THE VALUE OF NONSTRESS TEST IN THE ASSESSMENT OF FETAL WELL BEING BEFORE 34 WEEKS OF GESTATION - A PROSPECTIVE ANALYSIS

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SUMMARY

The purpose of the present study was to evaluate prospectively the fetal heart rate characteristics and determine fetal heart rate and fetal movement relations and the value of nonstress test (NST) in low risk pregnancies between 26 and 34 weeks. Twenty patients were enrolled in the study. Periodic NST with two weeks intervals were performed from 26 to 34 weeks. In a 30 minutes period fetal movements and fetal heart rate tracings were evaluated. Peripartum events, intrapartum fetal heart rate tracings, Apgar scores of the neonate were also recorded. There was a significant decrease in baseline fetal heart rate and a significant increase in the mean amplitude of accelerations after 30th week of gestation. The ratio of fetal movement associated with accelarations exceeding 10 bpm were 31.35, 38.3, 52.75, 68.25 and 84%, the ratio of reactive tests were 5, 40, 65, 90 and 100% for 26, 28, 30, 32 and 34 weeks respectively. It appears that NST is a useful technique in the assessment of well being for premature fetuses as well, especially after 30 weeks of gestation. However the criteria for interpretation of the tracings of these fetuses should be reevaluated and a consensus should be achieved.

Key Words: Nonstress Test, Prematurity

INTRODUCTION

Since the earlier studies of Lee el al (1) and Rochar et al (2) nonstress testing is of recognised value in the assessment of fetal well being. Presence of fetal heart rate (FHR) accelerations associated with fetal body movements (FBM) is accepted as a good indicator of fetal well being especially for mature fetuses. Because of the well known increased false positivity in earlier gestational weeks nonstress test (NST) did not gain popularity for less mature fetuses. There is relatively less information on the relation between FM and FHR accelerations, and criteria for a reactive NST in earlier gestational weeks.

Our purpose was to evaluate prospectively the FHR characteristics and determine FHR and FM relations and value of NST on low risk fetuses between 26 and 34 weeks.

MATERIAL AND METHODS

After informed consent was obtained, 24 pregnant women (18 primigravid and 6 multigravid) were enrolled in the study. None of them was in high risk group. Gestational ages were determined according to the first day of last menstrual period and confirmed by ultrasonographic measurements of biparietal diameter and femur length between 16 and 20 weeks of gestation. No medications but vitamins and iron fumarate were taken by the patients.

Nonstress tests were begun at 26 weeks and performed with two weeks intervals up to 34 weeks of gestation. All tests were performed by the same observer on a Corometrics 115 fetal monitor (Corometrics Medical Systems, Inc. Connecticut USA.) patient being on Semi-Fowler position and within two hours after a customary meal. In a 30 minutes recording period with a rate of 3 cm/min. Fetal movements (felt both by the mother and the observer who kept her hand on patient's abdomen) were recorded in two groups as gross body movements (GBM) and isolated extremity movements (IEM). If no FBM were observed the test was extended to another 30 minutes.

Data Analysis

The FHR tracings were then reevaluated by the observer and one of the authors. Baseline heart rate, accelerations, decelerations and their relation with FM were recorded. The tracings were interpretated in different ways using four different definitions for FBM associated with FHR accelerations.

I: Only GBM associated with accelerations exceeding 15 bpm
II: Only GBM associated with acelerations exceeding 10 bpm.
III: Both GBM and IEM associated with accelerations exceeding 15 bpm.
IV: Both GBM and IEM associated with accelerations exceeding 10 bpm.

NST was accepted as reactive if there was three or more FHR accelerations associated with FBM and if accelerations were present at least in half of FBM. If the number of FBM associated accelerations were less than three in 30 minutes the test was considered as non-reactive. The tracings which did not meet these criteria were accepted as equivocal.

Except 4 patients who had no follow-up visits, all patients (n = 20) continued their routine antenatal visits and were delivered in our clinic. These four patients were excluded from the study. Peripartum events and problems of the neonate were also recorded. All neonates were examined by pediatricians and gestational ages were confirmed according to Ballard system.

Statistical analysis

The significance of differences in the means for all variables were examined by Student t test.

RESULTS

A hundred tracings were obtained at the end of the study. Mean baseline FHR for each gestational week are shown in table I. There was a statistically significant decrease in the mean baseline FHR from 26 to 34 weeks ($p<0.0005$). Long term variability was normal in all of the tracings obtained.

