Antepartum fetal surveillance
NST

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The goal of antepartum fetal assessment is to identify fetuses at risk of intrauterine death or neurologic complications from slowly progressive (chronic) intrauterine hypoxia intervene to prevent these adverse outcomes, if possible.
Reactive nonstress test performed 8 days before the patient’s estimated delivery date

Case #1
38 year old RN, G4P3, EDC 6/3/08
Office worker of the physician who delivered her
Prenatal course uncomplicated

NST on 5/28/08 was reactive with acceleration
moment-to-moment autonomic modulation in response to many factors, including input from chemoreceptors,

input from baroreceptors,

central nervous system activities (eg, arousal, sleep),

catecholamines,

blood volume
Effect of gestational age on fetal heart rate

Parasympathetic and sympathetic nervous systems exert a progressively greater influence on the FHR as gestational age advances.

The sinoatrial (SA) and atrioventricular (AV) nodes

Parasympathetic stimulation slows the FHR,

blockade by parasympatholytic medications (eg, atropine) increases FHR

Sympathetic stimulation of the heart increases the FHR,

blockade of sympathetic activity slows the FHR
With advancing gestational age, the maturation of the parasympathetic system causes slowing of the baseline heart rate but usually not below the normal range of 110 to 160 beats per minute.

Before 32 weeks, accelerations may increase by only 10 beats per minute above the baseline and last 10 seconds,

later in gestation, accelerations of 15 beats per minute above the baseline and lasting 15 seconds are expected.
Cardiovascular response to hypoxemia

Fetal oxygenation depends upon the **adequate transfer of oxygen** from the environment to the fetal tissues.

Oxygen is transferred from the environment to fetal tissues by maternal and fetal blood along a pathway that includes the maternal lungs, heart, vasculature, and uterus and the fetal placenta and umbilical cord.

Fetal hypoxemia (usually expressed as the partial pressure of oxygen dissolved in blood, or PO) can result from interruption of the transfer of oxygen from the environment to fetal tissue at any point along this pathway.
NONSTRESS TEST

The NST is the most common cardiotocographic method of antepartum fetal assessment.

It is noninvasive and can be performed in any setting where an electronic fetal monitor is available.

There is no direct risk of maternal or fetal injury associated with NSTs.
The NST may be performed with or without **sonographic** assessment of **amniotic fluid volume**.

When using amniotic fluid volume assessment, the deepest vertical pocket of fluid, rather than the amniotic fluid index (AFI), may be associated with fewer unnecessary interventions without an increase in adverse perinatal outcomes.
Reactive tests

The NST is reactive from 32 weeks to term if there are two or more fetal heart rate (FHR) accelerations reaching a peak of at least 15 beats per minute (bpm) above the baseline rate and lasting at least 15 seconds from onset to return to baseline (15 x 15) in a 20-minute period.

A reactive test provides reliable evidence of normal fetal oxygenation, regardless of the length of observation time needed to demonstrate reactivity.
Before 32 weeks of gestation

a reactive NST may be defined as two accelerations that rise at least 10 bpm above baseline and have a duration of

at least 10 seconds (10 x 10)
Minimal duration of FHR monitoring

the NST should be continued for **at least 20 minutes**, even if two qualifying accelerations have been observed before that time.
Reactive NSTs with decelerations

Multiple observational studies have described an increased frequency of intrapartum FHR decelerations and operative delivery when this combination occurs except when the decelerations are brief.

Outcomes are usually good.

The majority of FHR decelerations during the NST are variable decelerations, reflecting transient episodes of umbilical cord compression.
Variable, late, or prolonged decelerations observed during antepartum testing require further evaluation, which might include extended FHR and uterine activity monitoring, ultrasound assessment of fetal growth and anatomy, BPP, amniotic fluid volume, Doppler velocimetry in the setting of fetal growth restriction.

