# Evaluation of Non Stress Test in High Risk Pregnancy

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**Summary**

Antepartum fetal heart monitoring was carried out in high risk pregnancy with the non stress test (NST) as the primary means of surveillance with the aims of correlating the results of NST with different variables of adverse perinatal outcome and finding out the diagnostic value of the NST. Four hundred and thirty two NSTs were carried out in 204 high risk pregnancies detected amongst patients attending antenatal clinic or admitted to a teaching armed forces hospital. Nonreactive NST were associated with significant increase in cesarean rate for fetal distress (20%). There was no significant difference in the over all cesarean rate and instrumental delivery. Non-reactive patterns correlated with significant poorer perinatal outcome in terms of incidence of fetal distress in labour (24%), low Apgar scores (32%), admission to neonatal intensive care unit (20%), neonatal seizures (12%), low birth weight (40%) and perinatal mortality (12%). Overall diagnostic values of NST observed in the present study were, sensitivity 41%, specificity 94%, positive predictive value 83%, negative predictive value 72%, accuracy 74% and prevalence 38%. NST as a primary mean of surveillance in high risk pregnancy is a reliable diagnostic approach.

## Introduction

Non-stress test as a biophysical method of antepartum fetal heart rate monitoring has become an established diagnostic tool for fetal surveillance in high risk pregnancy. Its ease of administration, lack of contraindications, less expense, easy interpretability and less frequency of equivocal results has made it replace contraction stress test as the primary means of surveillance. The rationale of nonstress test for antepartum evaluation is that the presence of accelerations of fetal heart rate with fetal movement indicates intact, responsive central nervous system mechanisms that are reflected by these changes.

A number of studies have reported correlation of abnormal nonstress test result with poor perinatal outcome. Nonreactive NST has been found to be associated with increased incidence of evidence of fetal distress in labour, low Apgar scores, IUGR, neonatal seizures, admission to special care nursery and perinatal mortality (Keane et al, 1981, Keegan and Paul 1980, Manning et al 1984, Baskett et al 1984). Good perinatal outcome has been found following antepartum monitoring with NST (Dastur et al 1982, Desai et al 1984). Although most of the studies have proved diagnostic value of NST, there has been a wide variation in the composition of study population monitored, gestational age at the inception of monitoring, frequency of testing, interpretative criteria, clinical response to test outcome, testing conditions and interval to delivery. Similarly sensitivity, specificity, predictive value and prevalence have also varied.

In the present study we have used NST as primary approach in the antepartum electronic fetal heart rate monitoring of high risk pregnancy. An attempt has been made to correlate results of NST with various variables of adverse perinatal outcome and find out the diagnostic value of NST.

## Material and Methods

This study was carried out in a teaching armed forces hospital providing maternity services to the families of armed forces personnel. The study population comprised of high risk pregnancy, detected amongst the patients attending antenatal clinic in the outpatient or admitted to the hospital. Two hundred and four high risk pregnancies were studied. NST was used as a primary means of surveillance. Testing was routinely commenced at 32 weeks of gestation and later if the high risk factor was identified subsequently. Frequency of testing was weekly in outpatients and biweekly in inpatients. Corometrics 115 Fetal Monitor was used. NST was performed in 60 degrees semi Fowler's position to avoid supine hypertension syndrome. Acceleration of fetal heart rate was defined as an increase of atleast 15 bpm above baseline, lasting atleast 15 sec. If there were two or more accelerations of fetal heart rate with fetal movements in 20 minutes window, manual stimulation of fetus for 60 sec was done; followed by recording for another 20 min. Test was terminated at the end of this second 20 min period.

**Interpretation of results of NST:**

(a) Reactive pattern: Two or more accelerations of fetal heart rate associated with fetal movement in 20 min diagnostic window, of atleast 15 bm above baseline lasting for atleast 15 sec, and baseline variability of more than 10 bpm

(b) Nonreactive pattern: Any trace not showing above criteria at the end of 40 mm of recording.

Reactive NST were repeated weekly for outpatients and biweekly for in patients. Nonreactive NST were repeated after 24 hr and if negative, were further evaluated for delivery. Facility of ultrasound scanning was available to all the patients. All patients were delivered in hospital.

Results of NST were correlated with the mode of delivery and the following variables of adverse permatal outcome

(a) fetal distress in labour
(b) 1 and 5 min Apgar < 7
(c) admission to NICU
(d) neonatal seizures
(e) low birth weight
(f) perintal mortality

Diagnostic values of NST were calculated in terms of different measures of adverse perintal outcome. Discrete variables are presented as cross tabulations. Chi square test has been used for frequency data. Standard 'four fold' format has been used to calculate various diagnostic values of NST.