Mean spontaneous and FBM associated with FHR decelerations decreased from 6 for 26th. week to 1.25 for 34th week.

Except one of the patients who delivered at 35 weeks all patients delivered at term. Mean duration of gestation was 38.25 weeks. Three cesarian sections were performed with indications of cephalopelvic disproportion, breech presentation and elderly primigravida. One of the patients was delivered by vacuum extraction because of persistant fetal bradycardia at the second stage. The Apgar scores of all babies were greater than 7 at 5th minutes after delivery.

The mean amplitude of FHR accelerations associated with FM for all gestational weeks are shown in table II. The mean amplitude of accelerations showed a significant increase at 30th week. The ratio of accelerations exceeding 15 bpm to all accelerations increased significantly from 24.77 % at 26th week to 54.13% at 34th week. The number of accelerations exceeding 15 bpm and between 10 and 15 bpm in amplitude for each gestational week are shown in table III.

The ratio of reactive, non-reactive and equivocal tests according to four interpretation criteria are shown in figure 1. When the accelerations exceeding 10 bpm associated with gross body movements were taken into account only 5 % of the tracings was accepted as reactive at 26th week. This increased to 40, 65, 90 and 100% at 28, 30, 32 and 34 weeks respectively. Once the NST was reactive, the consequtive tests remained reactive till the end of the study.

Fig 2 shows the relation of the fetal birth weights and the gestational week at which the NST became reactive. It seems that the earlier the NST becomes reactive, the higher the fetal birth weight.

False positivity rate of NST according to different interpretation criteria are shown in table IV for all gestational weeks.

Table I- Mean baseline FHR

Gestational Week	Mean Baseline FHR
26	158 ± 6.76
28	155 ± 7.77
30	146 ± 8.20*
32	146 ± 6.99
34	142 ± 7.50

* The difference in baseline FHR is significantly different from earlier gestational weeks ($p<0.005$)

Table II- Mean amplitude of spontaneous and FM associated FHR accelerations

Gestational Week	Mean amplitude of accelerations
26	11.83 ± 2.81
28	13.41 ± 2.73
30	16.17 ± 4.10*
32	17.38 ± 6.26
34	20.52 ± 7.14

* ($p<0.005$)

Table III- The ratio of FBM associated with FHR accelerations

Gest. Week	GBM > 15 bpm	GBM 10<&<15 bpm	IEM >15 bpm	IEM 10<&<15 bpm
26	14%	20.8	5.5%	22.4%
28	18.4%	27.6%	8.3%	22.3%
30	21.6%	34.5%	16.7%	28.2%
32	35.2%	35.9%	28.6%	36.8%
34	59.2%	30.9%	45.8%	32.1%

Table IV- The false positivity rates of NST for different interpretation criteria

Gest. Week	False Positivity Rate (%) I	II	III	IV
26	40	35	50	50
28	35	30	45	35
30	20	15	40	25
32	5	5	40	20
34	0	0	30	15

