Research Open

Integrative Gynecology and Obstetrics Journal

Volume 2 Issue 1

Research Article

Prevalence of Nonreactive Non-Stress Test in Low Versus High Risk Pregnancy

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Received: December 08, 2018; **Accepted:** December 21, 2018; **Published:** January 08, 2019;

Abstract

Objective: To determine the prevalence of non-reactive non-stress test (NST) in low risk and high risk pregnant women.

Materials and Methods: This prospective cohort study enrolled pregnant women with gestational age of 32 weeks or more who had been offered NST by their obstetricians at the antenatal clinic, King Chulalongkorn Memorial Hospital. High risk group were defined as having any maternal, fetal or placental risk factors. The NST result was interpreted by at least two obstetricians. All participants were followed until delivery and perinatal outcomes were recorded.

Results: A total number of 1,168 participants with 1,261 NST tests were included. 782 tests (62%) were offered to low risk and 479 tests (38%) to high risk group. Decrease in weight and maternal diabetes mellitus was the most common indication for low risk and high risk group, respectively. Overall prevalence of non-reactive NST was 0.32% (0.38% in low risk and 0.21% in high risk group). Only one newborn with non-reactive NST in high risk group was admitted in the NICU due to meconium aspiration syndrome. However, there was no significant association between non-reactive NST and obstetric risks or adverse perinatal outcomes.

Conclusion: The prevalence of non-reactive NST in this study was only 0.32%. NST is not routinely recommended in low risk pregnant women due to no association between non-reactive NST and perinatal morbidity.

Keywords: *Antepartum Fetal Monitoring, Non-stress test, Pregnancy*

Introduction

Various non-invasive antepartum fetal surveillance techniques are available including fetal movement assessment, non-stress test (NST), biophysical profile (BPP), contraction stress test (CST), and maternal uterine artery and fetal umbilical artery Doppler velocimetry [1,2]. The aim of antepartum fetal surveillance is to confirm the well-being of the fetus and detect early neonatal injury [3]. NST is currently and widely used in antenatal clinics as a continuous measurement of fetal heart rate (FHR) because it is simple and does not harm pregnant women or their fetuses.

Early detection in the abnormal change of FHR is useful to prevent neonatal injury [4]. NST aims to confirm whether the brain of the fetus is sufficiently oxygenated. [2] Non-reactive NST is significantly associated with fetal distress and low Apgar scores [5]. Testing is recommended for pregnant women who are at risk of fetal hypoxic injury or fetal death. Indications for NST can be divided into three groups as follows: (1) Maternal indications such as diabetes, hypertension, cardiovascular diseases, anemia, kidney disease; (2) Fetal indications such as decrease fetal movement, abnormal fetal growth, post-term pregnancy, abnormal amniotic fluid; and (3) Placental indications such as abnormal placentation, chronic abruption [6].

Due to the uncomplicated nature of the test, obstetricians in general practice often perform NST to pregnant women with minimal obstetric risks such as mothers with poor weight gain, decreased/static weight, or passed date [7]. No clear evidence exists to support the benefit of NST in this group. Even though NST is not an invasive testing method, it is not free of charge and the patient is required to spend at least 20 minutes in the examination room. Moreover, NST results can influence the decisions of the obstetricians. Based on a previous study, non-reactive NST results increased the incidence of labor induction by 90% and doubled the rate of cesarean delivery [8]; therefore, patients may be subjected to unnecessary obstetrics procedures.This study was conducted to determine the prevalence of non-reactive NST for each indication and also identify the necessity for the test in low risk group. We anticipate that this knowledge will be useful in making decisions whether to offer NST to pregnant women.

Materials and Methods

This prospective observational study was conducted at the antenatal clinic, King Chulalongkorn Memorial Hospital. Pregnant

women with gestation age of 32 weeks or more who had been offered NST by their obstetricians were invited to participate. We excluded pregnancies with antepartum diagnosed fetal congenital anomalies and those who have had multiple pregnancies. After the participants gave their informed consent, the participants were interviewed. This study was approved by the Institutional Review Board, Faculty of Medicine, Chulalongkorn University (IRB351/55). The high risk group was defined as participants at risk for fetal hypoxia or fetal death according to the antepartum surveillance bulletin of the American College of Obstetricians and Gynaecologists as described previously [6]. While the low risk group was defined as participants who did not show any maternal, fetal or placental risks. Demographic data and indications of NST were recorded in well-designed individual case records.