## Results

Results of 432 NST carried out in 204 pregnancies have been tabulated and analysed. Intrauterine growth retardation formed the commonest indication in the study comprising 20.5% of cases, closely followed by bad obstetric history 20% , postterm pregnancy (17.2%) and hypertensive disorders in pregnancy (14.7%) (Table I). 64.5 % of cases were in the age group 18-25 years. 37.7% of high risk population studied were of parity 1, and 28.99% were multiparae. Gestational age at the inception of monitoring was 32-34 weeks in 52.4% of cases (Table II). Of the 432 tests carried out on 204 patients, 375 (86.8%) showed reactive pattern and 57 (13.2%) nonreactive one.

**Table I: Primary indications for monitoring**

| Indication | No of patients (%) (N=204) |
|---|---|
| Intrauterine growth retardation | 42 (20.5) |
| Bad obstetric history | 41 (20.0) |
| Post term pregnancy | 35 (17.3) |
| Hypertensive disorders in pregnancy | 30 (14.7) |
| Decreased fetal movements | 21 (10.3) |
| Rhesus incompatibility | 18 (8.9) |
| Antepartum hemorrhage | 10 (4.9) |
| Rheumatic heart disease | 04 (1.9) |
| Diabetes mellitus | 03 (1.5) |

**Table II: Gestational age at the inception of monitoring**

| Gestational age in weeks | No of patients (%) (N=204) |
|---|---|
| < 34 | 13 (6.4) |
| 34-36 | 107 (52.5) |
| 37-39 | 28 (13.8) |
| 40-42 | 21 (10.2) |
| > 42 | 35 (17.1) |

Correlation of last pattern with mode of delivery is shown in Table III. There was no significant difference between two patterns with number of vaginal or instrumental deliveries. Though there was no significant difference between cesarean rates in the two NST pattern groups, cesarean rate for fetal distress in the nonreactive group was 20% as compared to 2.2% in the reactive group a difference highly significant (P< 0.001). Correlation of last NST pattern with adverse perinatal outcome is shown in Table V. All measures of adverse perinatal outcome were found significantly higher with the nonreactive pattern.

Table III: Correlation of last NST pattern with mode of delivery

| Mode of Delivery | Reactive N=179 | Nonreactive N=25 | Chi square value | Remarks |
|---|---|---|---|---|
| Normal Vaginal | 115 (64.2) | 12 (48) | 2.466 | P>0.1 NS |
| Vaginal Breech | 10 (5.5) | 01 (4.0) | 1.360 | P>0.1NS |
| Vacuum Forceps | | | | |
| Primary Indication: | | | | |
| (a) Fetal Distress | 01 (0.5) | 01 (0.4) | 2.161 | P>0.1NS |
| (b) Others | 18 (10.1) | 03 (12) | 0.088 | P>0.5NS |
| Total | 19 (10.0) | 04 (16.0) | 0.655 | P>0.1NS |
| Cesarean section | | | | |
| Primary Indication: | | | | |
| (d) Fetal Distress | 04 (2.2) | 05 (20) | 16.465 | P<0.001HS |
| (e) Others | 31 (16.) | 03 (12) | 0.433 | P>0.5NS |
| (f) Total | 35 (18.9) | 08 (32) | 2.001 | P>0.1NS |

Note: NS not significant, HS highly significant. Figures in parenthesis indicate percentage

Table IV: Correlation of last NST pattern with perinatal outcome

| Measure of Perinatal outcome | Reactive N=179 | Nonreactive N=25 | Chi square Value | Remarks |
|---|---|---|---|---|
| Fetal Distress in Labour | 05 (2.8) | 06 (24) | 27.186 | P< 0.001 HS |
| Apgar Score * | | | | |
| (a) 1 min | 10 (5.6) | 08 (32) | 18.396 | P< 0.001 HS |
| (b) 5 min | 03 (1.7) | 03 (12) | 08.271 | P< 0.005 HS |
| * Admission to NICU | 12 (6.8) | 05 (20) | 06.191 | P< 0.02 S |
| * Neonatal Seizures | 03 (1.7) | 03 (12) | 9.600 | P< 0.005 HS |
| Low Birth Weight | 37 (20.7) | 10 (40) | 4.674 | P< 0.05 S |
| Perinatal Deaths | 03 (1.67) | 03 (12) | 8.270 | P< 0.005 HS |

Note: * Percentage live borns, HS highly significant, and S significant. Figures in parenthesis indicate percentage

Table V: Percentage diagnostic values of NST in terms of various measures of adverse perinatal outcome

| Variable | Sensitivity | Specificity | Positive Predictive Value | Negative Predictive Value | Accuracy | Prevalence |
|---|---|---|---|---|---|---|
| Fetal Distress In Labor | 54 | 90 | 24 | 97 | 88 | 05 |
| Apgar * | | | | | | |
| (a) 1 min | 44 | 90 | 32 | 94 | 86 | 08 |
| (b) 5 min | 50 | 88 | 12 | 98 | 87 | 02 |
| Perinatal Deaths | 50 | 88 | 12 | 98 | 87 | 02 |
| Admission To NICU | 18 | 84 | 09 | 94 | 85 | 05 |
| Low Birth Weight | 21 | 09 | 40 | 79 | 74 | 23 |
| Neonatal Seizures | 50 | 90 | 13 | 98 | 88 | 03 |
| Above all Combined* | 41 | 94 | 83 | 72 | 74 | 38 |

Note: 18 of 25 nonreactive NST had more than one adverse perinatal outcome factors

## Discussion

The composition of high risk population in various studies has varied widely. Of the various studies only few are considered as subsets of same population (Platt et al 1983, Goldkrand & Benjamin 1984 and Barrett et al 1981). The most common indications for the test in various series were postterm pregnancy, hypertension, and IUGR. In the study of Rochard et al (1976) Rhesus isoimmunisation comprised 50% of cases. In our series, IUGR was the most common indication (20.5%), followed by bad obstetric history (20%), post term pregnancy (17.2%) and hypertensive disorders (14.7%).