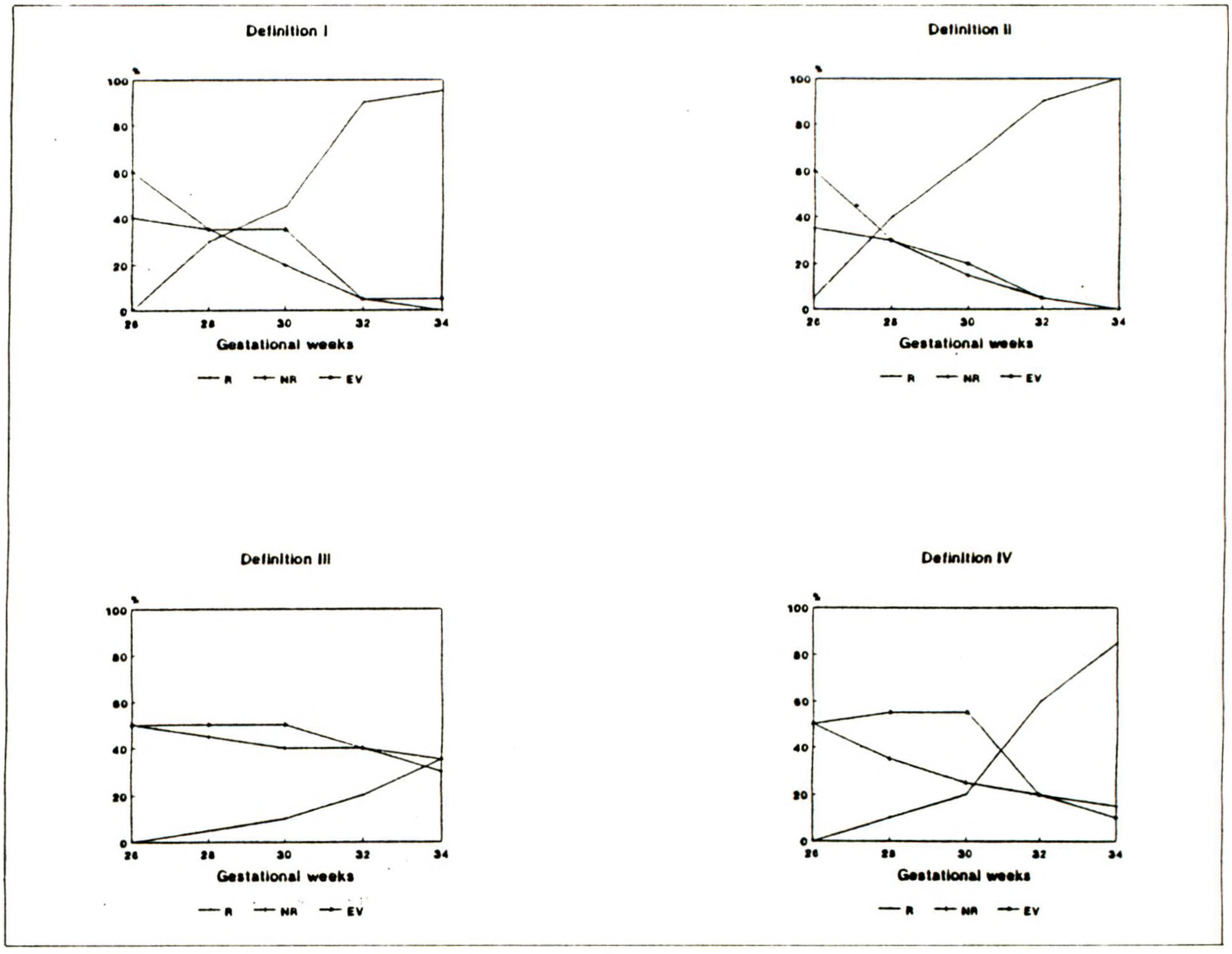

Fig. 1: The ratio of reactive (R) nonreactive (NR) and equivocal (EV) tests according to four different criteria for interpretation

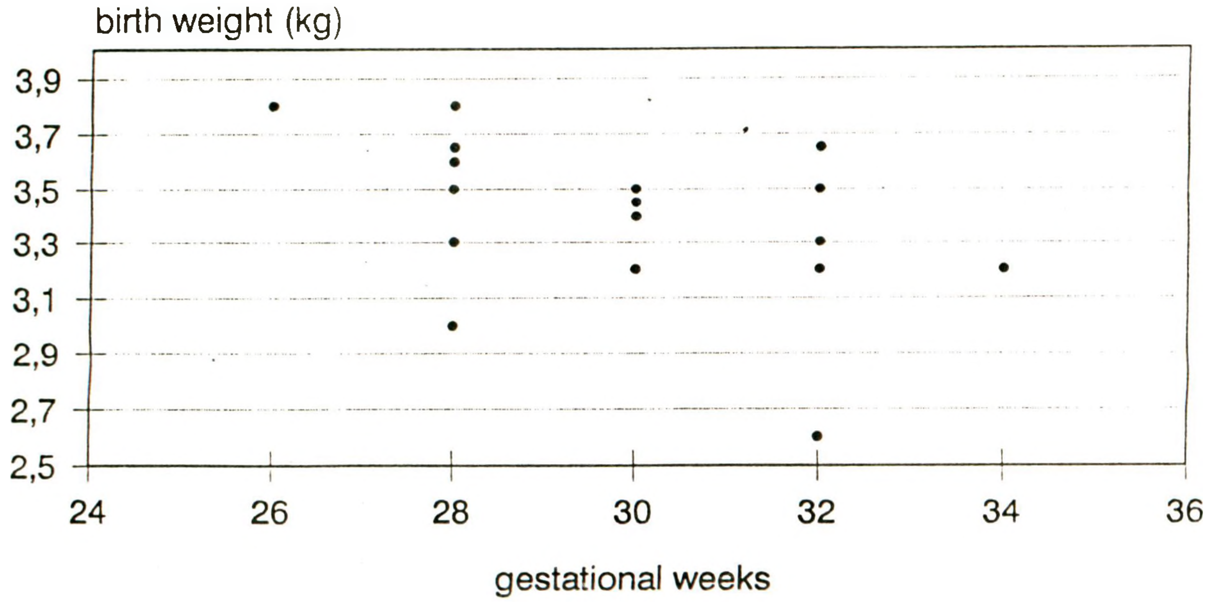

Fig. 2: The relation between the birth weights and the gestational week at which NST became reactive