Management decisions should be guided by the results of the additional evaluation and other details specific to the clinical situation.
<table>
<thead>
<tr>
<th><strong>Acceleration</strong></th>
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<tbody>
<tr>
<td>An abrupt(^*) increase in the FHR. Before 32 weeks of gestation, accelerations should last $\geq 10$ sec and peak $\geq 10$ bpm above baseline. As of 32 weeks gestation, accelerations should last $\geq 15$ sec and peak $\geq 15$ bpm above baseline.</td>
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<td>A prolonged acceleration is $\geq 2$ minutes but less than 10 minutes. An acceleration of 10 minutes or more is considered a change in baseline.</td>
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<tr>
<th><strong>Late deceleration</strong></th>
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<tr>
<td>A gradual(^*) decrease and return to baseline of the FHR associated with a uterine contraction. The deceleration is delayed in timing, with the nadir of the deceleration occurring after the peak of the contraction. The onset, nadir, and recovery usually occur after the onset, peak, and termination of a contraction.</td>
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<th><strong>Early deceleration</strong></th>
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<tr>
<td>A gradual(^*) decrease and return to baseline of the FHR associated with a uterine contraction. The nadir of the FHR and the peak of the contraction occur at the same time. The deceleration’s onset, nadir, and termination are usually coincident with the onset, peak, and termination of the contraction.</td>
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<th><strong>Variable deceleration</strong></th>
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<tr>
<td>An abrupt(^*) decrease in FHR below the baseline. The decrease is $\geq 15$ bpm, lasting $\geq 15$ secs and $&lt; 2$ minutes from onset to return to baseline. The onset, depth, and duration of variable decelerations commonly vary with successive uterine contractions.</td>
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<th><strong>Prolonged deceleration</strong></th>
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<td>A decrease in FHR below the baseline of 15 bpm or more, lasting at least 2 minutes but $&lt; 10$ minutes from onset to return to baseline. A prolonged deceleration of 10 minutes or more is considered a change in baseline.</td>
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Reactive nonstress test performed 8 days before the patient's estimated delivery date.
Nonreactive tests

A NST is nonreactive if it does not meet acceleration criteria for a reactive NST (see
The FHR should be monitored for at least 40 minutes before interpreting the test as nonreactive.
Nonreactivity may be a sign of interrupted fetal oxygenation to the point of metabolic acidemia.

The mean umbilical vein pH associated with a nonreactive NST is 7.28±0.11, which is higher than
the pH associated with a low biophysical profile (BPP) score, 7.16±0.08
Other possible causes of a nonreactive NST

- fetal immaturity,
- fetal sleep
- maternal smoking,
- fetal neurologic or cardiac anomalies,
- sepsis,
- or maternal ingestion of drugs with cardiac effects

Sleep is a common and benign cause of a nonreactive NST. Sleep cycles may last up to 40 minutes.
sleep cycles lasting up to 53 minutes.

In a study that observed late preterm fetuses from uncomplicated pregnancies for 100 minutes, quiet sleep occurred at least once in 30 percent of fetuses, but 96 percent of the fetuses cycled between quiet sleep and active states during the period of observation.
Evaluation of pregnancies with nonreactive NSTs

Up to 60 percent of nonreactive NSTs may be false positives, usually defined as a nonreactive NST that prompts delivery, but delivery is not associated with findings suggestive of acute interruption of fetal oxygenation

- FHR decelerations
- or loss of variability
- meconium passage,
- operative delivery for acute FHR changes,
- low Apgar scores,
- or abnormal umbilical cord blood gas values)

or chronic suboptimal fetal oxygenation

(eg, fetal growth restriction, oligohydramnios)
A nonreactive NST usually warrants further evaluation.

Repeat the test in 30 minutes.

- Perform vibroacoustic stimulation to elicit accelerations
- Perform a back-up test, (either CST or complete BPP)
- If possible, modify factors potentially causing nonreactive results (e.g., smoking proximate to the test)
Vibroacoustic stimulation

decrease the number of nonreactive NSTs and shorten test time without reducing the predictive value of a reactive NST.

A vibroacoustic source, typically an artificial larynx, placed on or just above the maternal abdomen, is used to stimulate fetal movement

vibroacoustic stimulation decreased mean overall testing time by almost seven minutes,
reduced the frequency of nonreactive NSTs by 40 percent (odds ratio 0.62)
as soon as five minutes after initiation of the NST. The stimulus is applied for one to five seconds and may be repeated.

The American College of Obstetricians and Gynecologists suggests positioning the device on the maternal abdomen and applying a stimulus for one to two seconds.

If no fetal response occurs, the stimulus may be repeated up to three times for progressively longer durations of up to three seconds.
Transabdominal light stimulation with a halogen light for 10 seconds appears to stimulate the fetus and may be as effective as vibroacoustic stimulation.

Musical intervention may be a noninvasive and inexpensive tool for shortening the time to reactivity.

Although commonly practiced, neither maternal glucose administration nor transabdominal manual fetal manipulation significantly decreases the incidence of nonreactive test results.
Changing maternal position does not increase reactivity as long as the patient is tested in a position that does not lead to hypotension from uterine compression of the great vessels.

Cocoa and caffeine consumption may affect fetal movement, but the dose, timing, and effect on NST reactivity have not been evaluated.

No randomized trials or observational studies have assessed the effect of maternal hydration (oral or intravenous) on FHR reactivity.

Maternal hydration (oral or intravenous) may increase the AFI and decrease the baseline FHR but there is no evidence that it increases fetal movement or heart rate reactivity.
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effect of maternal hydration

Maternal hydration (oral or intravenous) may increase the AFI, decrease the baseline FHR, but there is no evidence that it increases fetal movement or heart rate reactivity.
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38 year old RN, G4P3, EDC 6/1/00
Office worker of the physician who delivered her
Prenatal course uncomplicated

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