27% in the HR group and 21% in the LR group, as shown in Table 2.

NST Result	Low Risk group (n=100)	High Risk group (n=100)
Normal / Reactive test group	79 (79)	73 (73)
Abnormal / Non-reactive test group	21 (21)	27 (27)
Total	100 (100)	100 (100)

TABLE NO.2.DISTRIBUTION OF PATIENTS ACCORDING TO NST RESULTS.

The mean gestational age in low risk cases with reactive NST and non-reactive NST result were 37.84 weeks and 36.9 weeks respectively.There were statistical difference in the mean gestational age between the two results as p value is 0.000 as seen in Table no.3.The mean gestational age in high risk group with reactive and non reactive NST were 38.36 weeks and 37.05 weeks respectively.There was statistical difference between NST as p value 0.0001.

NST results	Number of subjects	Mean (weeks)	SD	95% confidence interval for mean		t-value	p-value
				Lower bound	Upper bound		
NR	21	36.90	0.301	37.75	37.92	10.543	0.000
R	79	37.84	0.373	38.15	38.32		
Total	100	37.64	0.523	37.54	37.74		

TABLE NO.3 DESCIPTIVE STATISTICS OF MEAN GESTATIONAL AGE IN LOW RISK GROUP BASED ON NST RESULTS

The patients in the present study were followed up for mode of delivery.27% and 56% underwent LSCS in low risk and high risk group respectively.In the low risk group,27% were induced for labour while in high risk group 28% were induced for labour. In low risk group,22.8% with reactive NST underwent LSCSand 42.9% of cases with non reactive NST underwent LSCS. .In high risk group,52.1% with reactive NST underwent LSCSand 66.7% of cases with non reactive NST underwent LSCS as seen in Table No.4

Mode of Delivery	Low Risk group		High Risk group	
	R (%) (n=79)	NR (%) (n= 21)	R (%) (n= 73)	NR (%) (n=27)
Vaginal	61 (77.2)	12 (57.1)	35 (47.9)	9 (33.3)
LSCS	18 (22.8)	9 (42.9)	38 (52.1)	18 (66.7)

TABLE NO.4 DISTRIBUTION OF CASES IN LOW RISK AND HIGH RISK GROUPS BASED ON MODE OF DELIVERY AND NST RESULT

In our study,14.3% and 18.5% of cases with non reactive NST developed intrapartum fetal distress (IPFD) in low risk and high risk respectively as seen in Table no.5.Among the low risk group there was no perinatal death in reactive NST group while there was one in non reactive group and the incidence of low Apgar score was not significantly between the non-reactive test group (P <0.354) compared to reactive test group.whereas in high risk group perinatal mortality rate was 1.4% in reactive NST group and 11.11% in non reactive NST group and the incidence of low Apgar score was more significant in non-reactive test group (p<0.043) compared to reactive test group as seen in Table No.6.The predictive accuracy of NST for perinatal mortality is tabulated in Table 7 The sensitivity of NST for predicting perinatal mortality was found to be 75% in the HR group, while it was 100% in the LR group as there were no perinatal deaths in the reactive test group among the LR group.

IPFD	LR-NST Result			HR-NST Result		
	R (n=79)	NR (n=21)	Total	R (n= 73)	NR (n=27)	Total
Present	2 (2.5)	3 (14.3)	5 (5.0)	4 (5.5)	5 (18.5)	9 (9.0)
Absent	77 (97.5)	18 (85.7)	95 (95.0)	69 (94.5)	22 (81.5)	91 (91.0)
Total	**79 (100)**	**21 (100)**	**100 (100)**	**73 (100)**	**27 (100)**	**100 (100)**

TABLE NO.5 DISTRIBUTION OF CASES WHO UNDERWENT LSCS IN FOR IPFD

The specificity and negative predictive value (NPV) for perinatal mortality were 75.04 and 98.63%, respectively, among high-risk pregnancies.NST was very specific among LR patients and picked up all the cases of perinatal deaths making specificity 79.79% and NPV 100% with a false-negative rate of 0%.

Parameter	LR Group				HR Group			
	R (n=79)	NR (n= 21)	Total	P-value	R (n=73)	NR (n= 27)	Total	P-value
Low Apgar score	9 (11.4)	4 (19.0)	13 (13)	0.354	11 (15.1)	9 (33.1)	20 (10)	0.043
Perinatal Mortality	0	1 (4.8)	1 (1)	0.136	1 (1.4)	3 (11.1)	4 (4.0)	0.41

TABLE NO.6 NEONATAL OUTCOME VARIABLES OBSERVED IN LOW RISK AND HIGH RISK GROUPS.

