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Fetal Heart Rate Accelerations at Gestational Age 28-41 Weeks

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ABSTRACT

Objective To study the pattern of fetal heart rate accelerations at gestational ages between 28-41 weeks and to compare the accuracy of nonstress tests (NST) as evaluated by different criteria for reactive tests at gestational ages of 28-31, 32-36 and 37-41 weeks, respectively.

Design Descriptive prospective study.

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Subjects One hundred and twelve normal pregnant women aged 18-35 years of between 28 and 41 weeks' gestation.

Main outcome measures Means of fetal heart rate acceleration, proportion of reactive NSTs. "Type I" and "type II" accelerations were defined as a fetal heart rate ; acceleration of ≥10 bpm above baseline for ≥10 seconds and of ≥15 bpm for ≥15 seconds, respectively. An NST was considered "reactive" if there were at least two accelerations in 20 minutes.

Results One hundred and twelve normal pregnant women were recruited and divided into three groups according to their gestational age : 44, 35 and 33 cases in group 1 (28-31 weeks), group 2 (32-36 weeks) and group 3 (37-41 weeks), respectively. The mean number and standard deviation of type I accelerations were 11.2 ± 5.8, 12.4 ± 6.4 and 9.3 ± 5.5 in groups 1, 2 and 3, respectively. The mean number and standard deviation of type II accelerations were 5.4 ± 4.0, 7.5 ± 4.8 and 5.8 ± 4.1 in groups 1, 2 and 3, respectively. Proportion of reactive NSTs (type I acceleration) : group 1 : 100%, group 2: 97.1%, group 3 : 93.9%. Proportion of reactive NSTs (type II acceleration): group 1: 90.9%, group 2 : 91.4%, group 3 : 81.8%. Means of accelerations and the proportions of reactive NSTs for either criteria were not statistically significant different between the groups.

Conclusion The patterns of fetal heart rate accelerations at gestational ages of 28-31, 32-36 and 37-41 weeks were similar. NSTs were reactive in 81.8 -100% of the cases.

Key words : fetal heart rate, accelerations, gestational age, 28-41 weeks, nonstress test

Fetal heart rate acceleration tests have been widely used to evaluate fetal condition. As neonatal care has improved, so have the survival rates and prognosis of preterm infants. Therefore, earlier initiation of fetal surveillance has been considered in high risk groups.[1] However, preterm and term fetuses differ markedly in their heart rate patterns and frequency of movement.[2,3] The presence of fetal heart rate accelerations in association with fetal movement as in a "reactive" nonstress test (NST), is a generally accepted indicator of fetal well-being.[4,5] Many different criteria for "reactive" NSTs have been proposed. Evertson et al[5] suggested two or more accelerations of fetal heart rate of ≥ 15 bpm above the baseline for at least 15 seconds duration associated with fetal movement within a twenty minute period, while Schifrin et al[6] used the same criteria but within a ten minute period. Using Evertson's definition, Sadovsky et al[7] observed that the rate of reactive NSTs increased from 27% at gestational age 20-24 weeks to 95% at gestational age 32-36 weeks. Therefore, the use of the same criteria for reactivity at all gestational ages has been questioned.[3] Our study aimed to determine whether normal standards could be defined so it would enable appropriate use of this modality for antepartum assessment of preterm pregnancies.