Gestational age at the inception of monitoring has varied from 24 weeks to 32 weeks in various series (McCune et al 1983, Keegan and Paul 1980, Keane et al 1981). Bishop (1981) observed a high frequency of (30-36%) nonreactive tests in a low risk population when fetal assessment was performed prior to 30 weeks. This rate declined to 6% after 34 weeks. In our series, in 52.5% of cases testing was started at 34-36 weeks.

Interpretative criteria in various series have varied widely. Minimum of 2 accelerations of 15bpm lasting for 15 sec in 20-min diagnostic window have been used in most of the studies (Keegan and Paul 1980, Baskett et al 1984, Manning et al 1984). In our study we have included baseline variability of > 10 bpm also in addition to number of accelerations as it has been reported to increase the diagnostic value (Devoe et al 1983).

Percentage of reactive tests in various series has ranged from 78-93%. (Manning et al 1984, Barrett et al 1981). Reactivity of 87% in our study compares favorably. The average number of tests per patient of 2.1 compares favourably with 1-3.1 reported by other (Platt et al 1983, Phelan 1981). True positivity of 12.5% was found in present study as compared to 2.8-29.4% reported by others (Keane et al 1981, Phelan 1981). False negative test rate reported varies from 0.3-1.3% (Keane et al 1981, Manning et al 1984, Platt et al 1983). In our study it was marginally higher at 1.6%.

64.2% of reactive patterns were associated with normal vaginal delivery as compared to 48% with nonreactive pattern but this difference was not significant. Similarly a marginally higher rate of 16% instrumental delivery in nonreactive pattern as compared to 10.6% in reactive pattern was not significant and compares favourably with that reported by Lumley et al (1983). There was no significant increase in overall cesarean rate in the nonreactive (32%) and reactive groups (18.9%), which is similar to that observed by Lumley et al (1983), though Keane et al (1981) have reported a significant increase. But the cesarean rate for fetal distress in labour was significantly more with nonreactive pattern (20%) as compared to that (2.2% with reactive pattern, which is similar to that reported by Keegan and Paul (1980).

Nonreactive pattern was associated with significantly increased incidence of fetal distress in labour, low Apgar scores admission to NICU, low birth weight neonatal seizures and perinatal mortality. This is similar to that reported in various other studies (Keane et al 1981, Keegan and Paul 1980, Platt et al 1983).

Sensitivity of NST in most series ranges from 21-57% (Baskett et al 1984, Platt et al 1983, Manning et al 1984). Value of 41% in the present series compare favourably. But Shantha et al (1989) in their series which comprised 59% of hypertensive disorder cases have reported a higher sensitivity of 80%. Specificity of 94% in the present study also compares favourably to 82-94% reported (Phelan et al 1981, Platt et al 1983). Positive predictive value of 83% is similar to that reported by Keane et al (1981). Negative predictive value of 72% is on the lower side of the values from 73-98% reported in other series (Goldkrand and Benjamin 1984, Manning et al 1984). A higher prevalence of 38% was found in our study as compared to 4-30% reported by others (Manning et al 1984, Keane et al 1981).

Devoe et al (1983) after analyzing a large number of studies in order to assess the status of NST as a diagnostic test observed that the minimum diagnostic values that should be satisfied were sensitivity 50%, specificity 94%, positive predictive value 50% and negative predictive value 94%. They derived these with assumption of a disease prevalence of 10%. In our study overall specificity (94%) and positive predictive value (83%) fulfill these criteria. A lower sensitivity of 41% could have increased by increasing the number of accelerations to more than 2 and increasing the observation time, as reported by Devoe et al (1983). But increasing the accelerations would have decreased the high positive predictive value observed. A higher prevalence of 38% explains the higher positive predictive value (83%) and lower negative predictive value (72%) as compared to 94% defined by above criteria.

## Conclusion

Antepartum fetal heart rate monitoring in high risk pregnancy with Non Stress Test as the primary means of surveillance is a reliable diagnostic approach. Nonreactive tests are associated with statistically significant increase in cesarean rate for fetal distress.

Nonreactive patterns correlate with statistically significant poorer perinatal outcome in terms of incidence of fetal distress in labour, low Apgar scores, admission to neonatal intensive care unit, neonatal seizures, low birth weight and perinatal mortality.

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