The sensitivity of NST for predicting LSCS performed for IPFD was 55.55% in high risk group and 60% for low risk group was statistically not significant.The specificity for low risk risk group was 81.05% with a NPV of 97.46% whereas for high risk group specificity was 75.82% with NPV of 94.52%.There was no statistically significant difference in predictive value among the two groups

V. Discussion

NST is one of the easiest test to perform and cost effective. There are considerable number of clinical literatures that support the use of NST in the management of high risk pregnancies. In our study majority were in the age group of 18-20 years of .However, in the study by Himabinduet al[4]50% of subjects were in the age group of 21-25 years, followed by 26-30 years and 18-20 years (23% each).

In the present study total number of cases with reactive NST was 76% and with non-reactive NST was 24%.This result is consistent with the study done by Himabindu et al[4]which showed 70% reactive and 30% non-reactive NST, Panchal et al[5] which showed 55% reactive and 45% non-reactive NST. Also, the study done by Mehta et al[6] showed similar results.

In our study 27% (27/100) of cases of high risk pregnancies were non reactive while in low risk group 21% (21/100) tests were non-reactive. The percentage of non-reactive tests in our study is almost similar to other studies, for example Nochimson DJ et al[7]in his study had 23.8% (187/786) non-reactive traces.

Perinatal Mortality	LR Group (%)	HR Group (%)	P-Value
Sensitivity	100	75	0.000
Specificity	79.79	75	0.397
PPV	4.76	11	0.118
NPV	100	98.63	0.23
FP	95.2	88.88	0.495
FN	0	1	0.90

TABLE NO.7 PREDICTIVE ACCURACY OF NST FOR PERINATAL MORTALITY

Mode of delivery in the study by Edessy et al[8] included 61% vaginal and 39% LSCS, study by Raouf et al[9] had 57.3% vaginal whereas 42.7% LSCS,in the present study 58.5% of the patient had vaginal delivery and 41.5% underwent LSCS which is comparable to the above mentioned studies.

In the present study 63.16% of women delivered vaginally with reactive NST and 36.84% of women delivered with caesarean section with reactive NST which was almost comparable to study done by Himabinduet al[10]and Deshpande et al[11]

According to Keegan K.A. et al[12] the very high false positive rates of NST could be diminished if there was a method of fetal stimulation by means of assuring the non-reactive fetus. For this purpose, vibroacoustic stimulation was used in our study to arouse the sleeping fetus as well as extended the testing time to 40 minutes.Schifrin BS et al[13]and Kubli F et al[14]have demonstrated good results with the use of NST in screening low risk pregnancy as shown similarly in our study.

There were 5 perinatal deaths in all among 200 pregnant women studied; 4 of them occurred in high risk group and 1 in low risk group.In low risk 1 death happened innon reactive NST group.In high risk group,perinatal mortality rate 1.4% in reactive group and 11.11% in non reactive group.

VI. Conclusion

The antenatal surveillance of high risk pregnancies with NST can effectively screen for identification of high risk fetuses and segregate the population that is at risk for perinatal mortality and morbidity.The use of NST in monitoring high risk pregnancies may result in an increase in the incidence of operative delivery as seen in our study (56% LSCS rate in high risk pregnancies when compared to 27% in low risk pregnancies) and hence, associated high LSCS rates has to be considered in such pregnancies.

In high risk group there was statistical significance of increased incidence of IPFD, low apgar score. Though the incidence mSAF, decreased liquor quantity, perinatal mortality was not statistically significant but it appears clinically significance.In low risk group incidence of IPFD, MSAF and decreased liquor quantity was statistically significant between the 2 groups (reactive and nonreactive). Though the incidence of low apgar score was statistically not significant but it appears clinically significant. NST can be effectively used in both high risk and low risk pregnancies.

In conclusion, NST is a valuable screening test for detecting fetal compromise in both HR and LR fetuses that may have a poor perinatal outcome. But, larger randomized controlled trials are needed to know if

the use of NST in HR and LR pregnancies for antenatal surveillance, benefit by a reduction in the incidence of adverse perinatal outcome.

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