Materials and Methods

Normal pregnant women aged 18-35 years and of gestational ages between 28 and 41 weeks (by accurate menstrual dates) attending antenatal clinic at Songklanagarind Hospital were enrolled in the study. In cases of uncertain dates, ultrasonography were performed to determine the correct gestational age in the first or early second trimester. Fetal heart rate tests were performed using a Corometrics 115 monitor. The patients were placed in the semi-Fowler position with lateral tilt in order to avoid supine hypotension. Blood pressure was recorded at fifteen minute intervals. No drugs (including coffee, tea or cigarettes) were taken for at least six hours before the study. Monitoring was started within two hours of the patient's last meal. Subjects were excluded from analysis if the following were observed at any stage of pregnancy: any medical or obstetric complications, small for gestational age fetus, meconium stained amniotic fluid, 5-minute Apgar scores < 7, evidence of antepartum fetal distress within a week of the tests or intrapartum fetal distress. A "reactive" nonstress test was defined by two different criteria. The first was if there were two or more accelerations of at least 10 bpm above baseline for at least 10 seconds associated with fetal movement in a twenty minute period. The second was the presence of two or more accelerations of at least 15 bpm above baseline for at least 15 seconds associated with fetal movement in the same period. Mean baseline FHR, number of FHR accelerations, number of FHR decelerations, and proportion of reactive tests were calculated and analysed in 3 groups (Group 1 = 28-32 wks, Group 2 = 33-36 wks and Group 3 = 37-41 wks). Statistical analysis was performed using Chi square tests and a P value < 0.05 was considered significant.

Results

Nonstress tests were performed on a total of 112 women. Groups 1, 2 and 3 consisted of 44, 35 and 33 patients, respectively. Mean age, parity, mean gestational age at delivery, mean birth weight and Apgar scores are shown in Table 1. The relationship between fetal heart rate pattern and gestational age are demonstrated in

Table 2. There was a slightly decreased baseline FHR with advanced gestational age which was not statistically significant. There was no significant difference between the three groups in terms of mean long term variability and mean frequency of accelerations or decelerations. Table 3 demonstrates the percentage of reactive tests in the different gestational age groups during 20 minutes of observation. Using either criteria, there was no statistically significant difference between the groups. In those patients whose test was non-reactive after 20 minutes, recording was extended for an additional 20 minutes. All of these patients subsequently showed a reactive test during the second twenty minutes by both criteria.

Table 1. Patient characteristics and pregnancy outcomes

Patients (N)	112
Mean age (yr)	25.8 ± 3.8
Parity (N, %)	
Nulliparous	65 (58%)
Multiparous	47 (42%)
Gestational age (wk)	33.8 ± 3.6
28-32 wks (N,%)	44 (39.3%)
33-36 wks (N,%)	35 (31.3%)
37-41 wks (N, %)	33 (29.4%)
Gestational age at delivery (wk)	39.1 ± 1.7
Birthweight (gm)	3,110 ± 363
Apgar scores at	
1 minute	8.2 ± 0.7
5 minute	9.4 ± 0.6

Table 2. Fetal heart rate pattern and gestational age

Fetal heart pattern	**Mean ± SD**		
	Group 1	**Group 2**	**Group 3**
Baseline FHR (bpm)	143.5 ± 7.7	142.2 ± 9.0	139.4 ± 9.2
Long term variability (bpm)	10.3 ± 3.4	11.2 ± 4.7	10.8 ± 3.1
Accelerations			
I. ≥ 10 bpm, ≥ 10 sec	11.2 ± 5.8	12.4 ± 6.4	9.3 ± 5.5
II. ≥ 15 bpm, ≥ 15 sec	5.4 ± 4.0	7.5 ± 4.8	5.8 ± 4.1
Decelerations			
I. ≥ 10 bpm, ≥ 10 sec	0.2 ± 0.6	0.7 ± 1.4	0.3 ± 0.7
II. ≥ 15 bpm, ≥ 15 sec	0.0 ± 0.0	0.1 ± 0.4	0.0 ± 0.2

Table 3. Percentage of reactive NST by different criteria in first 20 minutes

Criteria	Reactive NST (%)		
	Group 1	Group 2	Group 3
I. ≥ 10 bpm and ≥ 10 sec, ≥ 2 times	100.0	97.1	93.9
II. ≥ 15 bpm and ≥ 15 sec, ≥ 2 times	90.9	91.4	81.8

Discussion

Gestational age and reactivity of the fetal heart rate (FHR) have long been known to be related. Several factors known to influence interpretation of nonstress tests appear to change with advancing gestational age including : frequency of fetal movement,[7-9] fetal electrocortical activity,[10] baseline fetal heart rate,[11] type and frequency of fetal heart rate response associated with fetal movement and neurohumoral control of the fetal cardiac system.[11] Therefore, it is reasonable to postulate that the frequency of reactive and nonreactive nonstress tests might differ at various gestational ages.