NST examination requires at least 20 minutes. Participants were placed in a supine position and a fetal heart rate monitor was attached to an abdominal belt. The participants were asked to record any fetal movements by clicking a button. In cases where there was suspicion that the baby was asleep, vibroacoustic stimulation was performed. Results were interpreted by at least two obstetricians. Results are classified as reactive or non-reactive. Reactive NST is diagnosed if there are at least two times of FHR acceleration in 20 minutes, with each acceleration 15 beats per minute (bpm) or more above baseline and lasting for at least 15 seconds. The baseline FHR should be between 110–160 bpm with moderate variability of 6–25 bpm. If the FHR is elevated less than 15 bmp within a 20–40 minute period, the interpretation is non-reactive. [9] Two obstetricians were required to agree with the interpretation of each result. If their analyses differed, a third obstetrician was consulted. If the final results showed a non-reactive then further investigations including biophysical profile, CST or ultrasonography were immediately performed. If the participants were offered NST more than once, the worst pattern was analyzed and included in the research results. All participants were monitored until delivery, with data and perinatal outcome collected and recorded in detail. Participants who did not deliver their babies at the King Chulalongkorn Memorial Hospital or lost their medical data were excluded from the study. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 22. Descriptive data were analyzed using frequency and percentage, while significant associations between the categorical data were assessed by Fisher's exact test or Chi-square test. When the p-value was < 0.05, this was considered statistically significant.

Results

A total of 1,536 pregnant women were offered NST. After obtaining informed consent, 1,297 women participated in this study. A total of 129 were not included because their medical records after follow-up was incomplete or unavailable. The remaining participants in final analysis were 1,168 participants. Mean age was 29.7 ± 6.3 years with mean gestational age on the testing day was 36.6 ± 3.0 weeks. Basic clinical characteristics of the participants are shown in (Table 1).

Ninety-three participants were offered NST twice; therefore, a total of 1,261 tests were analyzed in our study. A total of 782 NSTs were offered to low risk participants and 479 tests were offered to high risk pregnant women. For women in the low risk group, decrease in weight was the most common reason for requesting NST (275 cases). Maternal indications, especially diabetes mellitus were the most common indication for high risk participants (Table 2).

Table 1. Demographic data.

Demographic data	Number of cases (N= 1,168)
Mean age, years (SD)	29.7 (6.3)
Mean gestational age on the testing day, weeks (SD)	36.6 (3.0)
Primigravida	573 (49.1%)
Mean BMI, kg/m^2 (SD)	22.8 (4.8)
Concomitant medical diseases	412 (35.3%)
History of previous surgery	278 (23.8%)
Smoking	12 (1.0%)
Illicit drug use	4 (0.3%)
Alcohol consumption	16 (1.4%)

Table 2. Indications for NST.

Indications	Number (Total number = 1,261)
Low risk group	782 (62.0%)
Static weight gain	193 (15.3%)
Decrease in weight	275 (21.8%)
Poor weight gain	84 (6.7%)
Passed date (GA 40^{+1}–41^{+6} weeks)	98 (7.8%)
Other	132 (10.5%)
High risk group	479 (38.0%)
Maternal indications	346 (27.4%)
Fetal indications	119 (9.4%)
Placental indications	8 (0.6%)
Maternal and fetal indications	6 (0.5%)

Obstetrics and perinatal outcomes were shown in (Table 3). Mean gestational age at delivery was 38.7 ± 1.3 weeks. The rate of spontaneous vaginal delivery was 53.5% and cesarean delivery rate was 43.5%. Neonatal morbidity occurred in 11.9% of infants with 5.7% of them required admission. Four participants had non-reactive NST with overall prevalence at 0.32%; three out of 782 (0.38%) from the low risk group and one out of 479 (0.21%) from the high risk group had non-reactive NST. Only one new born with non-reactive NST in high risk group was admitted in the Neonatal Intensive Care Unit (NICU) for 5 days due to meconium aspiration syndrome. This newborn had complete recovery and discharged with mother. The other three non-

reactive NST in low risk group, intrauterine resuscitation was given, and repeated tests became reactive. These three newborns had no perinatal morbidity (Table 4). Fisher's exact test showed there was no association between NST result and pregnancy risk (P = 1.00). There were no associations between NST results and adverse perinatal outcomes such as Apgar scores, neonatal morbidity, NICU admission, perinatal ventilator requirement and fetal anomalies (Table 5).

Table 3. Obstetrics and perinatal outcomes.