DISCUSSION

In recent years number of iatrogenic preterm deliveries for high risk patients increased significantly. With improving survival rates, some very low birth weights are believed to do better in a neonatal intensive care unit than in a hostile intrauterine environment (3). The antepartum surveillance tests here becomes the major factor which determines clinicians' consideration for delivery or intrauterine fetal care.

However, in earlier gestational weeks the reliability of tests depending on fetal heart rate monitoring is generally accepted to be low because of the high ratio of false positive tests. Nonstress test is usually accepted to be of diagnostic value only after 32 weeks of gestation (4), and this is ascribed to the immaturity of the fetal heart rate reactivity center which is located in posterior hypothalamus. This center achieves functional capabilities by the end of second or early third trimester (5). Tonic parasympathetic influence on fetal heart rate is minimal in the first 100 days of gestation and becomes increasingly important after 100 to 120 days. Thus resting fetal heart rate is high at midgestation (attributable in part to a relatively high degree of sympathetic and low degree of parasympathetic control) and decreases as gestation progresses and parasympathetic tone increases (6).

Although NST is widely used for mature fetuses, there is no clear cut consensus on the reactivity criteria. Twenty-one different criteria were described in 45 studies performed between 1978 and 1984. In some of these studies even the gestational weeks were not mentioned (7,8). For less mature fetuses the condition was far less clear.

Earlier studies on preterm fetuses suggested that the nonstress test before 32 weeks was an unreliable predictor of fetal well being (9). But some authors accepted nonstress test as a suitable technique for assessing the fetal well being of preterm fetus (10,11).

In our study mean baseline FHR were significantly high at 26 and 28 weeks, indeed they were just below the upper limit of normal FHR. For such a high baseline FHR; accelerations exceeding 15 bpm occured less frequently and the ratio of accelerations between 10 and 15 bpm was relatively high. At 30th week a significant fall occured in the mean baseline FHR and the amplitude of accerelations increased significantly. Natale et al reported similar results. The ratio of FHR accelerations exceeding 15 bpm was found to rise to 46% at 30-32 weeks from 20,6 % at 24-26 weeks (12).

It seemed that at 30th week of gestation the fetal heart rate characteristics reached the mature state and only there after NST (with generally accepted criteria) could be used in the assessment of fetal well being. The baseline FHR and characteristics of FHR accelerations were different before 30th week and the definition of acceleration as an increase of 15 bpm from the baseline was not applicable to the tracings prior to this week.

When definition II (FHR accelerations exceeding 10 beat per minute associated with only GBM) was accepted to define an acceleration the ratio of reactive tests would be 5, 40, 65, 90 and 100 % for 26, 28, 30, 32 and 34 weeks of gestation. For definition III (FHR accelerations exceeding 15 beat per minute associated with all fetal movements) these would be 0, 5, 10, 20 and 35% respectively. All of the patients in our study group delivered uneventfully and all of the neonates had good Apgar scores. Because of this all of the non reactive tests were accepted as false positive. The false positive rates of NST in the present study demonstrated that NST is a reliable test after 30 weeks of gestation. Prior to this week only GBM associated with accelerations exceeding 10 bpm in amplitude has to be considered and yet a relatively low false positivity rate has to be anticipated.

Similar to our findings Gagnon et al reported that there was no difference in the mean FHR and acceleration amplitude between 30 and 40 weeks. They suggested that, the currently used definition of an acceleration as exceeding basal heart rate equal or more than 15 beat per minute and longer than 15 seconds could be accepted only after 30 weeks. Decreasing the amplitude to 10 beat per minute to define an acceleration would be suitable at 26-28 weeks (13).

NST is a rapid, relatively less expensive and easy to perform test which requires relatively less skilled personnel, and should complement the risking system even for the fetuses before 32 weeks. However the commonly accepted criteria for interpretation is not applicable to the relatively high baseline FHR and low amplitude FHR accelerations of these premature fetuses. The future studies with larger groups will enlighten the new criteria for interpretation of NST in premature fetuses, especially before 30 weeks of gestation.

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