Castillo et al[12] studied mean baseline FHR at gestational ages of 24-32 weeks and reported a significant decline with increasing gestation. The mean total incidence of FHR accelerations of ≥ 10 bpm or ≥ 15 bpm increased significantly from 24-30 weeks, but remained stable between 30-32 weeks. Our study showed no difference in either mean baseline FHR or number of accelerations between the three gestational age groups.

Sorokin et al[2] found that 97.1% of FHR changes observed at 20-22 weeks were decelerations, compared to only 33.9% at 28-30 weeks. However, in Castillo's study, the number of FHR decelerations exceeding 10 bpm remained relatively constant for all gestational ages between 24-32 weeks. We found no significance difference in the number of FHR decelerations of ≥ 10 bpm for at least 10 seconds between the different groups with the mean number of such decelerations ranging from 0.2 - 0.7 in 20 minutes.

It is generally accepted that the proportion of nonstress tests that are reactive increases with gestational age. Smith et al observed that 16.7% of tests were reactive at 23-27 weeks, 65.6% at 28-32 weeks, 90.5% at 33-37 weeks and 94.4% at 38-42 weeks. They concluded that after 32 completed weeks, the majority of tests (90%) were reactive.[13]

Druzin et al[14] found that the proportion of reactive nonstress tests increased from 27% at gestational age 20-24 weeks to 55% at 24-28 weeks. At 28-30 weeks, the reactivity rate was 76%, and after 30 weeks, it approached that of term gestations. The study defined NSTs as reactive if there were two accelerations of FHR ≥ 15 bpm for at least 15 seconds associated with fetal movement within a twenty minute period. An NST was considered nonreactive if it failed to meet these criteria in two consecutive twenty

minute periods. If our study had used the same criteria as Druzin, 100% of our cases would have had a reactive NST. All cases showed reactive tests when recording was extended to 40 minutes. During the first 20 minutes, there was no difference in the proportion of reactive tests between the gestational ages of 28-32, 33-36 and 37-41 weeks. When reactive tests were defined as two or more accelerations of FHR ≥ 10 bpm for at least 10 seconds within 20 minutes, 93.9-100% of tests were reactive without any difference between groups. When recording was extended up to 40 minutes, 100% were reactive in every groups.

DeVoe et al[1] presented detailed data regarding the clinical use of NST in patients whose gestational age was 25-34 weeks. Twenty-one percent of these women had a nonreactive NST, of whom 45% had a positive contraction stress tests (CST). There were no significant differences seen in the proportions of nonreactive NSTs when tests performed at two-week intervals from 25-26 weeks through to 33-34 weeks were compared. Those fetuses who delivered before 34 weeks' gestation with a previously nonreactive NST and a positive CST experienced higher rates of fetal distress, low Apgar scores, intrauterine growth retardation and perinatal mortality. On the other hand, Sorokin[2] and Aladjem[15] suggested that nonreactive NSTs occurring among the less advanced gestational age group may to some extent be a reflection of gestational age. However, many women with obstetric and medical complications of pregnancy are at risk for inadequate uteroplacental function from an early gestational age.

Antepartum FHR testing may be of benefit in detecting these potentially compromised fetuses. In those patients with a nonreactive NST, a subsequent CST could serve as a basis for any therapeutic decisions regarding intervention. Freeman[16] reported an extremely low incidence of premature labour occurring after a CST.