Delivery data	Number of delivery (N=1,168)
Mean gestational age at delivery, weeks (SD)	38.7 (1.3)
Mean birth weight, grams (SD)	3,142.5 (455.5)
Delivery route	
Spontaneous vaginal delivery	625 (53.5%)
Cesarean delivery	507 (43.5%)
Forceps extraction	30 (2.6%)
Vacuum extraction	6 (0.5%)
Sex of fetus	
Male	621 (53.2%)
Female	547 (46.8%)
Fetal anomalies	
No	1,127 (96.5%)
Yes	41 (3.5%)
Neonatal morbidity	
No	1,029 (88.1%)
Yes	139 (11.9%)
NICU admission	
No	1,120 (94.3%)
Yes	66 (5.7%)
Ventilator required	
No	1,149 (98.4%)
Yes	19 (1.6%)

Discussion

This study showed the rate of non-reactive NSTs was low only 0.32%. Most NSTs (62.5%) were conducted in low risk participants. Prevalence of non-reactive testing was 0.38% and 0.21% in the low and high risk pregnant women, respectively. Overall prevalence of non-reactive NSTs in our study was very low compared to previous studies. Rayburn et al. conducted a prospective study of 315 pregnancies and determined 12% of NSTs had non-reactive patterns [10], while Abitbol et al. reported 10.9% of patients had non-reactive NSTs [11]. The results from these two studies were different compared to our study. These 2 studies were conducted before 1990, most patients had risk factors and different terminologies of abnormal NST result might be plausible explanation. The use of vibroacoustic stimulators in these two previous studies might be another possibility. There is clear evidence that vibroacoustic stimulation can reduce testing time but can contribute to higher rates of false non-reactive results [12].

Table 4. Clinical characteristics of non-reactive NST cases.

Gravida	G4P1	G1P0	G2P1	G1P0
GA at testing day (weeks)	39	37	40	39
Indication for NST	Gestation diabetes (High risk)	Decrease in weight (Low risk)	Decrease in weight (Low risk)	Unspecified (Low risk)
Delivery route	Emergency cesarean section	Cesarean section due to breech presentation	Vaginal delivery	Cesarean section due to CPD
Neonatal outcomes	Male fetus 3,325 grams	Male fetus 2,935 grams	Male fetus 2,800 grams	Male fetus 3,220 grams
APGAR scores at 1 and 5 mins	9,9	9,10	9,10	9,10
Perinatal morbidity	Maconium aspiration syndrome 5 days of NICU admission	No	No	No

GA = Gestational age

Data from our study confirmed that offering NST to low risk pregnant women was pointless, waste of time and resources. Although, NST is simple and widespread use, there is poor evidence that it can reduce perinatal morbidity or mortality. One major drawback is high frequency of false positive rates. Pregnant women usually placed on supine position during the test. Compression of abdominal aorta results in reduction of uterine blood flow and associated with fetal heart rate change. [11] Repeated test in lateral decubitus position usually returns into normal results. Our study confirmed that non-reactive NST in low risk participants did not associated with perinatal morbidity. However, it may not conclude in high risk participants due to very low percentage of non-reactive results. Only 1 patients with maternal risk factors (gestational diabetes) showed non-reactive NST and meconium aspiration syndrome was diagnosed in this newborn. Despite low specificity to predict perinatal morbidity, antepartum NST is still recommended to use only in pregnant women with risk factors for adverse perinatal outcome [13].

To the best of our knowledge, this is the first and large study that looked at the results of NST in low risk pregnant women. The results indicated that NST is unnecessary for low risk pregnant women. However, there were some limitations in our study. Firstly, the prevalence of non-reactive NST was very low in both low and high risk pregnant women. As this result, it may not have enough power

to significantly confirm our findings. Secondly, about 10% of the pregnant women who were lost to follow-up were excluded from the final analysis.

Table 5. Association between NST results and perinatal outcomes including Apgar score, neonatal morbidity, NICU admission, perinatal ventilator requirement and fetal anomalies.

		NST		P value
Perinatal outcomes		**Reactive**	**Non-reactive**	
Apgar score at 1 min*	<7	25	0	1.00
	7–10	1,138	4	
Apgar score at 5 min*	<7	3	0	1.00
	7–10	1,160	4	
Neonatal morbidity	Yes	138	1	0.40
	No	1,026	3	
NICU admission	Yes	65	1	0.21
	No	1,099	3	
Perinatal ventilator need	Yes	19	0	1.00
	No	1,145	4	
Fetal anomalies	Yes	41	0	1.00
	No	1,123	4	

* one missing data

Conclusions

Overall, non-reactive NST was 0.32% (0.38% in low risk and 0.21% in high risk groups). NST is unnecessary for low risk pregnant women. There was no association between NST results and adverse perinatal outcomes including Apgar score, neonatal morbidity, NICU admission, perinatal ventilator requirements and fetal anomalies.

Declaration of interests

The authors declared no conflicts of interest.

Acknowledgement

This study was supported by Ratchadapiseksompoch Fund (RA55/69), Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand.

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Citation:
Tarinee Manchana, Pinyada Panyavaranant, Patou Tantbironj, Porntip Sirayapiwat, Ruangsak Lertkachonsuk and Surang Triratanachat (2019) Prevalence of Nonreactive Non-Stress Test in Low Versus High Risk Pregnancy. *Integr Gyn Obstet J* Volume 2(1): 1–4.