In summary, the use of NST at early gestational ages seems to have a clinical application, particularly in the group > 28 weeks' gestation. In women of 28-32 weeks' gestation, a nonreactive NST could be followed by a CST which, if positive, has been shown to be predictive of poor obstetric outcome in this early gestational age group.[17] In our study, 81.8-100% of NSTs were reactive at the gestational ages of 28-41 weeks according to different criteria to define reactivity. Nonstress tests could be performed at 28-32 weeks and interpreted by standard criteria. When NST is non-reactive after 20 minutes, an additional 20-40 minutes of testing should be performed before considering as non-reactive. For those who still have nonreactive tests, contraction stress tests or biophysical profiles should be considered to assess fetal condition.

References

1. De Voe LD. Antepartum fetal heart rate testing in preterm pregnancy. Obstet Gynecol 1982 ; 60 : 431-6.
2. Sorokin Y, Dierker LJ, Pillay SK, Zador IE, Schreiner ML, Rosen MG. The association between fetal heart rate patterns and fetal movements in pregnancies between 20 and 30 weeks' gestation. Am J Obstet Gynecol 1982 ;143 : 243-9.
3. Natale R, Nasello C, Turliuk R. The relationship between movements and accelerations in fetal heart rate at twenty-four to thirty-two weeks gestation. Am J Obstet Gynecol 1984 ; 148 : 591-5.
4. Evertson LR, Paul RH. Antepartum fetal heart rate testing : the nonstress test. Am J Obstet Gynecol 1978 ; 132 : 895-900.
5. Evertson LR, Gauthier RJ, Schifrin BS, Paul RH. Antepartum fetal heart rate testing : I. evolution of the nonstress test. Am J Obstet Gynecol 1979 ; 133 : 29-33.

6. Schifrin BS, Foye G, Amato J, Kates R, Mackenna J. Routine fetal heart rate monitoring in the antepartum period. Obstet Gynecol 1979 ; 54 : 21-5.
7. Sadovsky E, Yaffe H, Polishuk WZ. Fetal movement monitoring in normal and pathologic pregnancy. Int J Gynecol Obstet 1974 ; 12 : 75-80.
8. Woods C, Gilbert M., OûConnor A. Subjective recording of fetal movement. Br J Obstet Gynaecol 1979 ; 86 : 836-42.
9. Leader L, Baillie P, Van Schalkwyk D. Fetal movement and fetal outcome. A retrospective study. Obstet Gynecol 1981 ; 57 : 431-6.
10. Clapp J, Szeto H, Abrams R. Physiologic variability and fetal electrocortical activity. Am J Obstet Gynecol 1980 ; 136 : 1045-50.
11. Assali N, Brinkman C, Woods J. Development of neurohumoral control of fetal, neonatal, and adult cardiovascular functions. Am J Obstet Gynecol 1977 ; 129 : 748-59.
12. Castillo RA, DeVoe LD, Arthur M, Searle N, Metheny WP, Ruedrich DA. The preterm nonstress test: Effects of gestational age and length of study. Am J Obstet Gynecol 1989 ; 160 : 172-5.
13. Smith CV, Commander L, Phelan JP, Paul RH. A prospective analysis of the influence of gestational age on the baseline fetal heart rate and reactivity in a low risk population. Am J Obstet Gynecol 1985 ; 153 : 780-2.
14. Druzin ML, Fox A, Kogut E, Carlson C. The relationship of the nonstress test to gestational age. Am J Obstet Gynecol 1985 ; 153 : 386-9.
15. Aladjem S, Vuolo K, Pazos R. Antepartum fetal testing evaluation and redefinition of criterion for clinical interpretations. Semin Perinatol 1981 ; 5 : 145-54.
16. Freeman RK. The use of the oxytocin challenge test for antepartum clinical evaluation of uteroplacental respiratory function. Am J Obstet Gynecol 1975 ; 121 : 481-9.
17. Gabbe SG, Freeman RK, Goebelsmann U. Evaluation of contraction stress test before 33 weeks gestation. Obstet Gynecol 1978 ; 52 : 649-52.